Federal Aviation Administration

Draft Transition Plan to Unleaded Aviation Gasoline – For Public Comment

January 2026, Version 1.0

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EXECUTIVE SUMMARY

The 2024 FAA Reauthorization Act (the Act) Section 827 directed the Federal Aviation Administration (FAA) to continue to partner with industry and other Federal government stakeholders in carrying out the mission of the industry-government initiative, Eliminate Aviation Gasoline Lead Emissions (EAGLE), and take such actions as may be necessary to facilitate:

- Safe elimination of the use of leaded aviation fuels by piston-engine aircraft in the United States by the end of 2030 (end of 2032 for Alaska) without adversely impacting the safe and efficient operation of the impacted, general aviation (GA) fleet
- Approval of the use of unleaded alternatives to leaded aviation gasoline for use in all piston-engine aircraft types and piston-engine models
- Implementation of the requirements relating to the continued availability of aviation gasoline
- Efforts to make unleaded aviation gasoline widely available for purchase and use at airports in the National Plan of Integrated Airport Systems (NPIAS)
- Development of a Transition Plan to Unleaded Aviation Gasoline (Transition Plan)

The FAA's goal in providing this document is to comply with the Act and provide a nationwide plan to support a safe and orderly transition to unleaded fuels. This plan is provided with an understanding that many of the factors that affect the ultimate transition are market driven. The decisions made by private individuals and companies could have a significant influence on the ultimate transition. The FAA also acknowledges that the process of the transition will continue to evolve as 2030 approaches, more information becomes available, and therefore may require an update to the Transition Plan at a later date. The Transition Plan is intended to provide an overview and considerations of the following areas:

- The fuel evaluation and authorization activities already undertaken by the EAGLE initiative
- Efforts toward evaluation and development of necessary airport infrastructure
- Efforts to address supply chain and other logistical barriers inhibiting the timely distribution of unleaded aviation gasoline(s) to airports
- Outreach efforts to educate and update piston-engine aircraft owners and operators, airport operators, and other members of the general aviation community on the potential benefits, availability, and safety of unleaded aviation gasoline, and
- Efforts to establish best practices for impacted personnel to protect them against exposure to lead when conducting related operations

The information contained in this document is intended to be leveraged by various stakeholders – including the FAA, fuel developers, producers, suppliers, resellers, fixed base operators (FBOs), pilots, and associations – to facilitate a structured, safe, timely, coordinated, and orderly transition from 100 low-lead (LL) aviation gasoline to its unleaded replacement(s).

The guidance provided in the Transition Plan relies on recommendations in the congressionally mandated 2021 NASEM report, "Options for Reducing Lead Emissions from Piston Engine Aircraft," as well as the recommendations from the "Unleaded Avgas Transition Aviation Rulemaking Committee (UAT ARC)." Both documents were developed in coordination with specialists representing a breadth of

industry knowledge and experience in the affected areas. Draft Framework to the Transition Plan proposes four main phases of the transition as shown in Figure 1.

Figure 1 – Four Phases in the National Transition to Unleaded Fuel for the General Aviation Fleet and Ongoing Activities

The four-phased approach for the transition to unleaded fuels recognizes the impacts that market factors will have on the demand and supply of unleaded fuels as the FAA and industry progress on their path from fuels approvals and authorizations to the full national transition.

The first phase of the transition will address two prerequisites to the transition: what are the approved fuels, and how do the fuels compare? Three candidate unleaded fuels are in various stages of obtaining FAA approvals or authorizations, deployment to, and use of new unleaded fuel(s) by early adopters. That work must be completed in this phase. Recognizing that the market will select the fuel(s) and that there are additional factors, beyond an FAA approval that affect the market, Phase 1 also includes comparison testing and reporting on the results of such testing to facilitate more informed decision making.

The second phase of the transition will provide time for the market to gain experience with the various unleaded fuels. Lessons learned from early market experience can be used to facilitate further market integration during the second phase of transition when more airports and aircraft are expected to adopt unleaded fuels.

Phase three is the National Transition in all states except Alaska. During Phase 3, all aircraft and all airports (outside of Alaska) are expected to leverage lessons learned from Phases 1 and 2 and switch to unleaded fuel(s). Due to unique challenges, the Alaska transition (described in more detail later) is anticipated to be the fourth and final phase of transition.

Development and dissemination of best practices, providing guidance, and continued communications are the ongoing activities that are vital to the successful transition. These activities are expected to take place throughout the entire transition, supporting both short-term and long-term goals during each phase. These activities ensure all stakeholders are engaged and informed, contributing to a safe and efficient transition.

1. INTRODUCTION

1.1 TRANSITION TO UNLEADED FUELS

Currently, aviation gasoline (AvGas) is the only transportation fuel in the United States that contains TetraEthyl Lead (TEL), a lead-based additive that has been added to AvGas since 1921 to boost octane ratings and prevent engine damage and knocking at higher power settings. As of Fall 2025, 100-octane low lead (100LL) is the most used AvGas for spark ignition piston-powered aircraft. Many piston-engine aircraft designs are best suited for 100LL. However, in response to the evolving market factors and public health considerations, the FAA has initiated transition efforts from 100LL to unleaded aviation fuels.

Market factors are significantly influenced by two forces, the first of which is the supply of TEL additive. There is a single source TEL provider for the U.S. market. This provider has indicated an eventual end of production of the TEL additive, which will affect the global market. The only other potential sources for TEL could lead to reliance on sources such as China, resulting in potential supply chain concerns as well as long-term availability issues.

The second force is tied to the fluctuating supply and demand for 100LL itself. Producers and refiners are constantly adjusting their production volumes based on the anticipated demand, especially in relation to other, more commonly used aviation fuels such as jet fuel. To demonstrate, according to the U.S. Energy Information Administration, in 2023, the U.S. consumed approximately 25.3 billion gallons (Bgal)[1] of jet fuel as opposed to 180 million gallons (Mgal) of AvGas[2]. These numbers could necessitate a production shift away from AvGas, as evidenced by a recent plant repurposing, reducing the total number of U.S. AvGas production facilities.

These market factors are further influenced by public health concerns from exposure to lead, motivating the FAA and the aviation community to seek alternative fuels.

The following are examples of the transition enabling government-industry actions over the years:

In 2012, FAA authorized the Unleaded AvGas Transition Aviation Rulemaking Committee (UAT ARC) to investigate, prioritize, and summarize the current issues relating to the transition to an unleaded AvGas, and to recommend the actions necessary to investigate and resolve these issues. The committee was comprised of key stakeholders from the General Aviation (GA) community including aviation trade/membership associations, aircraft and engine manufacturers, petroleum and other fuel producers, and U.S. government agencies such as the EPA and the FAA. The UAT ARC produced a comprehensive report[3] and made them available to the public. Pursuant to these recommendations the FAA and industry established a program called Piston Aviation Fuels Initiative (PAFI)[4] to support the evaluation of candidate unleaded fuels to replace approved leaded AvGas. The ultimate objective of the program is to qualify a fleet-wide solution.

Congress has supported the transition to the unleaded fuels by including two sections in the FAA Reauthorization Act of 2018, (Pub. L. 115-254), Section 177 to commission a consensus report by NASEM, and

[1] U.S. Energy Information Administration: US Jet Fuel Consumption in 2023
[2] U.S. Energy Information Administration: U.S. Product Supplied of Aviation Gasoline
[3] UAT-ARC Final Report – Body[3] UAT-ARC Final Report – Appendices
[4] PAFI - Background and Program Update

Section 565 to provide an alternate pathway to the traditional Type Certification/Supplemental Type Certification (TC/STC) process.

More recently, in February 2022, several general aviation industry associations, the American Petroleum Institute (API), and the FAA established the Eliminate Aviation Gasoline Lead Emissions (EAGLE)[5] initiative with a goal to "Eliminate the use of leaded aviation fuels for piston-engine aircraft in the United States by the end of 2030 without adversely impacting the safe and efficient operation of the existing GA fleet." This public-government initiative was formed in response to the NASEM 2021 report mentioned in the previous paragraph. The EAGLE initiative provides a framework to coordinate and align a wide range of research and development efforts, fuel testing and evaluation activities, and other actions needed for the transition to unleaded AvGas. For more information please refer to the EAGLE website.

In 2023, the Environmental Protection Agency (EPA) issued its final Endangerment Finding[6] that engine emissions of lead from certain aircraft cause or contribute to the lead air pollution that may reasonably be anticipated to endanger public health and welfare under the Clean Air Act.

In 2024, the FAA Reauthorization Act supported the EAGLE goal, while further clarifying that airport owners and operators must not restrict the continued use of 100LL until the earlier of 2030 (2032 for Alaska), or when a replacement fuel meets a predefined criteria described in Section 770, Grant Assurances, in the FAA Reauthorization Act of 2024 (the Act). In addition, it provided for similar obligation for FAA and EPA with respect to Alaska, where they shall not restrict 100LL until the earlier of 2032, or when a replacement fuel meets predefined criteria described in the Act.

The three sections in the FAA Reauthorization Act of 2024 (PL 118-63), that support the transition to an unleaded AvGas future are: Section 770, Grant Assurances[7]; Section 771, Aviation Fuel in Alaska[8]; and Section 827, EAGLE Initiative[9]. The full text of these provisions is in Appendix E. This document will reference key provisions of each of these sections.

[6] U.S. EPA - Final Endangerment Finding Regarding Lead in Aviation Gasoline
[7] 2024 Reauthorization Act, Section 770, Grant Assurances
[8] 2024 Reauthorization Act, Section 771, Aviation Fuel in Alaska[9]2024 Reauthorization Act, Section 827, EAGLE Initiative
[9]2024 Reauthorization Act, Section 827, EAGLE Initiative

2. BACKGROUND

2.1 LEAD IN AVIATION (100-OCTANE LOW LEAD)

As previously stated, 100LL is the primary fuel utilized by spark-ignition piston-engine aircraft. As of Fall 2025, there were approximately 222,000 spark-ignition piston engine aircraft registered with the FAA, of which approximately 175,000[10] were estimated to be actively flying. These aircraft consumed an estimated 180 million gallons of 100LL in 2023 per the Energy Information Administration (EIA). These aircraft include airplanes and helicopters with a standard airworthiness certificate, light-sport category aircraft (LSCA) with a special airworthiness certificate, and a variety of aircraft with an experimental airworthiness certificate. Reference the EAGLE Interactive Toolkit at flyeagle.org for insightful statistics about the airports currently carrying 100LL, as well as the replacement fuel(s), AvGas supply logistics, sales volumes, piston fleet, and more.

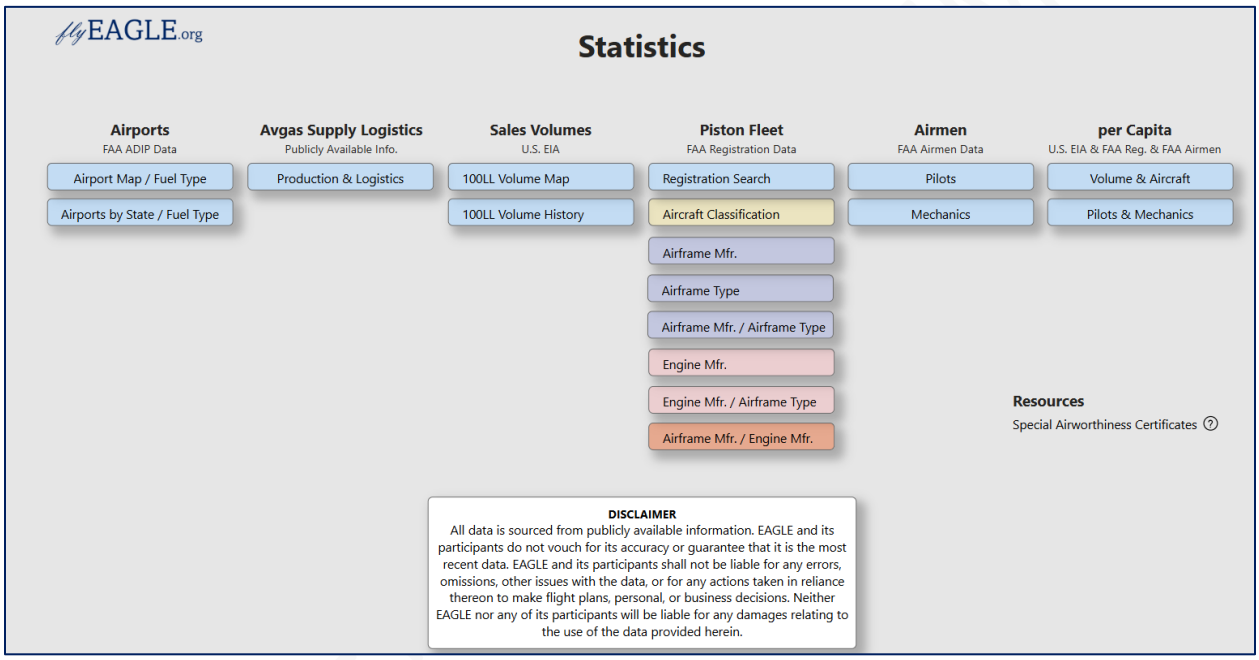
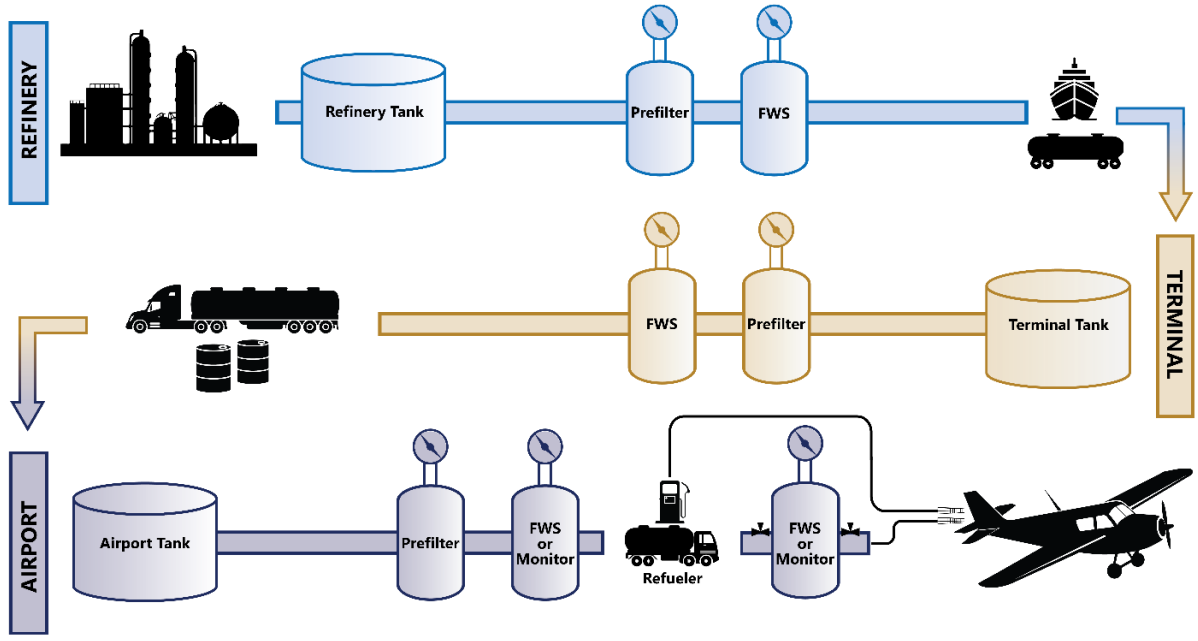


Image: EAGLE-created; used with permission

Figure 2 – EAGLE's Interactive Toolkit: Piston Engine Aircraft-Focused Statistical Dashboard

100LL has a well-established and effective process for the production and distribution of the fuel, ensuring product quality from initial production to its utilization in an aircraft. Figure 3 illustrates the scope and complexity of the 100LL distribution system and the critical entities that are required to bring the fuel from production to final distribution. Each of these entities has an important role in the transition to unleaded fuel, ranging from refiners scaling the production of unleaded fuel to meet fleet demands, to distributors safely moving the fuel to the local airports for use by aircraft owners and operators.

