Factors Affecting the Commercial Sale of Emerging Unleaded Aviation Fuels

Purpose

To educate both aviation and community stakeholders interested in understanding or communicating the dynamics of the commercial availability of unleaded avgas, including considerations on the status of UL fuels, the paths to authorization, and safety concerns around the transition.

Introduction

NATA (National Air Transportation Association) is committed to advancing the national effort to reduce lead emissions from piston-engine aircraft through safe and effective unleaded avgas implementation. NATA, along with other industry and government stakeholders including the FAA, supports the Eliminate Aviation Gasoline Lead Emissions (EAGLE) Initiative[1] goal of a lead-free future for U.S. piston-engine aircraft by the end of 2030. EAGLE aims to eliminate the use of leaded avgas without compromising the safe and efficient operation of the existing general aviation (GA) fleet and the economic contribution of general aviation – which includes maintaining 100 Low Lead (100LL) availability across the country during the transition. While EAGLE has targeted 2030 for the elimination of leaded avgas, NATA is optimistic that industry and government stakeholders can work together to achieve this goal sooner.

Ensuring a safe transition to unleaded avgas is a highly complex process at all stages, so it is critical that new fuels are properly vetted for safety, from the moment they are produced at the refinery until the moment they reach an aircraft. While the FAA approves avgas for use in aircraft types and aircraft engines, the FAA does not regulate or oversee the production, handling, operation, or quality control of avgas prior to the point it reaches the aircraft fuel tank. As a result, pilots, airports, fixed base operators (FBOs), and avgas distributors have historically relied on ASTM International (formerly American Society for Testing and Materials) product specifications for the safe and economical operation of aircraft with fuels that are clean, dry, and free of any contamination prior to use.[2] ASTM International is a globally recognized leader in the development and delivery of

[1] https://www.faa.gov/unleaded
[2] https://mcsdocs.astm.org/committee-documents/D02_Brochure_June%202021.pdf

voluntary consensus standards.[3] Today, over 12,000 ASTM standards[4] are used around the world to improve product quality, enhance health and safety, strengthen market access and trade, and build consumer confidence. ASTM's petroleum standards specifically are instrumental in the evaluation and assessment of the physical, mechanical, rheological, thermal, and chemical properties of crude oils, lubricating grease, automobile and aviation gasoline, hydrocarbons, and other naturally occurring energy resources used for various industrial applications. Aviation gasolines with an ASTM specification are tested for their composition, purity, density, miscibility and compatibility with other fluids and materials, and toxicity among others. ASTM standards allow refineries, terminals, fuel distributors, FBOs and other aviation stakeholders throughout the supply chain to appropriately examine and process aviation gasolines to ensure their quality towards safe and efficient use.[5]

Materials Compatibility

It is equally imperative that new fuels are tested with the materials they interact with throughout the supply chain. Among other characteristics, ASTM D7826-21 *Standard Guide for Evaluation of New Aviation Gasolines and New Aviation Gasoline Additives*[6] evaluates compatibility with materials throughout the supply chain upstream of the aircraft, including those used in hoses, filters, gaskets, and other wetted components among railcars, transport trucks, fuel farms, mobile refuelers, and other dispensing equipment. Just as aircraft owners and operators need assurances that the use of an alternative fuel will not compromise the integrity of any component of their aircraft nor void applicable warranties, the same is true for fuel distributors, transport companies, airports, and FBOs, who rely on ASTM specifications to minimize or eliminate the potential for degradation or contamination of either the fuel itself or the equipment used to transport, handle, and dispense it. In fact, the 2022 FAA document *Fuel Development & Testing LESSONS LEARNED 2014 through 2022*[7] specifically lists materials compatibility as a critical component of concern with the deployment of new fuels.

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[3] https://www.astm.org/about/overview/detailed-overview.html#:~:text=ASTM%20International%20is%20a%20globally,trade%2C%20and%20build%20consumer%20confidence.
[4] https://www.astm.org/products-services/standards-and-publications/standards.html
[5] https://www.astm.org/products-services/standards-and-publications/standards/petroleum-standards.html
[6] https://www.astm.org/d7826-21.html
[7] https://www.faa.gov/sites/faa.gov/files/PAFI_Fuel_Development_Testing_Lessons_Learned.pdf

Pathways to Approve Use of New Unleaded Fuel

It is important to understand the two pathways[8] for unleaded aviation fuel testing and approval: FAA Fleet Authorization through the Piston Aviation Fuel Initiative (PAFI) and FAA Supplemental Type Certification (STC).

