SwiftFuel Status update
March 3, 2011

ABS Air Safety Foundation executive director Tom Turner participated in a conference call March 1st that provided an update on the status of Swift Enterprises' proposed SwiftFuel 100LL aviation gasoline replacement. The call was hosted by Lee Buechler, ABS member and founder of the Clean 100 Octane Coalition, and was also attended by representatives of B2Osh, the Twin Cessna Association, Cessna Advanced Aircraft Club and the Alaska Air Carriers Association.

This report was compiled from notes taken by Tom Turner during the call, and was fact-checked before release by Jon Ziulkowski and PJ Catania of Swift Enterprises.

Jon Ziulkowski, Vice President/Renewable Fuels and Chief Pilot for Swift Enterprises, provided a roughly hour-long briefing that updated participants on Swift's latest activities and addressed a series of questions submitted by Coalition members before the call. Afterward Jon fielded additional questions from the callers for roughly 15 minutes. He began by stating that "ultimately it is industry users who are going to drive an alternative fuel solution, rather than the OEMs [Original Equipment Manufacturers] or regulators." Swift began work in 2005, knowing that a replacement for leaded aviation fuels was eventually going to be needed. Swift tried "hundreds of fuel formulations" and "fixed on the current blend" in April 2007.

Jon calls this a "near drop-in replacement fuel." Knowing that users groups are looking for a fuel that provides power and detonation margins without engine or airframe modifications, Jon was quick to explain what he means by "near" drop-in. "A drop-in fuel will never exist," Jon states. "By definition a drop-in fuel is one that meets all ASTM specifications for 100LL fuel," a document called ASTM D910. One of the specifications in D910 is that aviation gasoline contains tetraethyl lead (TEL) in some form. It does not specify how much lead aviation gasoline must contain, but if a fuel is called an aviation fuel under D910 by definition it contains TEL. Since lead will "never be approved" for a 100LL replacement, any replacement fuel must be made to a different specification, and, by definition, will not be a "drop-in" fuel.

That said, Jon notes that SwiftFuel meets all but two of the specifications for aviation gasoline under D910. One specification it does not meet is the requirement that it contain lead. The other is the D910 requirement that aviation gasoline be petroleum-based. Otherwise, SwiftFuel meets all specifications for aviation gasoline, including vapor pressures, detonation margins and all other requirements. Other characteristics of SwiftFuel:

- SwiftFuel has a minimum octane rating of 102.2, with the nominal blend being around 104.
- SwiftFuel contains 7-15% more energy per gallon than 100LL, meaning it provides more range per gallon.
- 100LL weighs from 5.8 lbs to 6.5 lbs per gallon. SwiftFuel weighs 6.5 to 6.7 lbs/gal.
- Water separates from SwiftFuel as readily as it does from 100LL.
- SwiftFuel can mix "in any ratio" with 100LL and deliver specified performance.

- There are “no airframe or engine compatibility issues” with SwiftFuel.

Additives

How does SwiftFuel attain D910 specifications without TEL? It does so by using two components. One is very common. It’s used in E85 automotive fuel. The other component is “rather unique,” and “has not been used in the past” as a major fuel component. It is not made in the U.S. (except in some very small quantities in experimental labs), but only comes from a petroleum-based process used in China or Poland. In large industrial quantities, shipped into the United States this component costs about $20 per gallon. An “other” firm publicly working on an unleaded 100LL replacement fuel uses this same major fuel component.

Swift has instead chosen to make this additive locally from biological cast-offs, such as corn stalks and plant products discarded after harvesting of sugar beets and sugar cane. Swift chose this method because it is the cheapest source. Also, while currently aviation gasoline is moving away from lead as an additive, Swift sees the entire economy moving away from petroleum-based fuel sources. Jon says the component “can be bio-produced, but it doesn’t have to be.” It could be made from petroleum as well if it became cost-effective. Swift sees biofuels as “the long-term solution” but does not want to “hinge the future of general aviation on a bio product” if the industry demands otherwise. SwiftFuel can be either bio- or petroleum-based; in the end the formulation is the same because it’s the pure chemical created from biowaste or oil, not the biological or petroleum-based materials themselves, that end up in the fuel.

Certification and the Aviation Rulemaking Committee

The FAA and OEMs have a lot of experience certifying new engines and equipment on existing fuels, but almost none at certifying new fuels on existing engines and equipment. Currently there’s no mechanism to do so other than obtaining individual STCs for each specific model of airplane and engine. If this requirement stays the same, Jon said, “many types [of airplanes] would be orphaned” because no one would have the money to obtain STC approval for the engine or aircraft type.

That’s why Jon feels the upcoming Aviation Rulemaking Committee (ARC) meetings will be so valuable. A key goal of the ARC meetings is to determine how to implement the approvals process for a 100LL replacement fuel across the entire fleet. The ARC is “a really necessary step” to moving forward on replacing 100LL. Jon is hoping the ARC “bridges the gap” to a new fuel specification and approvals process “without having to go engine-by-engine and airframe-by-airframe” for approval.

Because D910-approved engines and airplanes cannot be “switched” to permit unleaded fuels under current rules, for most engine and airframes there is no alternative to leaded avgas. That’s why the ASTM process is so important. A new ASTM specification must be adopted for a completely unleaded avgas, and then engines and airframes must approved by OEMs to operate on fuels meeting this new specification.