[10] FAA Research Data: Aerospace Forecasts



(FWS – Fuel Water Separator)
Image: FAA created; adapted from Cross-industry Group – Unleaded AvGas Development

Figure 3 – Current 100LL Distribution System

The U.S. has a vast network of GA airports that supply AvGas, highlighted in Figure 4. The most up to date information is available via the [FAA's Airport Data and Information Portal (ADIP) Database](). These locations range from large fuel handling and distribution centers in Texas to small airfields in remote sections of Alaska. The modes and methods of distribution to all these locations have evolved in alliance with the GA demands for each region. The transition to unleaded fuels expects to leverage the existing distribution pathways and ensure that the unleaded fuel is available at all locations that currently distribute AvGas.

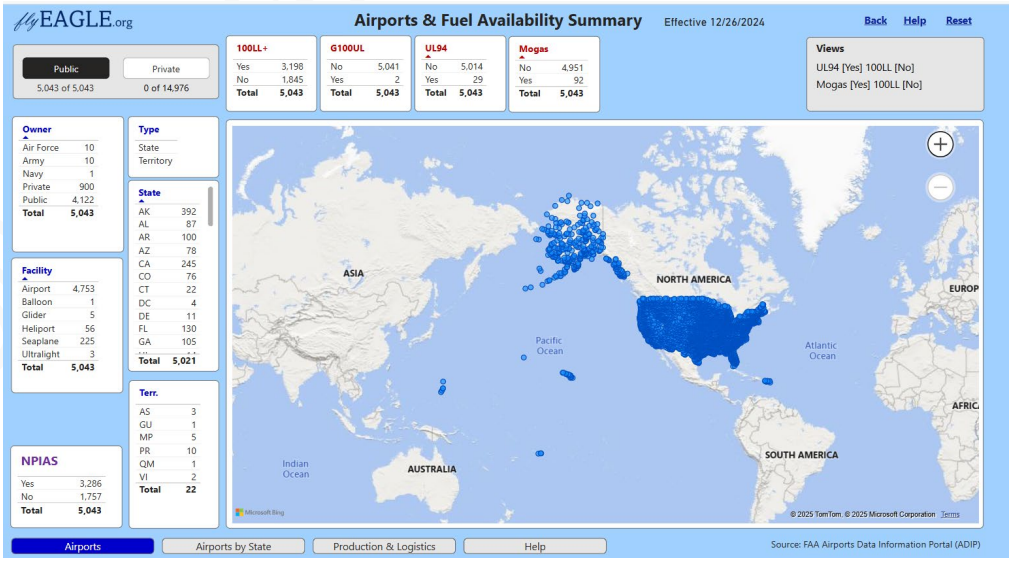


Image: ***FAA, December 2024***

Figure 4 – General Aviation Airports Across the U.S. that Supply Aviation Gasoline

As seen in the earlier figures, the introduction of new fuel to the GA fleet as a replacement for 100LL will directly impact every actively used spark-ignition piston-engine aircraft, pilot, owner, FBO, and the entirety of their supporting infrastructure. As the industry turns to unleaded fuel, the engagement of the various stakeholders that are integral components of this complex and robust system will be critical to achieve a safe and efficient transition to unleaded fuels.

2.2 UNLEADED FUEL DEVELOPMENT

Finding replacement unleaded fuel involves in-depth testing and evaluation of many fuel characteristics such as performance, detonation resistance, materials compatibility, durability, maintenance impacts, and the potential need for related aircraft alterations. Critical market considerations such as fuel availability and quality control of the fuel make the task even more complex.

As of September 2025, in the U.S., there are three candidate high-octane unleaded fuels at various stages of development and deployment. These fuel candidates are shown in Table 1. Additional information concerning these fuels is provided in Table 2 in Section 4.2.

UNLEADED FUEL	FUEL PRODUCER
G100UL	General Aviation Modifications, Inc. (GAMI)
100R	Swift Fuels
UL100E	LyondellBasell/VP Racing

Table 1 – Candidate unleaded fuels

2.3 GOVERNMENT AND INDUSTRY COLLABORATIONS

2.3.1 PAFI

In response to the UAT ARC recommendations and Section 910 of the FAA Modernization and Reform Act of 2012, the FAA established the PAFI program at the FAA Technical Center in Atlantic City, New Jersey, in 2014. This program's goal was to identify candidate unleaded AvGas, to provide for the generation of qualification and certification data on those fuels, and to support fleet-wide certification of the most promising fuel(s). At the time of PAFI's inception, it was recognized that broad approval of a novel fuel composition was unprecedented in the fleet. This recognition greatly influenced the approach and structure of the PAFI program.

Approval of fuel(s) is complicated by numerous challenges, ranging from technical challenges related to fuel performance and aircraft-fuel compatibility, to the logistics associated with the production, delivery and storage of fuels for use. As a result, PAFI relied on coordinated activities among the various stakeholders to define and implement test and evaluation of candidate fuels for the existing fleet, production and distribution infrastructure. After pursuing a variety of different possible fuel chemistries, the program determined that there is no feasible unleaded fuel that would comply with the 100LL fuel specification and meet the performance requirements of all aircraft engines. Additionally, in the vetting of numerous fuel candidates, the program was successful in documenting testing considerations, lessons learned, and best practices in the FAA and industry's search for the ultimate replacement unleaded fuel(s)[11]. These learnings have been carried forward into the

[11] Piston Aviation Fuel Initiative (PAFI) - White Paper
Fuel Development and Testing Lessons Learned
PAFI Fuel Development and Testing Best Practices
PAFI Fuel Development and Testing Considerations

current PAFI program, which is finalizing testing of UL100E for Fleet Authorization process described in greater detail in section 3.3.2.

2.3.2 EAGLE

As mentioned in previous sections, GA industry associations, the API, and the FAA established the EAGLE initiative in 2022 with the goal to "eliminate the use of leaded aviation fuels for piston-engine aircraft in the United States by the end of 2030 without adversely impacting the safe and efficient operation of the existing GA fleet". In response to the congressionally directed NASEM 2021 consensus study report, "Options for Reducing Lead Emissions from Piston-Engine Aircraft," the EAGLE initiative focuses on a multi-faceted approach to reduce and eliminate lead emissions by way of four integrated pillars:

Image: TOP: EAGLE-created; BOTTOM: EAGLE member logos used with permission

Figure 5 – Four EAGLE Pillars and Members of EAGLE

The four EAGLE pillars are committed to the following:

- Facilitate supply chain and infrastructure readiness for commercial market acceptance and deployment of unleaded aviation fuels from refining to distribution into the aircraft. Provide options for airports wanting to pursue near-term reductions of lead emissions.
- Conduct research and development on technical solutions or modifications that may be necessary for certain aircraft to safely facilitate transitioning to unleaded fuel.
- Support the development and deployment of viable unleaded fuel(s) to replace 100LL that meets the safety needs of the fleet; this includes fuels assessed through both Fleet Authorization and fuels going through the traditional FAA Type Certification program.

- Support governmental, regulatory, and programmatic activities focused on safely transitioning to an unleaded replacement and eliminating lead emissions from aircraft engines.

The EAGLE initiative supports the goal of safely eliminating lead in AvGas used by piston-engine aircraft as codified by the Act by addressing fuel production and distribution concerns, in addition to identifying and addressing any gaps in efforts undertaken by government and industry toward the lead-free AvGas future.

3. ROLE OF THE FAA IN THE TRANSITION TO UNLEADED FUEL

3.1 RESEARCH AND DEVELOPMENT

3.1.1 FAA RESEARCH

In addition to its regulatory role, the FAA has supported technical efforts for unleaded fuel development and deployment since the early 1990s. Previous efforts have focused on testing octane boosters and unleaded fuels by evaluating their performance, including knock, in aircraft engines. These efforts are summarized in Appendix H – Early FAA research activities related to unleaded fuels.

Beginning in 2014, FAA technical effort transitioned to the PAFI program. The PAFI program leveraged lessons learned, testing capabilities, and test methods developed from previous efforts to continue the development of unleaded fuels and develop a pathway for fleet wide approval of unleaded fuel. In 2018, the FAA Reauthorization Act directed the FAA to continue to utilize the PAFI program to identify unleaded fuels and work with industry partners through cooperative research and development to explore additional unleaded fuel candidates. Please see Appendix H – Early FAA research activities related to unleaded fuels.

In addition to support for PAFI, the FAA has continued to support research and development with current efforts focused on sensitivity testing for engine operability, engine octane demand, support for potential in-service issues, and the comparative assessment discussed in Section 5.3. The impacts of these activities will directly support Phases 1 and 2 of the Transition Plan.

3.1.2 FLEET RESEARCH

The aviation industry has also supported research activities for the development of unleaded fuels. Of note is the Coordinating Research Council (CRC) Report No AV-7-07, which highlights the evaluation of 279 experimental test fuels, engine testing on nearly 80 unleaded fuel blends, and comparisons between engine testing on leaded and unleaded fuels. This report documents a significant portion of the industry initiative to facilitate the evaluation and development of unleaded fuel prior to the initiation of the PAFI program. Copies of the report are available at www.crcao.org.

3.2 AUTHORITY TO REGULATE FUEL

Historically, the FAA has not regulated or approved any fuel. However, with the EPA Endangerment Finding related to lead emissions, the FAA must exercise its authority in 49 USC 44714 to prescribe standards for the composition or chemical or physical properties of a fuel or fuel additive. 49 USC 44711 (a)(9) prohibits the manufacture, delivery, sale, or offer for sale of fuel that is in violation of FAA fuel composition requirements once they are established. These two provisions grant FAA the authority to prescribe and enforce fuel standards and will represent a shift in the FAA's role with respect to the regulation of aviation fuels as the transition to unleaded fuels takes place.

3.3 PATHWAYS TO AUTHORIZE USE OF FUEL

Currently, the FAA utilizes two processes to authorize the use of a fuel: (1) Fleet Authorization and (2) traditional Type Certificate (TC) or Supplemental Type Certificate (STC) approval.

3.3.1 FAA TYPE CERTIFICATION (TC)/SUPPLEMENTAL TYPE CERTIFICATION (STC) PROCESS

When approving aircraft and engines under the TC process, the FAA has always included corresponding limitations to identify the fuel that is approved for use in that aircraft or engine. As with any aircraft modification, companies may revise that approval by amending the TC (if the company holds the TC approval) or obtaining STC approval. TC/STC approval may be limited to individual aircraft and engine types, or it could be granted for a broad range of applicable types of aircraft and engines by creating an approved model list (AML) STC that bundles the FAA approval of an STC in many aircraft models in a single approval.

This process requires the applicant to establish that each model of aircraft and aircraft engine for which approvals are requested are compliant to FAA regulations when using the alternate fuel. Each applicant adopts or develops a means of compliance with the regulations. Performance equivalence to 100LL is not required, and the compatibility of a fuel with the supply infrastructure is outside the scope of the FAA's evaluation for the TC/STC process. The applicant retains ownership of the compliance data and can choose to provide data to the end users upon request.

The TC/STC process only applies to engines and aircraft with a standard airworthiness certificate.

TC and STC policy is governed by 14 CFR Part 21. The implementation of those requirements, including specific guidance on obtaining an approval to use a new fuel, is addressed in FAA Advisory Circular (AC) 21-40A, AC 20-24D, and FAA Order 8110.4.

The TC/STC process can be used to approve any change in the aircraft design, use of fuel, or a combination of the two. Two fuel developers, GAMI and Swift Fuels, have elected to use this process to enable the use of their fuels in aircraft. GAMI has obtained an STC AML approval for all spark-ignition engines and airplanes to use G100UL. Swift Fuels initially obtained an engine STC for Lycoming IO-360-L2A engines and airplane STC for Cessna 172 R/S with plans to expand both. These approvals build on a previous approval that was in place for the use of UL94.

Other companies have obtained approvals for their fuel to operate in engines previously approved to operate on 100LL. For example, a number of aircraft and engine design approval holders modified their designs to authorize the use of UL94, a fuel defined by an industry consensus standard (ASTM D7547).

Aircraft and engine modifications may go beyond using the fuel itself, and may be motivated by other factors such as increased efficiency or lower maintenance. Some examples include changes to ignition timing and replacement of certain materials within the fuel system. The TC/STC process can also be used to install anti-detonation injection systems, or even to replace a spark-ignition piston engine with a compression-ignition engine. Compression-ignition can take advantage of the widespread availability of Jet A fuel.

Note that for any change that involves a change to the engine, there must be a corresponding change to the aircraft approval to reference the modified engine.

3.3.2 FAA FLEET AUTHORIZATION PROCESS

The Fleet Authorization pathway is a result of the 2018 Reauthorization Act, Section 565, that directs the FAA to adopt "a process (other than the traditional means of certification) to allow eligible aircraft and engines to operate using qualified replacement unleaded gasoline in a manner that ensures safety."

The Fleet Authorization process is intended to enable a broad use of unleaded AvGas as a replacement fuel for 100LL in the fleet. The eligible aircraft that may use the unleaded AvGas is determined during the Fleet Authorization process and identified in the Fleet Authorization itself. The FAA leads the evaluation of fuel in this pathway and conducts necessary tests under the PAFI program. The PAFI program is overseen by the FAA and coordinated through a collaborative government/industry body of technical experts such as aircraft and aircraft engine manufacturers, aviation fuel distributors and producers, and other stakeholders in the aviation fuel industry. The PAFI testing also addresses the compatibility of the fuel with the supply chain. As noted in the white paper published by the National Air Transportation Association (NATA), it is "imperative that new fuels are tested with the materials they interact with throughout the supply chain. 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.

Additionally, the data obtained through testing can be used to support development of the ASTM production specification for the candidate fuel, a requirement for Fleet Authorization under the FAA Reauthorization Act of 2018.

In addition to authorizing the use of fuel in an engine or aircraft with a standard airworthiness certificate, the Fleet Authorization process can authorize the use of fuel in aircraft with special airworthiness certificates and provide data for owners of aircraft with an experimental airworthiness certificate to safely use the fuel.

The Fleet Authorization process is described in detail in the FAA policy statement PS-AIR-600-20-01.

To summarize the Fleet Authorization process, , the FAA will authorize the use of qualified unleaded AvGas based on test data for aircraft and aircraft engines from the PAFI program and other sources as set forth in this policy statement and described below:

- In general, when the candidate fuel has successfully completed testing and evaluation and the ASTM production specification has been published, the FAA-approved data will be documented in the Eligible Fleet Authorization Summary Report (EFASR). The candidate fuel is then qualified as replacement fuel.
- The FAA will determine the make and model of aircraft and aircraft engines that can safely operate with the qualified unleaded AvGas and summarize that information along with other crucial information necessary to enable the use of the qualified fuel in the EFASR.
- The FAA will then issue a Special Airworthiness Information Bulletin (SAIB) to identify the qualified fuel, specify the aircraft and engines eligible to use the qualified fuel, and provide references and other information to accomplish the alteration necessary to enable the use of the fuel.
- The person performing the alteration is responsible for verifying the eligibility of the aircraft and aircraft engine for use of the qualified fuel. That person will also be responsible for performing all required actions and completing all required documentation in accordance with the information referenced in the SAIB and applicable regulations. This includes installation of fuel placards, Aircraft Flight Manual Supplement revisions, and associated logbook entries for the aircraft and aircraft engine.

- For aircraft with special airworthiness certificates in the light-sport category, the FAA may determine that alterations described in the SAIB meet the applicable and current consensus standard for the aircraft and authorize them accordingly. Such alterations meet the requirement specified in 14 CFR 91.327(b)(5) and no additional authorization from the manufacturer is required.

LyondellBasell/VP Racing's proposed fuel, UL100E, is the only fuel currently in the Fleet Authorization process. This fuel is adapted from experience with high-performance, unleaded auto racing fuel. The anticipated Fleet Authorization date for UL100E is Spring 2027.