PAFI is overseen by a collaborative industry/government group of technical experts and evaluates multiple characteristics of candidate fuels, including but not limited to detonation, durability, performance, and materials compatibility. PAFI testing data and results are also shared with engine and airframe original equipment manufacturers (OEMs) to provide confidence in the use of the new fuel[9]; this data is also used to support the fuel's ASTM production specification.

Individual companies may apply for FAA certification through the STC process, requesting approval for fuel use in each model of aircraft by showing compliance with FAA airworthiness requirements and demonstrating the aircraft's safe operation with the alternate fuel. Each applicant develops a means of compliance and submits analysis and test data showing compliance to the FAA, and all data remains proprietary. ASTM product specification and supply chain material compatibility testing are not included in the STC process, nor are legal regulated requirements, but individual companies may choose to pursue ASTM specifications independently.

Status of Unleaded Aviation Gasolines

In November 2023, UL100E developed by LyondellBasell/VP Racing became the first candidate to successfully pass the most rigorous PAFI phase of initial detonation and 150-hour engine durability testing. UL100E is slated to complete PAFI full-scale engine/flight testing and the ASTM process within 12-18 months. The FAA will approve Fleet Authorization of a candidate fuel once it has successfully completed PAFI testing and has a published ASTM specification.

The FAA has approved STCs that permit two unleaded fuels, Swift Fuel's UL94 and General Aviation Modifications, Inc.'s (GAMI) G100UL, for use by a broad portion of the GA fleet. The FAA's approval of unleaded avgas for use in these aircraft is an important first step in the process of transitioning to an unleaded fuel for the entire GA fleet, but it is not the only step needed to ensure a safe transition.

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[8] https://flyeagle.org/wp-content/uploads/2023/06/FAA-Pathways-Final.pdf
[9] https://flyeagle.org/wp-content/uploads/2023/06/FAA-Pathways-Final.pdf

UL94 unleaded avgas has been sold nationwide for 9 years with ASTM International Specification D7547, much like the D910 Specification for the current 100LL. Swift Fuels has also submitted an STC application for 100R, a 100-octane unleaded aviation fuel, and anticipates FAA approval in 2024. Swift is simultaneously seeking an ASTM fuel specification for 100R. G100UL has an FAA STC approval based on a proprietary fuel specification known only to the FAA and GAMI; however, no industry consensus standard or ASTM International product specification has been set for G100UL at this time. Because the FAA does not indemnify any entity in the supply chain for damages caused by fuel-related issues, fuel distributors and FBOs will similarly lack assurances that the unleaded fuel they are selling will not expose them to liability. At present, G100UL is not commercially available for distribution and sale in the U.S. largely due to the fact it does not have an ASTM International product specification.

Fostering a Safe Transition

NATA and its members have and continue to demonstrate leadership in keeping a safety-first focus on infrastructure support, as well as on the development of resources and training for airports, FBOs, and other refueling operators. As one example, in September 2022, NATA published its *Unleaded Avgas Conversion Considerations for Aviation Fuel Providers*[10], a white paper developed by NATA's GA Fuel Subcommittee to educate fuel service providers on best practices for safely deploying unleaded avgas.

As we approach a point where multiple grades of avgas may be available at airports, NATA also offers resources to mitigate increased risks for misfueling. When introducing new fuels, it is critical that airports and FBOs implement comprehensive management of change processes, perform risk assessments, and have a misfueling prevention program in place. To that end, NATA's Safety 1st program provides free training and resources at www.preventmisfueling.com.