Since the late 2000s Swift Enterprises has been an “organizational” member of ASTM and participated in the making of this new specification. ASTM D7547 now describes this unleaded avgas. D7547 is essentially the same parameters for D910 that exclude the requirements for

being petroleum-based and for the use of TEL. "We found out a lot we would not have thought of" without being a member of ASTM, Jon said.

The need now is for "extensive" operational data from a wide variety of engines and airframes. One "other" firm pursuing a 100LL replacement has run afoul of FAA by submitting test data with "changing formulations" for its "X-100" fuel. "The answer to this," said Jon, is "development of a test specification for a new fuel" so that all data comes from testing of the exact same fuel formulation. Swift got its ASTM test specification approved by the ASTM Aviation Fuels Subcommittee in December 2010 and has it on the next ballot for final approval by the Petroleum Products and Lubricants main committee. Swift is working on data collection, including cooperative work with Lycoming Engines, Cessna Aircraft, and Embry Riddle Aeronautical University. Jon calls this a "stepping stone to moving forward." He also notes that in earning this test specification, Swift is "two-thirds of the way there" to earning a full production ASTM certification. Swift will "have an ASTM specification number by the end of April."

False Hope, and Industry Acceptance

There "has to be a consensus of industry and government to find a resolution" to replacing 100LL. It's a "false hope" that the FAA can lead the process without an ASTM specification or at a minimum, industry consensus. Fuel distributors, liable for the quality of their product, "will not distribute a fuel without a specification." Their insurance companies and underwriters "would not permit it" without an ASTM specification.

The industry is working on a solution. Industry and regulators are "not going to make a rash decision" on what fuel or fuels will go forward. It will take "slow, measured steps" and not just "pouring it in [an airplane engine] and saying it works."

Swift has recently established the equivalent of a limited liability company in Germany to promote simultaneous approval of SwiftFuel by EASA and other non-U.S. regulators. Replacing 100LL is a "worldwide problem demanding a worldwide solution," and to achieve this Swift needs a "worldwide presence." Swift will be an exhibitor at Aero 2011 Friedrichshafen in April, and it has "some surprises" that will soon be announced.

Questions

Jon took a few questions from call participants, paraphrased here:

Q: Does Swift have any agreements with fuel distributors such that, if it somehow obtained approval and developed a production capacity tomorrow, it would be able to deliver the fuel to airports?

A: Swift has letters of intent or memoranda of understanding from five of the six U.S. distributors of aviation fuel. This accounts for 93% of the U.S. supply chain.

Q: What will be the cost of SwiftFuel at the pump assuming full-scale production?

A: Swift is working with several oil companies for contract fuel production. Contract production is being quoted by an oil company's research and development facility. It can also be produced in existing ethanol plants. This is to gather data to prove a case for commercial-scale production. This has "only been made possible by [Swift's] involvement with ASTM." Naming a "price on the product is premature," but Swift feels it will be able to produce the fuel at a cost that gets it to the pumps for the same cost as today's 100LL and is "aiming for lower."

Q: Has Swift tested, or will it test, for any health issues related to SwiftFuel?

A: Yes. Swift has tested for health and environmental issues with EPA and Embry Riddle, and "will have to do more." The health effects are "similar to gasoline without the lead issues." In other words, people will have to guard against ingestion, exposure or inhalation just as they should do currently with any gasoline. Swift has found that, over time, SwiftFuel scavenges existing tanks and lines of residual lead. The goal is to be "equal to or better than 100LL" in all health and environmental respects.

Q: Does Swift have the capitalization necessary to get SwiftFuel to market?

A: Swift is "working on some long-term deals" that "do not sell off the company" but are in the form of "strategic partners, some with very deep pockets." Jon feels Swift will get the funding it needs from large-scale stakeholders, and that there is "more to come on that."

Q: Despite significant reporting to the contrary in the media, there is evidence that, especially in radial engines but also in more modern opposed engines, lead in the fuel is necessary for lubricating valves and valve guides. Does SwiftFuel provide the lubrication necessary for these parts?

A: "Lead *is* in fuel in part for lubricity," according to Jon. "Lead performs four functions in fuel," including valve lubrication as well as octane boost. There is no specification in D910 for lubricity. Swift ran 4500 gallons of SwiftFuel through the "worst-case" engine, a TIO-540-K provided by Lycoming, in the FAA William J. Hughes Technical Center engine test cell in Atlantic City, New Jersey. The engine was boosted to as high as 38" manifold pressure during tests. Among other things, FAA measured all valve and valve guide dimensions before and after testing, and there was "less wear and tear" than if the engine had been run to TBO on 100LL. The test engine was brand new, and had "never seen 100LL," even during break-in, so there could be no question whether there was any residual lead in the engine. The FAA's conclusion is that SwiftFuel provides the "same level of lubricity" as 100LL at low, medium and high temperatures. More testing is slated for radial engines and multi-row radials, which appear to require more fuel lubrication than opposed engines.

Q: Has Swift tested for issues of cold starting at freezing and well below freezing temperatures? There are some reports that it is difficult to start engines with SwiftFuel even in moderate temperatures.

A: Cessna has tested the cold-starting properties of SwiftFuel in its environmental chamber in Wichita using a Cessna 172 and has not identified a problem. Swift plans to test starting properties in northern Canada and at high altitudes.

Q: Does Swift have this update briefing available in a PowerPoint presentation Coalition partners can post and show to their members?

A: Yes. Jon will send the PowerPoint to Lee, and he can distribute it to Coalition members.

Submitted 3/3/2011

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