Other fuel developers may elect to use the Fleet Authorization process at some point.

3.3.3 LIGHT-SPORT CATEGORY AIRCRAFT PROCESS

Light-Sport Category Aircraft (LSCA) includes both Light Sport Category Aircraft with a Special Airworthiness Certificate (SLSA) and Experimental Airworthiness Certificates (ELSA). The TC/STC process does not apply to these aircraft.

The process to authorize a new fuel is different for ELSA and SLSA aircraft. As discussed previously, the FAA's Fleet Authorization process will provide data regarding unleaded fuels for utilization by the owners of ELSA aircraft. Owners of ELSA aircraft who wish to utilize unleaded fuels with a STC will need to contact the owner of the STC for the appropriate data. For SLSA, FAA's Fleet Authorization can authorize the use of unleaded. Additionally, the original manufacturer of the SLSA aircraft may also determine that unleaded fuel is acceptable and notify their customers of a need for any corresponding aircraft alterations.

3.3.4 AIRCRAFT ALTERATIONS

Regardless of the process used, individual aircraft owners must take specific actions to implement the authorization to use unleaded fuel in their aircraft. Fuel limitations are indicated on a placard near the fuel tank access and are documented in the approved aircraft flight manual. Each individual aircraft must alter the placard and any associated limitations and may need to make other aircraft alterations to ensure compatibility with a particular fuel.

The information below highlights the alteration processes for use by various portions of the fleet:

- For aircraft with a standard airworthiness certificate, this is an aircraft alteration that is accomplished under 14 Code of Federal Regulations (CFR) part 43 and must be performed by an authorized mechanic, repairman, or certificated repair station (14 CFR 43.3). The authorized person confirms the applicability of the approval or authorization to that specific aircraft, replaces the fuel placard, revises the flight manual and instructions for continued airworthiness as appropriate, and records the alteration action per 14 CFR 43.9. If other aircraft changes are required to use the fuel, they would be made as part of this alteration. If the aircraft alteration is a major change, the alteration is also signed off by an individual with inspection authorization (IA) and reported to the FAA on Form 337 per 14 CFR 43.7 and 43.9.
- For special light-sport aircraft, this is an alteration that is accomplished under 14 CFR part 43 and must be performed by a light-sport repairman (14 CFR 65.107) or mechanic (14 CFR 65.73). The light-sport repairman or mechanic confirms the applicability of the approval or authorization to that specific aircraft, replaces the fuel placard, and revises the flight manual and instructions for continued airworthiness as appropriate. If other aircraft changes are required to use the fuel, they would be made as part of this alteration.

- For aircraft with a special experimental airworthiness certificate, including experimental light-sport and amateur-built aircraft, the pilot can determine the eligibility of a fuel for their aircraft and replace a fuel placard as appropriate. For aircraft with an experimental airworthiness certificate, owners are responsible for ensuring their aircraft is compatible with the new fuel. Owners may obtain data to support that determination from a Fleet Authorization or from a fuel offeror for fuels approved for use under TC/STC.

3.3.5 FUEL SPECIFICATIONS

Historically, one of the key roles of industry is the development of standards for the refining, blending, and distributing of AvGas and other transportation fuels including motor gasoline, diesel, and jet fuel. These standards are developed and maintained collaboratively by the petroleum, liquid fuels, and aviation industries. These standards facilitate the international handling of petroleum products and have been a key factor in the consistent and safe production, sale, transportation, and use of aviation fuel. Aviation fuel has been self-regulated through these standards. ASTM International has served as the primary body for this process in the U.S., resulting in standards with industry understanding and consensus. The industry consensus process allows producers, distributors, providers, users, and many other aviation fuels subject matter experts (SMEs) to conduct peer review assessments toward the establishment of testing standards and fuel production specifications. The FAA participates in the review and approval as one of the many stakeholders to ensure that the specification is adequate for use in aircraft and engine approvals. The FAA authorizes the use of these fuels by reference to the industry standard in the approval documents.

The FAA allows for an alternative to industry specifications when authorizing the use of a fuel. An independent specification is developed and maintained outside of an industry consensus process. The FAA reviews the independent specification and approves it once it is found to provide an equivalent level of property, performance, and quality control as specifications outlined in relevant regulations and standards.

For fuels approved under the TC/STC pathway, the FAA allows fuel offerors to rely on either the industry consensus specification or independent fuel specification, as long as the requirements described in AC 20-24D are met. At least one producer and distributor has invested in fuel with an independent specification. That fuel has been produced at volumes exceeding 1 Mgals and is currently available at five airports as of Fall 2025. The developer may need to address additional considerations required by industry stakeholders to support business risk decisions for expanded deployment and use of the fuel.

Fuels pursuing FAA Fleet Authorization are required to obtain the industry consensus specification per the 2018 FAA Reauthorization Act. Two producers are at various stages of obtaining the industry consensus standard as of Fall 2025.

An industry consensus standard provides advantages over an independent specification with respect to market acceptance. The consensus process provides for independent peer review and understanding of a new fuel and is widely relied upon by aircraft engine and aircraft manufacturers, airports, and FBOs for risk assessment, warranty support, and market acceptance. As noted in section 3.3.2, NATA has published a document discussing the advantage of the industry consensus standard at length.

In order to support a successful National Transition to unleaded fuel, the FAA plans to prescribe standards for unleaded fuel through reference to industry consensus standards. There are several precedents for the FAA referencing industry consensus standards in regulations (e.g., Final Rule for Modernization of Special

Airworthiness Certificates (MOSAIC)[12]. Practically, this would result in a regulation in which the FAA specifies that unleaded fuels must comply with an industry standard that limits lead to an allowable amount, in alignment with the FAA's authority previously described in section 3.2. There is sufficient time for all candidate fuels to complete the consensus standards process before Phase 3 completes.

[12] Final Rule for Modernization of Special Airworthiness Certificates

4. APPROACH AND HIGH-LEVEL OVERVIEW

4.1 TRANSITION OVERVIEW

As discussed in the Executive Summary the transition is anticipated to proceed through four phases to safe elimination of the use of leaded aviation fuels by piston-engine aircraft in the United States by the end of 2030 (end of 2032 for Alaska). The following section discusses a high-level approach to each of phases and the critical actions that are anticipated during that phase. This section is followed by in-depth discussion of each of phases contained within their own independent section, providing more detail and context of each of the phases. Additionally, the plan for the National Transition to Unleaded Aviation Gasoline is built around several core ideas that guide and shape the phases and the specific actions, which are anticipated to occur during those phases. Those core ideas are as follows:

- Federal regulations will be necessary to eliminate the use of 100LL.
- The marketplace will select the fuel, or fuels, that replace 100LL.
- Airports should not be required to invest in additional tankage solely to accommodate the transition period.
- The National Transition Framework should be structured to be easily adapted as additional information that could impact the transition becomes available and uncertainties related to the transition are reduced.

This plan proposes four main phases of the transition as shown in Figure 6.

Image: FAA created

Figure 6 – Four Phases in the National Transition to Unleaded Fuel for the GA Fleet and Ongoing Activities

4.2 PHASE 1 – FUEL AUTHORIZATIONS AND COMPARISON

The first phase will address two prerequisites to the transition: what are the approved fuels, and how do the fuels compare?

Three candidate unleaded fuels are in various stages of obtaining FAA authorizations or approvals. Two of these fuels have been deployed for demonstration or limited use by early adopters. Completion of FAA authorizations or approvals must be completed in this phase. Recognizing that the market will select the fuel(s) and that there

are additional factors, beyond the FAA authorization or approval, that affect the market, such as the availability of data about the replacement fuels, proximity of the replacement fuels, etc., Phase 1 also includes fuel(s) comparison testing and reporting.

During this phase, currently approved fuels will continue to progress toward and into Phase 2 as stakeholders gain initial experience with those fuels. The activities for approvals and authorization are shown in Table 2. The completion of those fuel approvals and authorizations is a priority and is projected to be complete by Spring 2027.

Unleaded Fuel	FAA Authorization Pathway	Current Status (September 2025)
LyondellBasell UL100E	• Fleet Authorization – Planned • ASTM Specification – In development	• Engine Testing – In progress • Materials Testing – In progress • Flight Testing – In progress
GAMI G100UL	• AML STC • Independent Specification	• Engine AML STC – Approved • Airplane AML STC – Approved • Rotorcraft AML STC – In progress
Swift Fuels 100R	• STC • ASTM Specification – In development	• Initial Engine STC – Approved • Initial Airplane STC – Approved • Expanded Engine AML STC – In progress • Expanded Airplane AML STC – In progress

Table 2 – Fuel authorization activities

This phase also includes comparative testing of the candidate fuels in areas that have been identified by market stakeholders as important to their consideration in adopting a fuel. This will include FAA-funded comparative testing under identical conditions to allow direct comparisons between fuels. For example, stakeholders have requested performance and detonation characteristics in high-performance engines, and material compatibility test results (including materials used outside of aircraft approvals, such as in the supply chain and unique materials in aircraft with an experimental airworthiness certificate.

A particular concern that has been raised by stakeholders is the effect of mixing the various unleaded fuels. There will be significant operational challenges and risks if multiple fuels are authorized for the same aircraft but cannot be mixed. This scenario would likely introduce a risk of regional market segmentation that could become a significant barrier to National Transition. It could also increase the risk of misfuelling, raising safety concerns. For these reasons, the FAA may conduct intermixability testing of the various fuels in this phase. The fuel offerors are encouraged to also evaluate the intermixability of fuels as they become available.

This phase is anticipated to conclude once all fuel approvals and authorizations have been finalized and the fuels comparison is completed. The activities in this phase will provide critical information concerning the aircraft alterations that may be needed for each fuel and the scope of potential changes in the supply chain for each fuel. Actions to be completed during this phase are shown in Table 3, organized by focus area. They will be described in more detail in subsequent sections.

PHASE 1: FUEL AUTHORIZATIONS AND COMPARISON	
	**Research** • Perform comparative testing between unleaded fuels and 100LL • Test intermixability between new unleaded fuels
	**Fuel** • Complete fleet approval via Fleet Authorization • Approve STCs for unleaded fuels

Table 3 – Phase 1 actions

4.3 PHASE 2 – GAINING MARKET EXPERIENCE

The second phase of the transition would provide time for the market to gain experience with the various unleaded fuels. Lessons learned from early market experience can be used to facilitate further market integration during the second phase of transition when more airports and aircraft are expected to adopt unleaded fuels. The lessons learned through Phase 2 of the transition will be directly applicable to the third phase of the transition.

In Phase 2 of the transition, the FAA and industry expect to see increased consumption of unleaded fuel(s) and expanded locations well beyond the early adopters, providing an opportunity to gain further market adoption and experience. Since 100LL will continue to be provided nationwide during this phase, the expansion of unleaded fuels will be at airports with the infrastructure available to supply more than one AvGas or through supplemental means such as added infrastructure or fuel trucks.

While every fuel undergoes representative testing prior to being authorized, there is potential for in-service challenges to arise due to the breadth of aircraft and engine designs, materials, and operations. Every reported issue involves a combination of a fuel in an aircraft/engine, and it can be challenging to differentiate the root cause for issues. For example:

- In October 2023, the University of North Dakota reported a concern with the usage of UL94 and valve seat recession (VSR) in Lycoming engines. Lycoming has initiated efforts to understand the cause of VSR. In an update provided in April 2024, Lycoming shared the results of their efforts. It indicated that UL94 may impact VSR under certain conditions. However, the influence of fuel characteristics and combustion dynamics is a complex issue, making it difficult to determine a potential root cause.
- In December 2024, AvWeb reported that G100UL unleaded fuel appears to damage aircraft paint under specific circumstances, according to a California Airframe and Powerplant Mechanic (A&P) who conducted his own compatibility tests on it and 100LL. The mechanic also said new nitrile O-rings swelled beyond certified limits when submerged in the unleaded fuel for five to six days. GAMI recommends replacing nitrile components with those made of silicone or fluoropolymer elastomers.
- In June 2024, Cirrus released Service Advisory SA24-14, identifying specific concerns with G100UL causing the degradation of fuel tank sealant. Again, multiple factors ranging from substrate preparations through fuel chemistry all potentially play a role in the observed degradation, making the root cause determination difficult despite continued efforts by both the fuel developer and Cirrus.

To facilitate investigations, the FAA requested increased reporting concerning unleaded fuel experience through an SAIB issued in March 2025. Accurate and complete reporting of user experiences will be invaluable throughout Phase 2 and will inform the National Transition in Phase 3. Reported issues will need to be investigated by the relevant aircraft, engine, and fuel entities. To the extent the resources are available,

affordable, and recognizing the scope of this challenge, the FAA will also conduct testing to support investigations.

Phase 2 will also provide experience in producing, distributing, and storing fuel.

Finally, Phase 2 will also provide the market with initial insights into the cost of the various fuels. Cost is one of the main concerns expressed by aircraft owners, who would prefer that the transition to unleaded AvGas does not increase their operating costs.

Phase 2 is projected to conclude by mid-to-late 2028, providing at least one year for gaining market experience prior to initiating the National Transition away from 100LL. Table 4 highlights the actions for Phase 2, also organized by focus area.

PHASE 2: GAIN MARKET EXPERIENCE	
	**Fuel** • Increased consumption of unleaded fuels • Potential in-service challenges experienced and reported • Provide initial insights into the price of the replacement unleaded fuels
	**Research** • Reported issues investigated by relevant aircraft, engine and fuel stakeholders, as well as the FAA (to the extent affordable), root cause determined (where possible), and mitigated
	**Infrastructure** • Initiate efforts to examine and potentially expand fuel storage infrastructure • Support transition readiness activities at airports with the infrastructure available to supply more than one AvGas through added infrastructure or fuel trucks • Provide experience in producing, distributing and storing fuel

Table 4 – Phase 2 actions

4.4 PHASE 3 – NATIONAL TRANSITION

Phase 3 will involve a National Transition to replace 100LL with unleaded fuels outside of Alaska. The National Transition will be influenced by Phase 1 and Phase 2 activities as well as progress by the FAA to prescribe standards for the composition or chemical or physical properties of a fuel or fuel additive for the regulation of aviation fuels containing lead. A key to phasing out 100LL at any given airport will be well-coordinated efforts by various stakeholders. Here are some sample actions that will require synchronization:

- Aircraft owners and operators of the aircraft that operate out of or frequent a given airport will seek predictability in the available fuels, as well as the details of the required alterations to use the fuel.
- Fuel producers and suppliers will look to finalize fuel(s) supply to airports and FBOs.
- Airports, FBOs, and the supply chain will sell 100LL until there is a competitive unleaded alternative or federal regulations prohibit it.
- Airports and FBOs will sell replacement fuel that most aircraft either using or frequenting their location have been modified to use, if it can be produced and delivered in a timely and reliable manner.

Some aircraft in the active fleet may require alterations beyond placarding and flight manual revisions to use a replacement unleaded fuel(s). It is important to align the transition activities in a manner that allows a reasonable timeframe to complete these alterations.