Mixing fuels of the same grade also presents safety concerns. The FAA has yet to communicate their role in testing the inter-mixability, or fungibility, of new fuels coming into the marketplace other than the assurance of an adequate detonation margin related to a fuel's inter-mixability with 100LL. A much broader array of testing is carried out for fuels with an ASTM specification to help provide for the safe and economical operation of aircraft with fuels that are clean, dry and free of any contamination prior to use.[11] While the FAA STC process has tested unleaded fuels against 100LL in the wings of aircraft,

[10] https://www.nata.aero/assets/Site_18/files/EAGLE/NATAUnleadedAvgasConsiderations.pdf
[11] https://mcsdocs.astm.org/committee-documents/D02_Brochure_June%202021.pdf

the FAA does not address the fungibility or compatibility of mixing different unleaded fuels in aircraft, airport storage tanks, or refuelers. NATA does not recommend mixing any new unleaded fuel with existing unleaded fuels in the marketplace until both the FAA and ASTM International have conducted this testing and concluded that the fuels can be safely mixed.

The safety risks of misfueling or improperly mixing fuels are compounded by the fact that the vast majority of FBOs do not have the tanking capacity to offer more than one grade of avgas. The permitting and approval process for adding a second fuel tank can take months or even years in certain jurisdictions, with the costs of adding a tank exceeding one million dollars in some areas. An FBO that immediately converts their single avgas tank to Swift UL94 would not be able to service aircraft that require a 100-octane fuel. And an FBO that immediately converts to G100UL would force pilots to fuel their aircraft with a fuel that lacks an industry consensus standard such as an ASTM specification.

NATA shares EAGLE's position that a safe transition from leaded avgas requires the continued availability of 100LL during the transition to unleaded fuel. NATA also notes that all federally obligated airports (i.e., any public airport having agreements with the FAA, including grant agreements for funding and real property transfers) are required by the FAA to offer 100LL for sale. Airports should consider that a ban on the sale or use of 100LL at any federally obligated airport is inconsistent with Grant Assurance 22(a), *Economic Non-Discrimination* (49 U.S.C. 47107(a)(1)[12]) and conflicts with the self-service provision of this grant assurance.

Consensus Needed on Commercial Availability

NATA is aware that, as part of a 2014 settlement[13] of a California Proposition 65 action for alleged exposures to lead from avgas, many fuel distributors and FBOs who operate in California agreed to offer a lower lead alternative to 100LL if and when such a fuel becomes "Commercially Available." NATA is also aware that the plaintiff in that action, the Center for Environmental Health (CEH), recently demanded that the settling distributors offer G100UL for sale by March 1, 2024. NATA's understanding is that most distributors and FBOs do not believe that G100UL is "Commercially Available" as defined in the settlement and have provided a detailed response to CEH explaining their reasoning. NATA shares the position of these distributors and FBOs. The FAA's approval of G100UL for use in a broad portion of fixed-wing (but not yet rotor-wing) aircraft engines and types

[12] https://www.faa.gov/airports/aip/grant_assurances
[13] https://oag.ca.gov/system/files/prop65/judgments/2012-00204J2440.pdf

is a positive step, but by itself should not be interpreted to force distributors and FBOs to offer G100UL as a sole replacement for 100LL at present. NATA is further concerned about market confusion, such as aircraft owners potentially purchasing STCs under the misimpression that there was an impending deadline for FBOs to offer unleaded avgas for sale in California. This same confusion and misrepresentation of commercial availability may also influence proposed state legislation calling for the removal of 100LL, such as California SB 1193[14].

Conclusion

Unleaded aviation gasolines should not be offered as a standalone fuel without an industry consensus standard such as ASTM International, confirmation of materials compatibility throughout the supply chain, and FAA testing for compatibility with other FAA-approved unleaded avgas formulations. These safety concerns alone challenge the commercial viability of requiring the sale of such fuels at airports, as CEH seeks and as a pending bill in the California legislature would mandate. Considerations such as increased prices, supply chain capacity, and the lack of rotorcraft approval raise additional concerns as to the commercial feasibility of these fuels as a standalone replacement for 100LL in the immediate term.

NATA remains committed to doing its part to eliminate the use of leaded avgas without adversely affecting the safe and efficient operation of the existing GA fleet by 2030—and ideally sooner. Safely achieving this goal will require that 100LL remain available during the transition to unleaded avgas. NATA looks forward to supporting the use of unleaded avgas that is FAA certified for engines and airframes and meets an ASTM International or other industry-approved specification when it is commercially viable and safe to offer this fuel for sale. NATA will continue to work with all stakeholders toward this goal.

[14] https://sd20.senate.ca.gov/news/protecting-communities-across-california-sb-1193-banning-sale-leaded-aviation-fuel