While some airports will begin selling an unleaded fuel in Phase 2, the majority of airports do not have the ability to offer more than one AvGas. At those airports, the transition to unleaded fuel cannot be gradual and must happen in a clear and controlled manner. Key milestones for Phase 3, in the order in which they are expected, include:

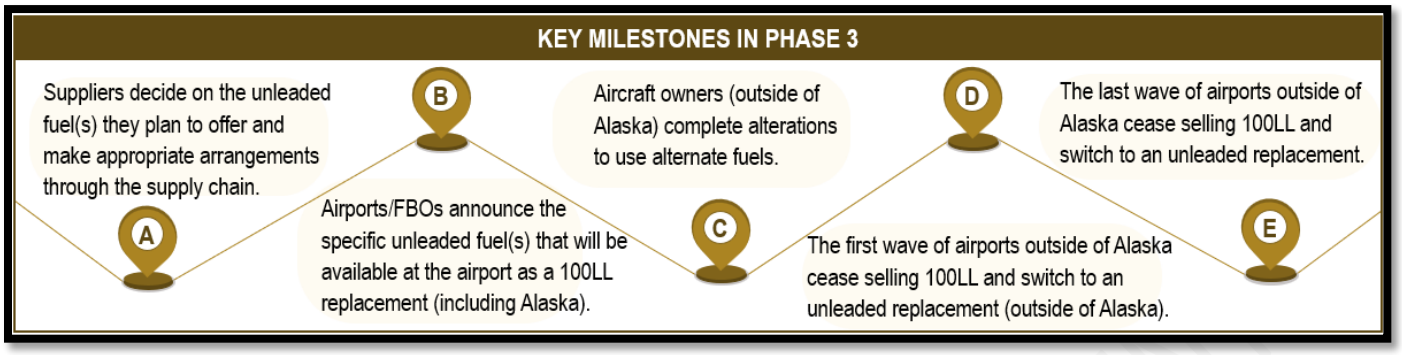


Table 5 – Key milestones in Phase 3

The transition at airports that can offer more than one fuel is considerably easier and provides more time for the aircraft owners to plan for and complete alterations before 100LL ceases to be available. However, depending on the market experience gained during the transition Phases 1 and 2, or factors unique to their location, individual airports and/or FBOs may ultimately adopt a different unleaded alternative to replace 100LL than the one they offered initially. Therefore, even airports/FBOs with multiple fuels should adhere to the same timeline by announcing their ultimate replacement fuel(s) at Milestone B, as shown in Table 5. The actions to execute during Phase 3 to enable a successful National Transition to unleaded fuels are highlighted in Table 6.

The duration of Phase 3 will be informed by the Phase 1 activities, in particular, the detailed insight of any aircraft modifications associated with the transition to various fuels. The time between Phase 3 Milestone B and Milestone D needs to be sufficient to allow those modifications to take place, while the additional time to Milestone E affords time to use up any remaining 100LL. The EAGLE goal is to achieve Milestone E by December 2030.

PHASE 3: NATIONAL TRANSITION	
	Fuel • Fuel suppliers and airports/FBOs/ decide the unleaded fuel(s) they plan to offer and make appropriate arrangements (including Alaska) (e.g. update the Airport Master Record and Chart Supplement) • 100LL in the supply chain is consumed and/or phased out • First airport/FBO outside of Alaska ceases to sell 100LL and switches to an unleaded replacement (outside of Alaska) • Last airport/FBO outside of Alaska ceases to sell 100LL and switches to an unleaded replacement • Aircraft owners (outside of Alaska) complete alterations to use alternate fuels • Full transition of distribution and storage infrastructure
	Aircraft • Aircraft owners (outside of Alaska) complete alterations to use alternate fuels
	Infrastructure • Full transition of distribution and storage infrastructure

Table 6 – Phase 3 actions

4.5 PHASE 4 – ALASKA TRANSITION

Spark ignition piston aircraft in Alaska provide a broad array of critical transportation for which there is no alternative. To ensure that Alaska can transition without adversely impacting those services, Congress provided additional time for Alaska to complete its transition (see Section 771 of the FAA 2024 Reauthorization Act).

Alaska does not have dedicated refineries or producers, so Milestone A (Suppliers decide on the unleaded fuel(s) they plan to offer) in Phase 3 will trigger the onset of the transition in Alaska. While the sequence of events in Alaska is the same, a longer transition period is needed, particularly due to the seasonal nature of fuel delivery (summer) and any aircraft alterations (winter). Providing a longer period to perform aircraft alterations ensures there is no conflict between altering the aircraft or providing essential services, given the challenges posed by executing aircraft alterations in Alaska. In addition, the highly seasonal nature of Alaska's consumption of AvGas may impact its ability to consume residual 100LL during the winter months. A unique issue for Alaska is that FBOs will need to mix 100LL and an unleaded replacement within a tank prior to the point-of-sale to the aircraft, which will require appropriate testing protocols to ensure that the blended fuel is compliant to the expected characteristics. Following the National Transition schedule, appropriate recommended milestones for Alaska would be as follows:

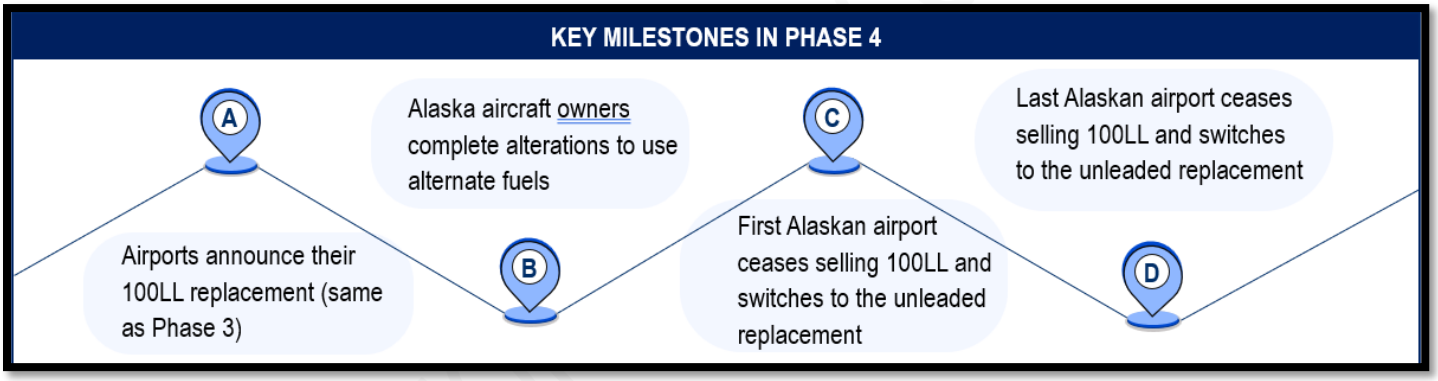


Table 7 – Key milestones in Phase 4

PHASE 4: ALASKA TRANSITION	
	Fuel • Annual unleaded fuel volume moved to Alaska • Unleaded fuel distributed throughout Alaska
	Aircraft • Aircraft alterations complete across the fleet in Alaska
	Infrastructure • Resolution of infrastructure fuel blending limitations for 100LL and unleaded fuels

Table 8 – Phase 4 actions

5. TRANSITION PLAN DEEP DIVE: PHASE 1 – FUEL AUTHORIZATION AND COMPARISON

5.1 FUELS: STATUS AND PLANS FOR AUTHORIZATIONS

One of the primary activities of Phase 1 is the approval or authorization of unleaded fuels for widespread use across the fleet of GA aircraft. As mentioned previously, there are currently three fuels that are in the various stages of approval, authorization, distribution and early sales. Please refer back to section 4.3, Gaining Market Experience, for some in-service challenges documented to date.

The subsections below highlight the current (as of Fall 2025) status of each of the fuels, as provided by the fuel developers along with each fuel developer's perspective on their transition to unleaded fuels.

5.1.1 GENERAL AVIATION MODIFICATIONS, INC. (GAMI) G100UL

GAMI G100UL AvGas is approved for use in nearly all of the aircraft found in the FAA TC database via STC SA01967WI. G100UL AvGas is also approved for use in 100% of all of the aircraft spark ignition piston engines found in the FAA TC database, with STC SE01966WI. G100UL AvGas has been successfully operated in a Commemorative Air Force WWII, R-2800 powered "Warbird." GAMI is fully engaged in support of rotorcraft approval for G100UL AvGas. Additionally, several aircraft with an experimental airworthiness certificate have been modified and approved to use G100UL with GAMI providing data to support the use of G100UL on the aircraft with an experimental airworthiness certificate. GAMI has proposed several strategies to determine the way forward with approvals of G100UL for LSCA aircraft.

G100UL AvGas has already been produced in a large commercial volume (> 1 million gallons) and distributed the fuel to aircraft using the existing FBO/airport infrastructure. Currently, G100UL AvGas is deployed and available for sale at two airports in California, one in Mississippi, and will shortly be available at a fourth airport in Oklahoma. GAMI has indicated to the FAA that it is able to support the transition for the entire 48 contiguous states within an 18-to-24-month timeline, and concurrently, or shortly thereafter, to Alaska and Hawaii. As of Fall 2025, GAMI has not submitted a formal plan to do so to the FAA.

5.1.2 LYONDELLBASELL/VP RACING UL100E

LyondellBasell and VP Racing Aviation (VPRA) are seeking FAA fleet approval under the FAA/Industry PAFI Test Program for their jointly developed fuel, UL100E. UL100E successfully passed the initial set of tests and has been in the full-scale PAFI testing program since the end of 2024. On-going testing efforts are focused on three critical areas: engine testing, aircraft flight testing, and materials compatibility.

Engine testing is focused on detonation, performance, and durability. Detonation and performance testing is now complete on two of six engines and durability testing on two of five engine models. Flight testing was completed on a Lancair Super Legacy powered by a turbocharged Continental TSIO-550K engine, is ongoing with a Harvard IV, and is planned on seven other aircraft representatives of the General Aviation fleet, including the popular Robinson R44 Raven II helicopter, equipped with a fuel-injected Lycoming IO-540 engine.

Comprehensive materials testing of over 200 materials including metals, plastics, composites, sealants, paints, and aircraft components such as O-rings, tubing, bladders, and other materials common to aircraft is 42%

complete. Details on the material testing can be found in the PAFI Materials Test Plan (PAFI-MTP-002)[1] and an up-to-date status of all testing activities is available at flyEAGLE.org.

LyondellBasell/VP Racing are concurrently working with ASTM International to obtain an industry-consensus test fuel specification leading to a production specification. This is a requirement under the Fleet Authorization approval pathway. This allows major industry players like the OEMs, distributors, airports, and other stakeholders to have a visibility into the process and assess the necessary data to inform their selection of an unleaded fuel to replace 100LL.

UL100E is anticipated to complete the full-scale testing in Fall 2026. It is targeting to have both the ASTM production certification and Fleet Authorization in Spring 2027. The fleet authorization process will support traditional type certificated engines, airplanes and rotorcraft along with enabling authorization of the fuel in light-sport category aircraft and providing technical data to support the use of the fuel in aircraft with an experimental airworthiness certificate.

Currently, VP Racing Aviation is fully operational, producing the fuel in bulk and distributing to PAFI Technical Advisory Committee members as needed for testing. Additionally, VPRA has developed a preliminary transition plan that includes several components:

- Minimize disruption
- Production at 7 proprietary locations in the Americas
- Shipping/distributing globally via barge, rail, truck, tote or drum to secondary distribution/storage, terminals and consumers
- Supporting tank conversions from 100LL to UL100E preserving FAA recommended mixing percentages during the transition period. This includes repurposing excess 100LL into other VP products
- Supporting terminal owners to convert redundant 100LL tanks to ethanol-free, high octane motor fuels
- Leveraging the existing distributor/FBO network to make the fuel available to the GA community to avoid/minimize disruption
- Supporting the required placarding
- Educating stakeholders: transparent communications on the fuel deployment plan/timing, performance, fuel cross-compatibility, required modifications (if needed), etc.

VPRA has also considered the challenges of supplying Alaska and international markets. VPRA is confident in its ability to support the transition to unleaded fuels as soon as the fuel is fleet authorized, the ASTM test and production specs are final, and placarding is available.

5.1.3 SWIFT FUELS 100R

Swift Fuels began the deployment of 100R in November 2024 following FAA's approval of the initial 100R STC in September 2024. So far, 100R has been actively utilized on FAA-approved aircraft located at five US flight schools located in California, Missouri and Illinois. Swift Fuels is actively working with FAA as of Fall 2025 to finalize the certification requirements for approving 100R unleaded AvGas to fully replace UL94 fleetwide in the engines and aircrafts with octane levels at or below min 94-motor-octane requirements.

Swift Fuels certification work is being completed in tranches to allow critical segments of the unleaded AvGas market to utilize FAA-approved fuels once the certification work is completed. According to the applicant, Swift Fuels is targeting deployment of the lower octane (≤ 94 motor octane) portion of the market (including ROTAX

testing) to replace UL94 by the end of 2025, followed by the middle tier of higher horsepower naturally aspirated and turbocharged engines (called the "550-Series") expected by end of 2026, followed by a final diverse set of moderate compression, large bore, turbocharged and radial engines planned for completion by the end of 2027. These dates may depend upon the availability of FAA and Tech Center resources. All aircraft with an experimental airworthiness certificate are expected to start transitioning to 100R by the end of 2026.

In addition to certification efforts, Swift Fuels has presented the 100R fuel specification and comprehensive research results to ASTM International for balloting of a production specification. The ASTM industry consensus body maintains oversight of the fuel standard impacting the global supply chain. On September 4, 2025, ASTM International published the final voting results approving Swift Fuels' 100R unleaded AvGas for an ASTM International Production Specification. The specification will be maintained as long as the fuel remains active in the commercial marketplace. Airports and FBOs across the country work with Swift Fuels to accommodate the fuel requirements for their local and transient aircraft fleets. Swift Fuels also works collaboratively with all the major AvGas distributors in various US and global markets, many of whom mandate the use of ASTM International fuel standards.

As previously mentioned, Swift Fuels began the deployment of 100R in November 2024 following FAA's approval of the initial 100R STC in September 2024. By the end of 2027, the company expects to have over 300 airfields actively deployed with 100R to demonstrate the basis allowing the regulatory transition away from 100LL. In October 2026, Swift Fuels plans to begin a process to solicit a formal waiver of 49 U.S.C. 47107(a)(22) grant assurance obligations to reflect the readiness of 100R in all or selected NPIAS airports to replace 100LL. Large scale deployments will follow in 2027. 100R rollouts are planned to continue across all regions that demonstrate readiness as the December 2030 deadline approaches. Alaska is planned to be coordinated by a similar method through the end of 2032.

Additionally, Swift Fuels began the deployment of 100R internationally in early January 2025 following the FAA's approval of the initial 100R STC in September 2024 using existing bi-lateral arrangements with various regulatory bodies. As of Fall 2025, Germany, Belgium, Netherlands, and Austria are all using the new 100R fuel in FAA-approved aircraft. These sites are expected to expand across UK and greater Europe soon. Canada, Australia, and Latin America will be added in the months ahead. The company anticipates achieving a global reach by the end of 2027.

5.2 FUELS: COMPARATIVE ASSESSMENT

The FAA will compare proposed high-octane unleaded fuels to FBO 100LL and minimum specification 100LL. This comparison will look at critical materials properties, detonation characteristics, and critical fit-for-purpose properties. The initial assessment will also be utilized to inform a subsequent phase of comparative assessments, which will leverage the initial learning to develop additional testing, examine engine durability, and test the comingling compatibility of various unleaded fuels. Additionally, the data will be made available to all stakeholders to provide information on fuel performance and characteristics to support stakeholders in their assessment of the fuel for a safe and efficient transition to unleaded fuel(s).

Additional details of the initial comparative testing are described in Tables 10-13 in Appendix B.

Testing is planned on up to three 100-octane, unleaded fuels as they can be obtained (GAMI G100UL, Swift Fuels 100R, and LyondellBasell UL100E) and three leaded reference fuels (FBO 100LL, a minimum specification 100LL

fuel, and a high-aromatic blend 100LL [min 15% aromatic by volume]). Each of the leaded fuels will serve as a reference fuel for comparison for that block of testing. Engine detonation, materials compatibility, and laboratory analytical testing and evaluation will be performed targeting key engines and materials that act as bellwethers for unleaded fuel analysis.

The testing is divided into four blocks, with block one focusing on fuel fit for purpose and composition, block two focusing on engine testing, block three focused on materials testing, and block four being a toxicological assessment. The testing in block one will be performed on the neat unleaded fuels, referenced leaded fuels, 50-50 blends of unleaded fuels and FBO 100LL, and 50-50 blends of two unleaded fuel candidates.

5.3 EXPLORATION AND IMPLEMENTATION OF ALTERNATE ENGINE TECHNOLOGIES

Some stakeholders may wish to explore alternative solutions or technology to the usage of unleaded fuels with their current aircraft configuration. The implementation of these aircraft or engine modifications may go beyond the fuel itself and may be motivated by other factors such as increased efficiency or lower maintenance.

Some examples include installation of electronic ignition or timing controls, installation of anti-detonation injection systems, propulsion technologies including hybrid electric, or even replacement of a spark-ignition piston engine with compression-ignition engines that can take advantage of the widespread availability of Jet A fuel. Many of these alternative solutions are in continued development and looking to expand to additional engine classes and airframes in the future.

Stakeholders may wish to explore these options as alternatives or to supplement the use of unleaded fuel(s).

6. TRANSITION PLAN DEEP DIVE: PHASE 2 – GAINING MARKET EXPERIENCE

6.1 SUPPLY CHAIN AND LOGISTICS BARRIERS

As part of this Transition Plan, Section 827(b)(1)(D) of the Act directs an assessment of "efforts to address supply chain and other logistical barriers inhibiting the timely distribution of unleaded aviation gasoline." FAA, through collaboration with industry and EAGLE stakeholders, has identified and captured known supply chain and logistical barriers, shown in Table 9.

Ideally, the impacted stakeholders would need to actively address all the identified items during transition Phases 1 and 2. However, until all fuels are available, production and distribution scale to regional levels, and a larger portion of aircraft have been altered, stakeholders may not realize a full understanding of the supply chain and logistical barriers or the efficacy of the proposed risk mitigations. This area should be a continued area of focus as the transition to unleaded fuels evolves.

BARRIER	RISK	POTENTIAL MITIGATION
Fuel mixing	• Unleaded fuels are unable to be mixed with one another • Lack of guidance on mixing unleaded fuels and 100LL for infrastructure	• Plan for appropriate comparative testing early • Work with fuel developers and distributors early to put a plan in place
Additional storage requirements	• Insufficient 100LL supply during the transition • Insufficient planning/budgeting	• Maintain 100LL supply during the transition • Plan for upfront costs early. Distributors who provide fuel trucks may need to undertake software upgrades, changes to signage and other compliance items in adherence to their contracts

BARRIER	RISK	POTENTIAL MITIGATION
Fuel composition and continuity	• Replacement fuel sponsor does not disclose the components used to manufacture a new unleaded fuel, leading to uncertainties about its safety and continuous availability • Insufficient supplies could lead to costly delays; excess supply could compromise the fuel integrity by aging	• Work with the fuel sponsor to obtain necessary information under a non-disclosure agreement (NDA) or similar arrangement • Encourage the fuel sponsor to seek industry consensus • Encourage key transition decisions early so that fuel developers, distributors, FBOs, airports and others plan for sufficient supply
Fuel composition and materials compatibility	• Lack of insight into the testing program leads to uncertainties as to the replacement fuels' compatibility with the existing transportation and storage materials • Concerns with fuel aging	• Identify the differences in test methodology, prioritize the differences and potentially test for major items • Perform testing to understand unleaded fuel aging in different environments and storage conditions
Logistics/continuity of the supply chain	• Not all refineries accept and mix a replacement fuel, leading the distributors to costly detours and a potential breach of their FBO contracts requiring them to fulfill the terms timely • These factors could lead to distributor/FBO reluctance for advocating replacement fuels	• Communication and collaboration between fuel suppliers and FBOs and airports • Early transition decisions
Price of the replacement unleaded fuels	• Price under full production is unknown • Cost of potential STC installation • Government taxes	• Potential federal, state, local subsidies • Economies of scale
Liability	• Most FBO liability insurance covers the cost of the fuel alone and not the repercussions directly related to an incident • OEM warranties	• Work with the key industry players early to mitigate these concerns • Encourage fuel developers to attain a consensus standard, which facilitates fuel quality control and provides stakeholder better understanding of the replacement fuel, reducing liability concerns
Communication and transition timing	• Confusion, uncertainties, inefficient flight routes, expensive detours, inadequate infrastructure, etc.	• Managed early engagement with all impacted stakeholders to understand their expected transition timing, anticipated mechanisms for transition, plans for their respective municipalities, etc.

Table 9 – Supply chain and logistics barriers

6.2 FUELS: INCREASING UNLEADED FUEL PRODUCTION

Any unleaded fuel producer should create a robust production management plan with a timeline and sufficient detail to facilitate production in support of the delivery schedule to meet the end of 2030 (end of 2032 for Alaska) timeline. This plan should include management of change in the transition from 100LL to unleaded fuel(s). Other factors to consider are the modification or addition of production equipment, handling and storage of unleaded fuel, internal process control, training to produce unleaded fuels, and compliance with all other applicable regulations. These processes can take considerable time to bring production online (>24 months) as producers evaluate market demands, existing production capabilities, and potential reallocation of resources for production, handling, distribution, and storage of unleaded fuel.

Throughout Transition Phase 2, production of unleaded fuels should be increasing toward meeting the full annual demand of the GA fleet. Based on total annual usage of 100LL and future projections, a total estimated fuel volume of approximately 180 Mgal of unleaded fuel would be required by the end of 2032.

In addition to economic considerations in transitioning to the production of unleaded fuels, many large-scale refiners and producers have indicated that the industry's acceptance of the unleaded fuel(s) is a significant factor in their decision to move forward with that fuel. Acceptance by the aviation industry could be indicated by OEMs' approval for usage of the fuel on their equipment or the development and acceptance of a voluntary industry consensus specification. Fuels without an industry specification will need to address additional considerations required by industry stakeholders to support business risk decisions for deployment and use.

Additionally, fuel producers and developers should work with airports and FBOs to identify locations that have the capacity to support multiple unleaded fuels and look to develop regional markets to further enhance unleaded fuel availability and grow market experience. The sooner these replacement fuels are accepted at scale, the sooner large-scale producers can evaluate the market demand with increased fidelity.

6.3 FUELS: 100LL PHASE OUT INITIATION

Through the 2024 FAA Reauthorization Act, Congress mandated that the airport owners/operators continue to make 100LL available while replacement fuels are developed and deployed. To support this legislative mandate, the FAA Office of Airports released a Q&A document on May 19, 2025, clarifying the Grant Assurance 40 and prohibiting airports from restricting 100LL availability until an alternative fuel meets the established criteria. Additionally, the FAA has found that banning the sale or self-fueling of an authorized fuel, such as 100LL, may place the airport sponsor in violation of Grant Assurance 22 or 23. The Q&A document stated that as of the date of its initial publishing, no unleaded fuel had met such criteria. The intent is that 100LL remains available through National Transition until all piston aircraft have been modified to use an unleaded fuel. Active engagement with the TEL supplier is being utilized to ensure a proper supply of TEL through the transition.

However, as viable replacement unleaded fuels gain user acceptance, a critical element to an orderly transition will be a timely decision on when 100LL sales will discontinue. Understanding the transition activities planned for each phase allows for certainty in the marketplace when planning for the discontinuation of 100LL. Major players in this process will be the fuel distributors, airports, FBOs, fuel retailers, the sole producer of TEL (see Section 2.1), and the ultimate end users, including the ones with unique needs such as the Alaska community.

Phasing out 100LL fuel should be closely aligned with the increased production of unleaded fuel(s) to meet market demand and capacity. Airports and FBOs will have a critical role in phasing out 100LL as they will need to ensure they have infrastructure in place to also facilitate increased usage of unleaded fuel(s). Coordination

with the TEL producer is important to ensure that a sufficient volume of TEL is available to support the transition through its entirety, including the extended transition in Alaska.

Fuel producers will have to ensure their production and storage capacity for 100LL is aligned with the phase out dates for 100LL. It should be noted for non-Alaskan United States locations, that there is an approximate 9 to 18-month supply of 100LL in the system at any given time. Alaskan operations typically receive a limited supply of 100LL during specific time periods, usually once per year. This will require careful coordination with respect to volumes for production and delivery to Alaskan operators.

6.4 FUELS: COMINGLING OF UNLEADED FUELS

FAA and industry plan to conduct a comparative assessment of the unleaded fuels soon after completion of the Phase 1 activities. Examining the ability of the various unleaded fuels available in the marketplace to be safely mixed and not impact safe and efficient operations of the GA fleet will be an important activity in Phase 2. This activity will look at critical material properties, detonation characteristics, and critical fit-for-purpose properties of unleaded fuel mixtures. The data will be made available to all stakeholders and provide information on fuel performance and characteristics to support their assessment of the fuel for a safe and efficient transition to unleaded fuels.

The misfueling measures that airports and FBOs are expected to undertake to support new fuels may also help mitigate comingling concerns. Additionally, comingling of fuels presents unique challenges for Alaska. See Section 8.4 for further discussion on this topic.

6.5 FUELS: INITIAL DELIVERIES INTO ALASKA

As discussed previously, Alaska presents unique challenges and opportunities in the transition to unleaded fuel(s). Bulk fuel is typically moved into the state via a single delivery, once per year, and then distributed to additional locations. As part of the transition, efforts to determine an initial location or region to utilize unleaded fuels should be identified. This location will require the ability to support distribution of both 100LL and the unleaded fuels. Getting fuel into the state as early as possible will provide opportunities to identify unique challenges and reduce the risk to the full transition at later dates.

Having early utilization of initial deliveries will allow stakeholders to pilot the use of the fuel and gather first-hand experience about the utilization of the fuel in the Alaskan operational environment. Early utilization may facilitate the development of the enabling infrastructure to supply and deliver fuel throughout the distribution system for Alaska. It may also allow producers to explore pathways for increasing production and deliveries to the region.

6.6 INFRASTRUCTURE: FUEL STORAGE AND DISTRIBUTION INFRASTRUCTURE

During Phase 2 in the transition, the goal is to encourage safe, early adoption of unleaded AvGas variants at U.S. airports. As of 2025, airports, operators, and industry are still very early in the transition with approximately 3,200 U.S. airports reporting sales of 100LL (includes public use and private facilities),[13] and of those, 2,741 airports in the National Plan of Integrated Airport Systems (NPIAS)[14] report selling 100LL.

[13] FAA ADIP Database
[14] Current NPIAS

NOTE

NPIAS airports are eligible for Federal funding under the Airport Improvement Program (AIP). The FAA is authorized to provide funding for some aircraft fueling systems such as fuel farms for an additional fuel type not currently offered. This provides opportunities for airports to support early transition.

As of Fall 2025, a total of 212 airports offer unleaded AvGas variants. Of those facilities, 80 airports in the NPIAS offer unleaded AvGas variants.

At this stage in the transition, airports are encouraged to take early action by offering initial unleaded fuel types while maintaining 100LL. Airports that have more than one tank available for AvGas are ideal locations to support the early transition, as a new unleaded fuel can be offered along with 100LL. Airports that do not have that capacity should consider other options, such as using a fuel truck, skid-mounted system, fuel trailer, or bowser. Alternately, some airports have spare transition-enabling infrastructure that can be leveraged to support an early transition.

Each airport will have to intentionally evaluate its unique operating scenarios, available infrastructure, and plan for a safe transition.

There are scenarios that may encourage early adopters to offer unleaded fuel(s) prior to the National Transition. These scenarios include federal regulatory actions[15], responding to community pressure, responding to a specific customer or set of customers with a demand for unleaded AvGas (e.g., flight schools that have a compatible aircraft fleet), and lastly, the desire of some airports to lead as early adopters.

FAA grant programs (Airport Infrastructure Grant (AIP) and Infrastructure Investment and Jobs Act (IIJA) can support transition-enabling infrastructure. IIJA and AIG allocated funds can be used on sponsor-owned revenue producing aeronautical support facilities such as fuel farms. For additional information, see the IIJA page and FAQs[16]

Existing airport equipment, procedures, markings, and training are specific to the characteristics of the current 100LL fuel. The physical and chemical differences of an unleaded replacement fuel may have negative safety or operational impacts that require mitigations or changes to processes and equipment. Deployment of a new unleaded fuel to airports requires that the storage tanks be ready for the new product (clean, compatible, labeled properly for receiving), that the delivery trucks are available/ready, that required placards and labeling are in place, and that training has been implemented at the airport and FBOs to ensure dispensing of the correct fuel to the specified aircraft.

There are several considerations in ensuring that airports and FBOs are ready to safely receive, store, and deliver a new unleaded fuel to the specified aircraft. Considerations include the following:

- Decals and labeling
- Aircraft fill ports, trucks, and pumps
- Training – education and awareness
- Fuel dispensing nozzle size

[15] U.S. EPA - Final Endangerment Finding Regarding Lead in Aviation Gasoline

[16] https://www.faa.gov/iija/faq/IIJA_FAQs.pdf

- Aircraft “fuel sumping”
- Comingling
- Personnel health and safety
- Compatibility with 100LL
- Storage tanks – cleaning
- Fuel color identification
- HAZMAT
- Multiple fuels

It will be important to address differences from 100LL fuel and implement the necessary changes to efficiently and safely support the implementation of a new unleaded fuel.

7. TRANSITION PLAN DEEP DIVE: PHASE 3 – NATIONAL TRANSITION

7.1 USE CASES

To facilitate the National Transition, three different use cases were developed to illustrate the potential scenarios tied to the National Transition occurring for unleaded fuels. These scenarios are designed to be illustrative to potential paths forward in National Transition. Each scenario has a brief description of the scenario and is followed by the necessary Phase 3 actions, described in greater detail in subsequent sections. The scenarios also highlight potential challenges faced by critical stakeholders.

SCENARIO 1: COMPATIBLE FUELS

The industry has reached the National Transition phase. The market has settled on a single fuel or determined that all three fuels can be mixed and provide equivalent performance.

Actions needed:

- Unleaded fuel production capacity meets fleet demand
- Airports/FBOs identify fuel(s) selections for their locations
- Aircraft owner/operators have sufficient data to understand the alterations required for their aircraft
- Aircraft alterations are completed
- Unleaded fuel(s) distributed to the airports/FBOs

Challenges:

- Timing with transition from 100LL to unleaded fuel(s)
- Lead time/potential costs of aircraft alteration

Stakeholders:

- Fuel producers
- Fuel distributors
- Airports/FBOs
- Aircraft owner/operators

SCENARIO 2: INCOMPATIBLE FUELS

The industry has reached the National Transition phase. There are multiple unleaded fuels available, but the fuels cannot be intermixed, or different fuels require different aircraft alterations, and fuel availability may vary by location.

Actions needed:

- Unleaded fuel production capacity meets fleet demand
- Airports/FBOs identify fuel(s) selections for their location
- Aircraft owner/operators have sufficient data to understand the alterations required for their aircraft
- Aircraft alterations are completed

- Unleaded fuel(s) distributed to the airports/FBOs

Challenges:

- Fragmented market with multiple choices
- Misfuelling risk/multiple fuels at locations
- In transit refueling (the aircraft's authorized fuel may not be available along the flight path)
- Complex supply and distribution chain
- Timing with transition from 100LL to unleaded fuel(s)
- Lead time/potential costs of aircraft alteration

Stakeholders:

- Fuel producers
- Fuel distributors
- Airports/FBOs
- Aircraft owner/operators

SCENARIO 3: MARKET DIFFERENTIATION

The industry has reached the National Transition phase. The market has adopted two fuels to meet the fleet's performance and maintenance needs. The fuels cannot be intermixed.

Actions needed:

- Unleaded fuel production capacity meets fleet demand
- Airports/FBOs identify fuel(s) selections for their locations
- Aircraft owner/operators have sufficient data to understand the alterations required for their aircraft
- Aircraft alterations are completed
- Unleaded fuel(s) distributed to the airports/FBOs
- Infrastructure capacity for two fuels

Challenges:

- Fragmented market with multiple choices
- Misfuelling risk/multiple fuels at locations
- In transit refueling, (the aircraft's authorized fuel may not be available along the flight path)
- Complex supply and distribution chain
- Timing with transition from 100LL to unleaded fuel(s)
- Lead time/potential costs of aircraft alteration

Stakeholders:

- Fuel producers
- Fuel distributors
- Airports/FBOs
- Aircraft owner/operators

7.2 FUELS: UNLEADED FUEL PRODUCTION MEETS DEMAND

Building on the factors outlined in Section 6.2, Increasing Unleaded Fuel Production, it is imperative that a sufficient volume of replacement fuel is available to accommodate an increased demand in all transitioning locations. This translates to roughly 180 Mgal of annual unleaded fuel by the end of 2030. This will help the airports and FBOs in their task to cease the distribution and sale of 100LL and fully switch to an unleaded replacement.

It is anticipated that some regions of the country may transition sooner. California plans to complete the transition by the end of 2030, consistent with the 2030 date identified in the 2024 FAA Reauthorization Act. But it has also passed its own legislation banning the sale of leaded fuel as of January 1, 2031[17]. Other states like Colorado are developing resources to incentivize an early transition to unleaded fuels.

It is anticipated that full-scale production and distribution of unleaded fuels should initiate during Phase 2 of the transition. This timing will allow producers and distributors to observe the market demands and drivers, evaluate the aviation industries' acceptance of unleaded fuels, scale production capabilities, and execute on the best and most efficient path toward full scale production. Increasing production will support all the Milestones in Phase 3 (see section 4.4, National Transition), ultimately with production meeting demand in order to meet Milestone E (The last wave of airports outside of Alaska cease selling 100LL…) for National Transition.

7.3 INFRASTRUCTURE: STORAGE AND DISTRIBUTION

By Phase 3 in the transition, the early adopters will have taken action to offer unleaded variants and shared lessons learned with their counterparts at other airports throughout the country. The remaining airports may be at various stages of transitioning to unleaded fuels. Airports may have implemented the recommended short-term actions (see Appendix C), as well as executed Milestones A and B. Under scenario 1, airports will be able to switch from the supply of 100LL to an unleaded alternative without additional storage requirements. The final 100LL delivery will need to occur with adequate time to deplete the 100LL storage prior to Milestone E (The last wave of airports outside of Alaska cease selling 100LL), and the initial delivery of the replacement unleaded fuel timed to arrive as the 100LL is consumed. Small amounts of residual 100LL may be offloaded to temporary storage such as a fuel truck or intermixed with the replacement fuel if supported by intermixability testing.

Under scenarios 2 and 3, the FBO would have to decide to either offer multiple unleaded fuels or select a replacement fuel that would not be usable by the entire fleet. The primary unleaded fuel that replaces 100LL in storage would occur following the same approach as in scenario 1. Storage provisions for more than one fuel would depend on the volume that is required.

Regardless of the timing of their individual transitions, all airports are encouraged to utilize the many resources available to them to facilitate a safe and orderly transition. Please refer to the list in Appendix C, Airport and FBO Resources.

7.4 FLEET READINESS: ACTIVE FLEET ALTERED FOR UNLEADED USAGE

Given the potential requirement that aircraft may need to be altered to use unleaded fuel(s), it is important that the alterations are aligned to the transition phases to allow a reasonable timeframe to complete these critical

[17] CA House Bill 1193 - Airports: leaded aviation gasoline

steps, allowing for an orderly and safe transition. As discussed in Section 4.4 National Transition, it is recommended that aircraft owners complete necessary alterations for their aircraft to use alternate fuels in alignment with Milestone C (Aircraft owners (outside of Alaska) complete alterations). It is anticipated that Milestone D (The first wave of airports outside of Alaska cease selling 100LL) will follow closely with Milestone C completion.

Aircraft may have to address alterations based on the unleaded fuel their owners select. These alterations could be as simple as placard changes and updating the aircraft flight manual supplement (AFMS) or could be more in-depth, requiring engine hardware modifications such as replacement of an engine, installation of new engine pistons, the installation of anti-detonation injection systems, ignition timing changes, or significant changes to operating limitations.

The transition at airports that can offer unleaded fuel early in the process provides more time for aircraft owners to plan for and complete alterations before 100LL is no longer available. Another consideration is the airports that may, through market experience gained, ultimately adopt a replacement unleaded fuel that differs from the one(s) they offered in the early days of the transition. For this reason, even the airports, FBOs, and fuel suppliers with multiple fuels should be encouraged to adhere to the same National Transition timeline by announcing their definitive replacement fuel(s) in alignment with Milestone B (see Section 4.4 National Transition), to provide sufficient opportunity for aircraft alterations to be completed. Owners and operators should also acknowledge that while their base airport may transition early, fuel availability at other airports while the transition is ongoing could result in scenarios such as those highlighted above and may impact transient refueling.

7.5 FUELS: 100LL IN SUPPLY CHAIN CONSUMED (ALASKA EXCEPTION)

As shown in Section 4.4, National Transition, and throughout this transition document, a recommended transition schedule would result in airports ceasing to offer 100LL the earlier of December 2030 (2032 in Alaska) or when the unleaded fuels that meet the predefined criteria become widely available. The consumption of 100LL will also be closely aligned with Milestone E (The last wave of airports outside of Alaska cease selling 100LL) as the final airports cease selling 100LL and switch to an unleaded replacement.

With this timing in mind, production and distribution stakeholders should leverage their internal processes and knowledge of the system to ensure adequate amounts of 100LL and replacement fuels are available throughout the transition. They must balance this need with a requirement to consume the existing 100LL throughout the supply chain, in alignment with the schedules of airports and FBOs ceasing the distribution and sale of 100LL. This will require close coordination and communication between all impacted stakeholders, including producers, distributors, and local fuel providers.

7.6 FUELS: EXPANDED DELIVERIES INTO ALASKA

Opportunities to leverage increasing production and distribution will become more readily available as the National Transition continues. Additionally, building on the lessons learned during the initial replacement fuel deliveries in Alaska (see Section 4.5), distributors serving the unique needs of the Alaskan community may be able to increase the volume of unleaded fuel moving into the state and potentially expand distribution to new locations to ensure wide commercial availability at airports throughout the state. These increased activities should account for the time needed to modify part of the fleet before using the new replacement fuel. Milestones

A-C of the Alaska Transition are directly impacted by the expansion of fuel availability in Alaska. Ultimately, the earlier a larger portion of the infrastructure and fleet transitions, the lower the risk to the planned timeline.

8. TRANSITION PLAN DEEP DIVE: PHASE 4 – ALASKA TRANSITION

8.1 FLEET READINESS: ACTIVE ALASKAN FLEET ALTERED FOR UNLEADED USAGE

In alignment with Sections 3.3.4 Aircraft Alterations, 7.3 Fleet Readiness: Active Fleet Altered for Unleaded Usage, and recommended timelines from Section 4.5 Alaska Transition, Alaska will need to follow a similar course of action for the alteration of active aircraft. Given challenges associated with the logistics, and capacity of repair and maintenance shops in Alaska, it is critical that the alternation process initiates as soon as feasible once the unleaded fuel(s) become available at the location. This will require additional levels of coordination amongst FBOs and airports, repair and maintenance shops, and aircraft owner/operators. To support this, Alaskan airports should be encouraged to adhere to the same timeline by announcing their replacement fuel(s) in alignment with Milestone A (Suppliers decide on the unleaded fuel(s) they plan to offer) in the National Transition.

8.2 FUELS: ANNUAL UNLEADED FUEL VOLUME MOVED INTO ALASKA

The uniqueness of the aviation fuel supply in Alaska will require a very proactive and well-planned approach. Given the timing and volumes of fuel needs in Alaska, it is recommended that the volume required for full usage in the state be moved into position for distribution as soon as is possible, ideally 24 months before ceasing the use of 100LL in December 2032 (i.e., December 2030). This timing will provide ample opportunity for distribution through the system as well as limit impacts from infrastructure challenges.

8.3FUELS: UNLEADED FUEL DISTRIBUTED THROUGHOUT ALASKA

If enough unleaded AvGas can be provided by December 2030, airport and aircraft owners can follow the model utilized for the National Transition in the lower states. Initiating the transition as soon as possible will enable individual schedules for transition that will be supported by the available infrastructure, ability to alter the fleet, and timing of fuel availability locally considering the unique challenges specific to Alaska. Two different delivery phases of large volumes could be targeted to enable a more flexible transition. The first phase would be to distribute as much fuel as possible 18-24 months prior to 2032, with a second effort looking to distribute fuel to those locations that have not obtained the fuel 6-18 months before the 2032 target date.

In order to achieve Milestone D of the Alaskan Transition, unleaded fuels must be available throughout the state.

8.4 INFRASTRUCTURE: FUEL BLENDING LIMITATIONS

Alaska poses unique challenges with infrastructure, fuel logistics, and distribution. As a result of these challenges, Alaska may require additional technical and policy support regarding the blending of 100LL with unleaded fuels. Many of Alaska's remote locations only have one central storage tank that holds a significant volume of fuel over a long period of time. It may not be possible to reduce the amount of 100LL in those tanks for a fuel swap without risking Alaska's critical flight operations.

MITIGATING A FORESEEABLE BARRIER

There is potential for single tank locations that may need to blend large volumes of 100LL and unleaded fuel to minimize operational risk associated with fuel supply. This could be a one-time allowance during the transition period to allow safe and efficient operations to continue while supporting the transition to unleaded fuels. The FAA will continue to consider how to address potential regulatory or policy challenges associated with the Alaska transition. In addition, stakeholders will need to address potential technical challenges prior to Alaska beginning its broad transition in the 2030 timeframe.

9. RISKS TO TRANSITION

Section 6.1 of the Transition Plan highlights specific risks and barriers associated with the supply chain and logistics as well as potential mitigations. The remainder of this section focuses on three overarching risks, cost, liability, and schedule, while highlighting the high-level factors impacting each of those risks. Inability to overcome these three risks could result in significant impacts to the ability to transition to unleaded fuels within the 2030 (2032 for Alaska) time frame.

9.1 COST

A variety of costs may be associated with the transition, although the potential magnitude of impact will likely evolve over time and may be influenced by the number of unleaded fuels in the market. Potential costs include the purchase of STCs and other airplane modifications, airport infrastructure modifications, and fuel price differentials. Conversely, there is potential for reduced maintenance costs from the use of unleaded fuels, such as extended oil change intervals and spark plug maintenance intervals. Given the breadth of various stakeholders involved, the transition will be driven by the acceptance, utilization, and satisfaction with the unleaded fuel(s). Market factors, including the cost of the various aspects as well as benefits that may be achieved, will be a critical driving force in the safe and efficient transition to unleaded fuels in the targeted time frame.

Some states and local airports have made efforts to mitigate some of the cost associated with new unleaded fuel. For example, in Colorado, House Bill 24-1235 was signed on May 17, 2024 (CO HB1235 2024). This bill provides tax credits to aircraft owners to offset the expenses of obtaining certification to use unleaded AvGas and offers financial grants to airports to assist with the transition to unleaded AvGas. Localities in Florida and California have offered similar incentives to transition (see ACRP, "Airport Guide for Transitioning to Unleaded Aviation Gasoline". End users have expressed concerns regarding price differential (i.e., the difference between the current leaded AvGas and a future unleaded AvGas).

9.2 LIABILITY

The introduction of new fuels has generated concern, as the industry has been built around the usage of 100LL for the last several decades with limited usage of unleaded fuels to date. FAA has heard from various stakeholders that they are concerned with how they will mitigate potential liability associated with introducing new unleaded fuel(s) into the system. These stakeholders include OEMs and STC holders, fuels producers and distributors, and airports and FBOs. The potential liability concerns result from the introduction of new fuel to the well-established marketplace. This concern was highlighted in a UAT ARC recommendation requesting that "a mechanism be developed to mitigate the liability exposure of design approval holders (DAH) due to modification of the type design of their products in approving a new aviation gasoline."

In addition, the FAA has received concerns about potential incompatibility or misfueling of unleaded fuels, particularly if there are multiple, authorized fuels for use. Liability is a critical area that affected stakeholders will need to resolve as failure to resolve the issues tied to liability risk can potentially result in delays to the transition to unleaded fuel(s). For more information about the FAA's plans to address these concerns, please refer to section 6.4 Fuels: Comingling of Unleaded Fuels earlier in this document.

9.3 SCHEDULE (CRITICAL PATH)

Possibly the most significant risk to transitioning to unleaded fuel is the schedule. The critical path forward can be distilled down to four critical items: fuels production, fuel infrastructure, fleet readiness, and supporting policy—all supporting a market-driven transition. Should there be significant scheduling delays in any one of these four areas, it would not only put the other areas at risk but would also put the entire transition timeline at risk. Acknowledging this risk and the potential severity of the impact helps emphasize the critical nature of all the actions described throughout the four phases of the Transition Plan. It also illustrates the criticality of engagement across the impacted stakeholder community and initiatives like EAGLE to push forward for a successful, market-driven transition to unleaded fuels in the proposed time frame.

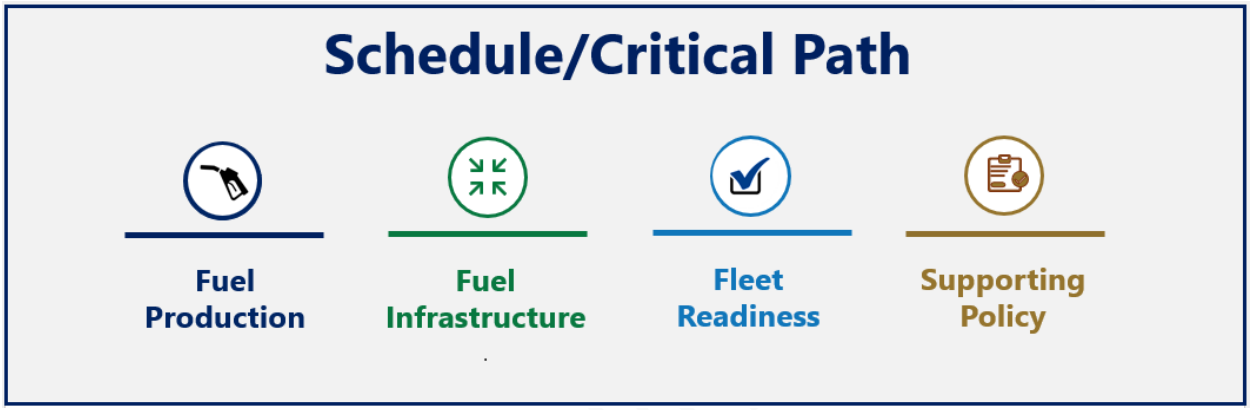


Image: FAA created

Figure 7 – Schedule/Critical Path for Transitioning to Unleaded Fuel

10. RULEMAKING ACTIVITIES

The FAA recognizes that the EPA's positive Endangerment Finding will require FAA to conduct rulemaking in support of removing lead as a fuel component of aviation gasoline and as a fuel additive(49 U.S.C. 44714). Exact timing of rulemaking activities cannot be determined until the transition has progressed sufficiently.

10.1 ENFORCEMENT OF FAA-PRESCRIBED FUEL STANDARDS

Key elements of the successful National Transition to unleaded AvGas include the ability to enforce any statutes or regulations that establish a fuel standard and then prohibit the development, blending, distribution, or sale of fuel that violates the standard. The FAA has existing statutory authority to both develop a fuel standard and enforce any FAA-prescribed fuel standards (49 U.S.C. 44714).

The FAA has different mechanisms it can use to enforce the standards. For instance, the FAA has authority to conduct investigations, issue orders, and amend, modify, suspend, or revoke a certificate, including an STC (49 U.S.C. 40113; 49 U.S.C. 44709(b)(1)(A)). The FAA's statutes also prohibit the development, blending, delivery, sale, or offer for sale of a fuel that violates a regulation related to the fuel standard established under Section 44714 (49 U.S.C. 44711(a)(9)). For violations of these provisions, the FAA has the authority to issue civil penalties. See 49 U.S.C. 46301 (a) and (d).

FAA will continue to evaluate whether any new regulations, amendments to any existing regulations, or updates to any orders, such as Order 2150.3C, FAA Compliance and Enforcement Program, are needed to address new fuel standard requirements.

For additional rulemaking considerations, please reference Appendix D, Additional Rulemaking Resources.

11. TRANSITION-ENABLING RESOURCES/APPENDICES

APPENDIX A: ACRONYMS

100LL	100 Octane Low Lead Aviation Gasoline
A&P	Airframe and Powerplant Mechanic
ACRP	Airport Cooperative Research Program
Act, The	2024 FAA Reauthorization Act
ADIP	Airport Data and Information Portal
AFM	Aircraft Flight Manual
AIG	Airport Infrastructure Grant
AIP	Airport Improvement Program
AIR	Air Certification Service
AC	Advisory Circular
AML	Approved Model List
AOPA	Aircraft Owners and Pilots Association
API	American Petroleum Institute
ASTM	ASTM International
AvGas	Aviation Gasoline (AvGas)
Bgal	Billion gallons
CFR	Code of Federal Regulations
CRC	Coordinating Research Council
DAH	Design Approval Holder
EAA	Experimental Aircraft Association
EAGLE	Eliminate Aviation Gasoline Lead Emissions
EFASR	Eligible Fleet Authorization Summary Report
EI	Energy Institute
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FAAST	Federal Aviation Administration Safety Team
FBO	Fixed Base Operator
FWS	Fuel Water Separator
GA	General Aviation
GAMA	General Aviation Manufacturers Association
HAZMAT	Hazardous material
IA	Inspection Authorization
IIJA	Infrastructure Investment and Jobs Act
LL	Low lead (refers to the 100LL AvGas)
LSCA	Light-sport category aircraft
Mgal	Million gallons
NASEM	National Academy of Sciences, Engineering, and Medicine
NATA	National Air Transportation Association
NBAA	National Business Aviation Association
NDA	Non-disclosure Agreement
NIST	National Institute of Standards and Technology
NPIAS	National Plan of Integrated Airport Systems

OEM	Original Equipment Manufacturer
PAFI	Piston Aviation Fuels Initiative
SAE	Society Automotive Engineering
SAIB	Special Airworthiness Information Bulletin
SME	Subject Matter Expert
STC	Supplemental Type Certificate
TC	Type Certificate
TEL	Tetraethyl Lead
UAT ARC	Unleaded AvGas Transition Aviation Rulemaking Committee
UL	Unleaded
VPRA	VP Racing Aviation

APPENDIX B: FAA COMPARATIVE ASSESSMENT

Please note that information in this appendix is intended to provide additional details for Section 5.3 Fuels: Comparative Assessment

As mentioned in section 5.3, The FAA plans to compare proposed high-octane unleaded fuels to FBO 100LL and minimum specification 100LL. The intent of this testing is not to generate data to support authorization or approval of fuels for use, but rather to provide the stakeholder community with a dataset comparing the performance of the unleaded fuels to that of 100LL.

BLOCK 1 TESTING: FIT FOR PURPOSE AND COMPOSITION

BLOCK 1 TESTING: FIT FOR PURPOSE AND COMPOSITION	
EFFORT	SUMMARY
Determine ASTM D910 Table 1 properties, + D7826 Table 1 Laboratory Tests – Basic Specification Properties and Laboratory Tests – Fit For Purpose Properties – Part 1	Compare and contrast leaded and unleaded fuel properties and verify conformity to their respective specifications prior to initiating engine and materials testing. REPORT: measured values aligned to fuel specification and D7826, detailed fuel composition will not be reported.
ASTM D6733 Gas Chromatography analysis + Additional precision chromatography methods to determine the concentration of components of increased interest e.g., benzene, toluene, oxygenates	Determine/confirm individual hydrocarbon components to support/confirm conformity to the fuel's specification (as applicable) and determine if any significant shifts occur because of additional testing. REPORT: Data aligned to compositional requirements of the specification.

Table 10 – Comparative testing: Fit for purpose and fuel composition

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Engine tests will be conducted on the fuels in a back-to-back manner, and results will be used to identify similarities and differences in the fuels' performance. For the engine testing, the neat unleaded fuels, minimum specification 100LL, 100LL, 50%-50% blends of unleaded fuels with FBO 100LL and 50%-50% blends of two unleaded fuels will be used. Current efforts plan for six engine models to be included in the performance and detonation testing from the following PAFI test articles list: Lycoming TIO-540-J2B and IO-540-K1A5, Continental IO-550-D, TSIO-520-VB, O-470-U, and TIO 540-AJ1A.

BLOCK 2 TESTING: ENGINE TESTING

BLOCK 2 TESTING: ENGINE TESTING	
EFFORT	**SUMMARY**
Performance testing	Evaluate sea level performance at rated and maximum continuous power settings and along constant speed lines in the range of normal cruise power settings for unleaded fuels as well as FBO 100LL. Perform dynamic fuel switching tests at rated power to obtain a direct comparison between FBO100LL and neat versions of each of the test fuels. REPORT: 1) Reproduce published curves from the engine OEM and plot verse all fuels, including FBO100LL. 2) Plot time-based parametric response curves while switching fuels
Limited detonation testing	Comparative testing of, minspec 100LL, and 50%-50% blend fuels on up to 3-6 Continental & Lycoming turbocharged and naturally aspirated engine models. Testing will be on a select subset of detonation test conditions and include critical altitude conditions for turbo-charged engine models. Naturally aspirated engine models will be tested at sea-level conditions only. REPORT: 1) Pressure/audio vs. time/cycle for each 2) Variation (percent difference) from FBO/Min. Spec

Table 11 – Comparative testing: engine testing

The materials testing will utilize neat unleaded fuels and high-aromatic 100LL.

BLOCK 3 TESTING: MATERIALS

BLOCK 3 TESTING: MATERIALS	
EFFORT	**SUMMARY**
Accelerated storage (PAFI Rig 4 Storage Stability)	This test simulates accelerated aging of fuels using a pressure vessel at elevated temperature. Post-test lab analysis of fuels. At week 3, 6, 9, and 12, 500ml fuel specimens will be tested for Karl Fisher moisture (D6304), Filterable

BLOCK 3 TESTING: MATERIALS	
EFFORT	**SUMMARY**
	and Adherent Insolubles (D4625), Potential Gum and Precipitate (D873), Net Heat of Combustion (D4809), Vapor Pressure (D5191), Lead, Sulfur, and Hydrogen Content, and GC-MS. At the end of 12 weeks, the 5-gallon specimens will be tested for full ASTM D910 Table 1 properties. REPORT: Any differences from leaded fuel results. Post-test lab analysis of fuels. REPORT: Any differences from base composition.
Cold storage (PAFI Rig 5)	Store in ultra-low temp (-65F) for ~1 week. Inspect for visual separation. May perform post-test lab analysis of fuels. REPORT: Visual images, chemical analysis if phase separation observed.
Polysulfides – 3 total	28-day day elevated temp jar soak test. Measure volume swell, hardness, tensile, and elongation of the sealants. REPORT: 1) Values for above test.
Tygon tubing	28-day jar soak test at elevated and room temperatures. Measure hardness, volume swell(density) of the tubing. REPORT: 1) Values for above tests.
BunaN, fluorosilicone, Viton (o-rings)	28-day jar soak test at elevated and room temperatures. Measure hardness, volume swell (density), tensile elongation of o-rings. REPORT: 1) Values for above tests.
Bladder coupons	28-day jar soak test. Visual inspection of coupons for changes in condition or size (swell, density change) and analyze fuel for comparative compositional

BLOCK 3 TESTING: MATERIALS	
EFFORT	**SUMMARY**
	analysis (pre and post-test). Fuel test: GC composition, potential gum, and existent gum. REPORT: Visual images, differences from base composition.
Paint and Fabric	Fabric test – 48-hour contact exposure of constructed panels. Measure Tensile/elongation of lap joints and open fabric specimens. REPORT: Values for exposed and unexposed specimens. Comparison of change from unexposed value to high aromatic 100LL. Paint test – Drip test – time to drip up to 5 gallons – Adhesion test – jar soak 28 days Measure visual changes, changes in adhesion. REPORT: Changes in staining and adhesion.

Table 12 – Comparative testing: materials testing

TOXICOLOGICAL AND EXHAUST EMISSION ASSESSMENTS

TOXICOLOGICAL ASSESSMENT: UNLEADED FUELS AND 100LL	
EFFORT	**SUMMARY**
Assessment compares the relative risks from exposure to fuels in the workplace and due to emissions.	Report that evaluates potential exposures, summarizes toxicology data including a comparison of the fuels based on their primary organic compounds, and characterizes risks.

Table 13 – Comparative testing: toxicological assessment

APPENDIX C: BEST PRACTICES, EDUCATION, TRAINING, AND COMMUNICATION

As discussed in the introductory section, the efforts to transition to unleaded fuels have been ongoing, and as highlighted throughout the document, there are already numerous resources in place to inform stakeholders looking to transition to unleaded fuel).

In addition to reinforcing existing materials, this section will also focus on areas where continued communication and outreach are needed to enable the safe and efficient transition to unleaded fuel.

DEVELOP KEY STAKEHOLDERS AND PLAN THE OUTREACH

One of the early recommendations from the NASEM report was to develop a diverse list of key stakeholders, define their potential roles and responsibilities, and plan a tailored outreach throughout each phase of the transition. Many of these activities have been ongoing in support of the transition to unleaded fuels to date and will need to continue until the culmination of the transition to unleaded fuels.

STAKEHOLDER	ROLE
Industry, Aviation, Airport Associations – (e.g., AOPA, EAA, GAMA, NATA, NBAA, AAAE, ACI-NA)	• Member safety, compliance, education, outreach, advocacy. Specific examples include providing ongoing • Collaboration with the FAA; defining roles, responsibilities, and timelines for preparation and implementation of training curriculums
Fuel developers	• Publish lessons learned and best practices • Publish detailed and robust testing and certification plans • Provide stakeholders with details about the fuel specifications, development, and approval
Engine and aircraft OEMs	• R&D efforts to identify and implement necessary changes, etc. • Participation in rigorous testing efforts; in-kind and other support
Flight schools	• Reference published guidance to the transitioning of flight schools and other available resources to leverage existing lessons learned and facilitate a smooth transition at their location; reference listing of resources under Section 5.4.1 Airport and FBO Resources and Section 10.7.1 Fuel Handling Resources • End-user awareness, fuels compatibility, compliance, safety
Pilots, owner operators, airframe and powerplant mechanics	• End-user education, compliance with new requirements, implementation, ensuring compatibility and safety • Provide feedback and input on end user experience
Fuel distributors/ airports/FBOs	• Safety, liability, and compliance with contract terms • FBOs are the "face of the industry"; FBO management of the new fuel implementation will be critical to the ultimate transition ○ Reference published guidance to transitioning airports/FBOs as documented in the ACRP 03-73 – Airport Guide for Transitioning to Unleaded Aviation Gasoline (Pending as of March 2025)
Other government entities (local, state, Tribal, international)	• Education, outreach, and advocacy • Publish/advocate lessons learned and best practices
Health Advocacy Groups	• Education, outreach, and advocacy • Publish/advocate lessons learned and best practices
Federal government (e.g., EPA, FAA, Occupational Safety and Health Administration [OSHA])	• Collaboration with stakeholders • Education and outreach for safe transition • Policy development (e.g., Fleet Authorization Process, etc.) • Rulemaking and enforcement • Publish lessons learned and best practices • Public Health • Employee occupational health and safety
Standards bodies (e.g. ASTM, NFPA)	• Responsible for establishing criteria for achieving test and production specifications

Table 14 – Key stakeholders and their role in the transition to unleaded fuel

ONGOING ACTIVITIES IN RESPONSE TO THE NASEM REPORT AND RECOMMENDATIONS

In the "Options for Reducing Lead Emissions from Piston-Engine Aircraft" report referenced earlier in this document, NASEM highlighted a need for the FAA to partner with prominent organizations within the GA community to initiate **an ongoing and continuous education, training, and awareness campaign** throughout the entire transition period. This is true regardless of the phase of the transition. Figure 8 shows some of the ways the EAGLE initiative has addressed and plans to continue to adhere to the NASEM recommendations:

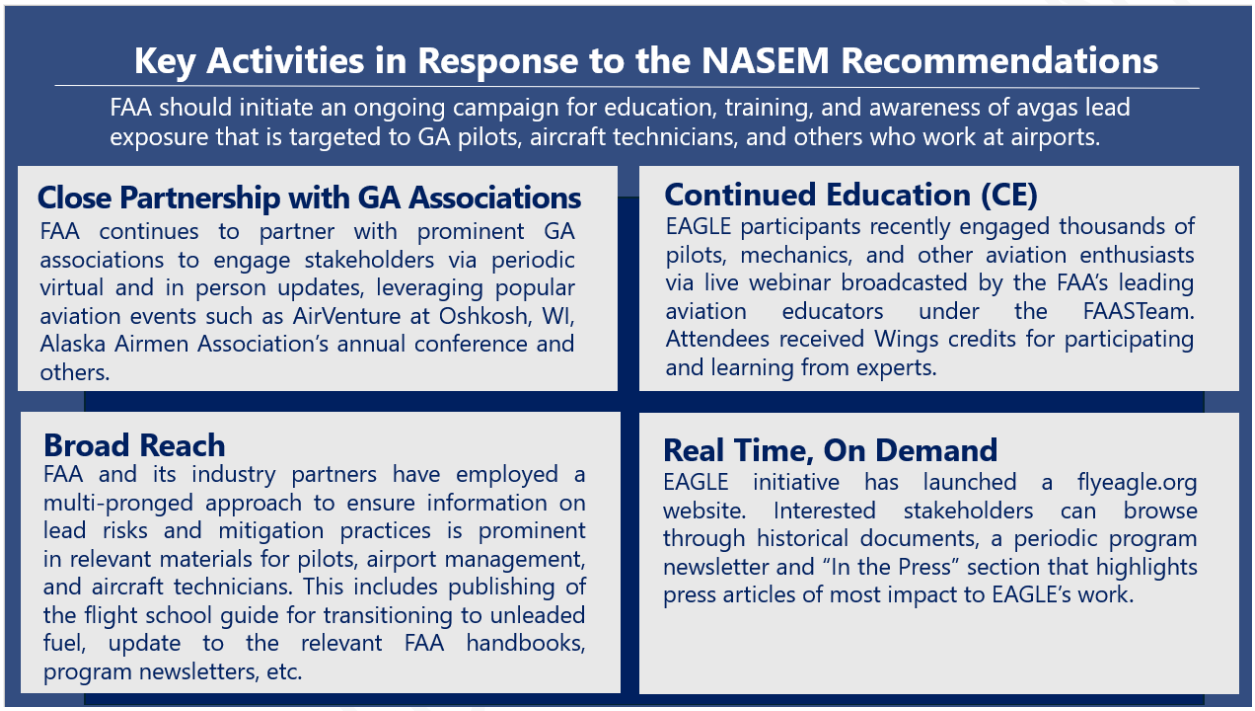

Image: FAA created

Figure 8 – Responding to NASEM Recommendations

TRANSITION GUIDANCE TO FLIGHT SCHOOLS

Flight schools offer a unique opportunity to transition to unleaded fuels early in the process. They often use low compression, spark ignition, piston-engine aircraft that are or can be authorized to operate on an unleaded AvGas that is currently available.

In addition, flight schools often carry out high levels of activities near the airport (e.g., touch-and-go operations), which concentrates the area where emissions are released. Such concentrated emissions may extend more than half a mile from the end of the runway. Therefore, flight schools and those engaged in flight training make excellent partners in working with their FBO, airport operators and/or fuel suppliers to encourage the supply of unleaded AvGas and to coordinate on the early transition. Engagement with flight schools could support Phase 1 and Phase 2 activities in advance of the planned National Transition dates.

For these reasons, in July 2023, the EAGLE initiative published a guidance document titled "Guidance on Transitioning a Flight School to Unleaded Avgas" to support flight schools with their decision-making as they

safely transition to unleaded AvGas. While this document may not fully cover unique aspects of all airport or FBO operations, it does offer a robust roadmap for common elements each flight school should evaluate during the transition.

Figure 9 shows the overall structure of the "Guidance on Transitioning a Flight School to Unleaded Avgas." It provides an overview of the overarching elements such as safety protocols, cost considerations, education, training, and a need for continued communications. It also describes three basic transition steps for a flight school to safely enable the use of unleaded AvGas.

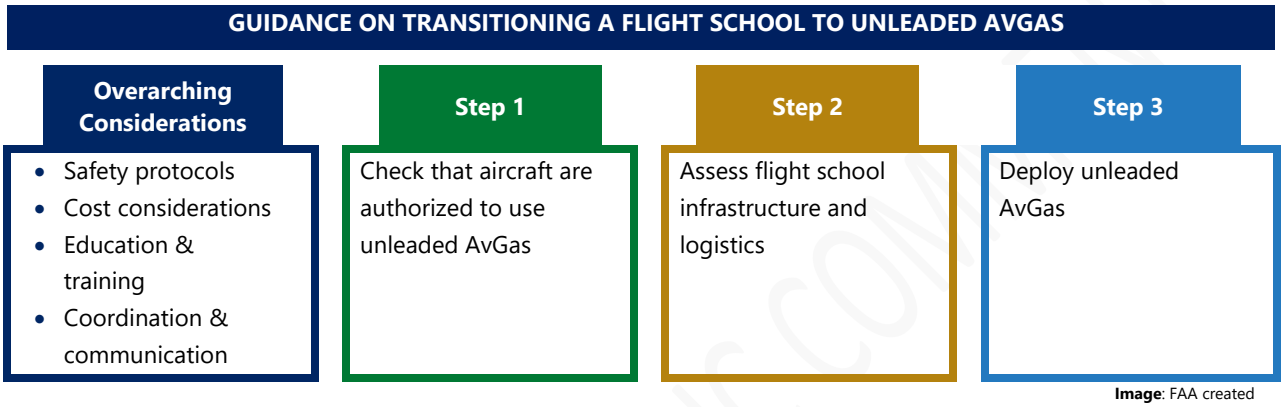

Image: FAA created

Figure 9 – Basic Transition Steps for a Flight School

Source: "Guidance on Transitioning a Flight School to Unleaded Avgas"

The EAGLE initiative believes that this flight school guidance document will help flight schools across the nation decide when to transition to unleaded fuels, while guiding them through the transition process.

AIRPORTS: NEAR-TERM ACTIONS

FAA and industry are moving cooperatively, safely, and with purpose toward unleaded fuel(s). To support the orderly transition, airport operators are encouraged to implement several common near-term measures described below as they consider specific operational and safety needs unique to their airport:

Implement the following NASEM Recommendations

- Work with aircraft owners and operators to minimize engine idling and run-up times.
- Relocate and distribute pre-flight and maintenance run-up locations.
- Offer alternative unleaded fuel to supplement AvGas sales.
- Promote airport and pilot awareness.

Assess Fuel Infrastructure and Incorporate Needs into the Airport's Planning Initiatives

Evaluate current fuel storage and dispensing systems to determine fuel infrastructure requirements to accommodate a new fuel. Explore the following questions:

- Does the airport have available infrastructure to support adding unleaded fuel while maintaining 100LL as required by the Act?
- If not, what infrastructure will be needed to support a seamless transition?

Analyze Costs

Consider the costs associated with transitioning, including changes to infrastructure, staff training, signage, increased communications to airport users, insurance, and an initial unleaded fuel purchase.

Secure Funding

As mentioned in section 6.6, fuel storage and distribution infrastructure, through the Act, the FAA has broader authority to support transition-enabling infrastructure. This includes storage tanks and airport-owned fuel trucks providing exclusively unleaded aviation fuels. Please refer to the IIJA FAQs website for further information.

Maintain 100LL Availability

The Act, Section 770, Grant Assurances, provides that 100LL shall remain available until the earlier of December 31, 2030, or the date on which the airport or any retail fuel seller makes available an unleaded AvGas that meets the criteria outlined in the Act. To that effect, the FAA Office of Airports released a Q&A document on May 19, 2025, clarifying the Grant Assurance 40 and prohibiting airports from restricting 100LL availability until an alternative fuel meets the established criteria.

The FAA has also found that banning sale or self-fueling of an authorized fuel, such as 100LL, may place the airport sponsor in violation of Grant Assurance 22 or 23.

Plan ways in which the airport will continue to offer 100LL throughout the transition period (see Appendix F, Applicable Federal Statutes, for the full text).

Disseminate Information

Keep airport personnel and users apprised of the planned activities and associated milestones for the transition to the unleaded AvGas and any changes they might expect such as changes in signage, placarding, or aircraft modifications.

As the transition grows closer, use newsletters, website updates, or other media to emphasize the benefits of unleaded AvGas and the upcoming transition milestones.

Plan the Transition

Create a timeline to include key milestones such as infrastructure changes, staff training, implementation strategy, and the introduction of unleaded AvGas at a given location, as well as when it may be both consistent with applicable laws and regulations and suitable to phase out 100LL.

Stress Safety

Train staff and airport users on safe handling, storage, dispensing, and intermingling of fuels (if applicable). Include prominently placed signage; oversee and ensure adherence to new procedures or safety measures.

Implement Fuel Management Procedures

Document and share standard operating procedures regarding how your facility handles the new fuel to provide a tangible reference and to set clear expectations.

Monitor and Evaluate the Transition Period

Carefully monitor the implementation of unleaded AvGas in your airport's operations and address concerns before scaling up to full implementation. Set up a feedback mechanism for staff and AvGas users to report any challenges during the transition. Have dedicated personnel responsible for reviewing and resolving those challenges.

PILOT AWARENESS

Maintaining safe operations for pilots, other operators at airports, and local communities is an essential part of a safe transition to unleaded fuel(s), along with improving the health of surrounding communities.

Airport managers, pilots, and aircraft owners will need to rely on their long-standing relationships to educate communities about plans to transition to unleaded fuels, as well as address safety concerns for those in the air and on the ground.

- Consider coordinating outreach activities with major aviation associations (e.g., American Association of Airport Executives [AAAE], AOPA, GAMA, NATA, NBAA, FAA Office of Energy and Environment [AEE], FAA Safety Team [FAAST]).
- Engage with relevant stakeholders (e.g., flight organizations, FBOs, airport communities).

BEST PRACTICES FOR MINIMIZING LEAD EXPOSURE

The following list of resources and guidance is in alignment with Section 827(b (1)(C) of the Act. It is derived from multiple reputable sources and available to various stakeholders in the GA community to help them understand the risks associated with lead and strategies for their mitigation. These resources can be utilized in protecting the stakeholder community against exposure to lead.

SOURCE	RESOURCE AND LINK
CDC	Childhood Lead Poisoning Prevention Program
CDC-NIOSH	Pocket Guide to Chemical Hazards – Lead
EAGLE	Transitioning a Flight School to UL Avgas
Energy Institute	EI/JIG Standard 1597: Procedures for overwing fueling to ensure delivery of the correct fuel grade to an aircraft EI/JIG Standard 1530: Quality assurance requirements for the manufacture, storage and distribution of aviation fuels to airports
Environmental Protection Agency (EPA)	The following text is from the Q&As that accompanied the EPA's final finding on aircraft lead emissions: • For community members who are concerned about their children's exposure to lead, the first step is to talk to their doctors and get tested. EPA offers help from local Pediatric Environmental Health Specialty Units (PEHSUs) who have the expertise to evaluate children's environments holistically since there can be multiple sources of lead in a child's environment. • PEHSUs also offers additional information about lead exposure. • EPA has developed recommendations for minimizing children's exposure to lead in the home from all potential sources. • Additional information on actions community members can take to minimize potential lead exposure is also available here.
FAA Handbook	• Aviation Maintenance Technician Handbook-Powerplant, Chapter 1 • Aviation Maintenance Technician Handbook-Airframe, Chapter 2
National Academies of Science	Options for Reducing Lead Emissions from Piston-Engine Aircraft
National Air Transportation Association (NATA)	• Unleaded Avgas Conversion Considerations for Aviation Fuel Providers • Safety Data Sheets (SDS) (100LL D910)
OSHA	Occupational Safety and Health Administration Fuel Handling and Storage
U.S. Department of Health and Human Services (USHS)	HeadStart.gov brochure, How to Protect Your Children from Lead Poisoning, to help community members and parents learn about the effects of unsafe levels of lead in blood and how to avoid lead exposure.
U.S. Health Systems (USHS), Centers fc Disease Control and Prevention (CDC), National Institute for Occupational Safety and Health (NIOSH)	Exposures to Lead and Other Metals at an Aircraft Repair and Flight School Facility

Table 15 – Resources related to the safe handling of leaded fuels

FUEL HANDLING MANAGEMENT

Handling 100LL fuel has been well managed for decades. A new unleaded fuel requires assessment for unique or special handling criteria. For example, identify whether the fuel has any characteristic that would cause concern in development, blending or distribution that does not exist with 100LL, and if so, document its impact and mitigating steps.

One key element in avoiding misfueling is closely monitoring dye colors of the fuels when handling or utilizing them. Dye colors are assigned in respective ASTM fuel production specifications and Energy Institute (EI) Standard 1542, Identification Markings for Dedicated Aviation Fuel development, blending and distribution facilities, airport storage, and mobile fueling equipment. Dye colors for piston-engine aircraft fuels are as follows:

FUEL	COLOR	SPECIFICATION
UL91	Red	ASTM D7547
UL94	Purple	ASTM D7547
UL100E	Orange	Pending ASTM specification
100R	Green	Pending ASTM specification
G100UL	Yellow-green to green to blue-green	GAMI G100UL-12C9
100LL/100VLL	Blue	ASTM D910

Table 16 – Dye colors for piston-engine aircraft fuels

Fuel quality control currently utilizes EI Standard 1530 to manage custody transfer of 100LL. Under this standard, unleaded fuels should have an identified test for Quality Assurance/Quality Control (QA/QC) during custody transfer of new a unleaded product to ensure the product is unchanged during the movement of the fuel. For 100LL, this is currently achieved using the white bucket test and hydrometer measurements. Fuel developers and producers should address any new or modified processes to the current QA/QC if changes are required. During the transition period in which multiple AvGas formulations may be available, stakeholders will need to be aware of the potential for misfueling.

Misfueling refers to any time an incorrect fuel type (e.g., jet fuel versus AvGas) or fuel grade (lower octane unleaded AvGas versus 100LL) is delivered into an aircraft. In the case of the transition period to unleaded AvGas, this would mean misfueling an aircraft that is only authorized to use 100LL with unleaded AvGas. There is currently no grade selectivity among AvGas nozzle spouts or filler ports. Unleaded AvGas filler spouts correspond to the filler ports of aircraft that may still require a 100-octane AvGas.

NOTE

Fuel colors are being coordinated between ASTM specifications, placard specifications, and EI 1542. FAA ACs, SAIBs, and other FAA safety communications will emphasize avoiding misfueling by raising awareness of anti-misfueling devices and fuel colors.

FUEL HANDLING RESOURCES

There are several resources available to support safe fuel handing management during the transition; examples include:

- FAA Dynamic Regulatory System (DRS)
  - AC 20-116 Marking Aircraft Fuel Filler Openings with Color-Coded Decals
  - AC 20-122A Anti-Misfueling Devices: Their Availability and Use
- NATA General Aviation Misfueling Prevention Online Programhttp://www.nata.aero/education-and-training/misfueling-prevention-program
- "Transitioning a Flight School to UL Avgas," Appendix 3

APPENDIX D: AIRPORT AND FBO RESOURCES

AIRPORT GUIDE FOR TRANSITIONING TO UNLEADED AVIATION GASOLINE

In 2023, the FAA, through the Airports Cooperative Research Program, initiated project 03-73, *Airport Guide for Transitioning to Unleaded AvGas* to answer the broad question: "What can we learn from airports working to offer unleaded AvGas and working to reduce lead emissions?" This research will result in a guidebook, summary of key research findings, and a series of spreadsheet tools to support airports working to offer unleaded AvGas while maintaining 100LL. The research assessed 48 airports that started offering unleaded fuel after 2011, and in 2024 it conducted case studies at seven of those airports that already offered or were considering offering unleaded AvGas.

Key topics the case studies analyzed included infrastructure, facility planning, construction, operations, presence of a flight school, fuel sales distribution, ASTM requirement minimum standards, offered incentives, unleaded fuel offer date, decision drivers, and the key dynamics that influenced the actions at the case study airports.

A resulting report summarizing the results of the case studies is organized in the following manner:

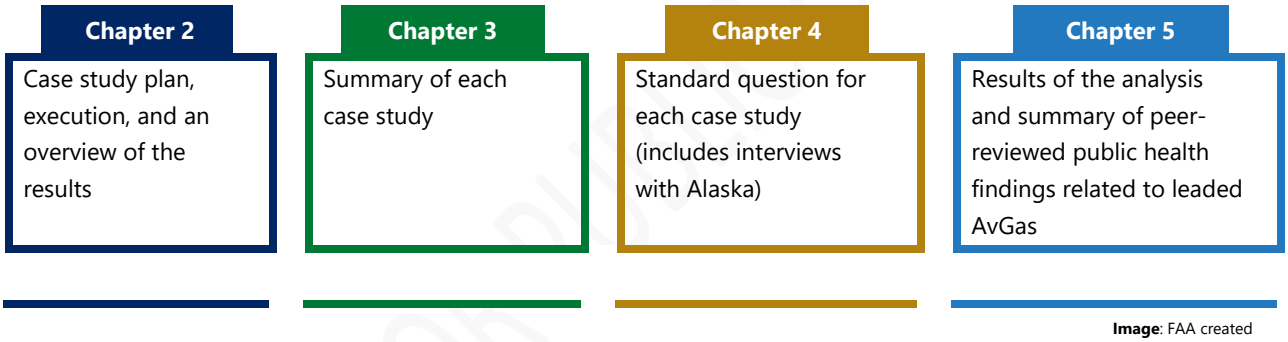

Image: FAA created

Figure 10 – ACRP Project 03-73 – Report Structure

The results of the case studies across seven participating airports and two major Alaska stakeholders were summarized in a standardized and comparable manner. These results provide excellent insights for those wishing to assess the requirements for providing unleaded AvGas at their locality and understand some of the challenges and opportunities for the transition.

Among many insights gained from this research, it is notable that five of the seven case study airports leveraged existing fuel storage and dispensing infrastructure to support offering unleaded fuel. One airport procured a new tank, and another purchased a used fuel truck to support unleaded fuel storage and dispensing. Each of the case study airports took decisive actions to facilitate offering unleaded fuel, which exemplifies supporting actions needed to facilitate a safe National Transition.

In support of this phase, airports are encouraged to begin planning and taking enabling steps for a safe transition.

OTHER AIRPORT AND FBO RESOURCES

To enable a safe transition, there are ample resources available to support airports, service providers, and operators in their decision-making. The following is a representative sample of available resources:

- EAGLE website – https://flyeagle.org/
- FAA – FAA.gov – What can airports do in the short-term?
- (Pending Fall 2025 publication) ACRP 03-73 – Airport Guide for Transitioning to Unleaded Aviation Gasoline
- National Air Transportation Association (NATA) – Unleaded Avgas Considerations for Aviation Fuel Providers
- NATA – Factors Affecting the Commercial Sale of Emerging Unleaded Aviation Fuels
- EAGLE – Guidance on Transitioning a Flight School to Unleaded Avgas
- National Academies – Consensus Report – Options for Reducing Lead Emissions

APPENDIX E: ADDITIONAL RULEMAKING RESOURCES

Although the exact timing of the unleaded AvGas related rulemaking is not known at the time of publishing this Transition Plan, the FAA has compiled the following information to inform interested stakeholders:

The EPA Aircraft Engine Emissions Standards

With EPA's 2023 Endangerment Finding, the EPA is now subject to a duty under 42 U.S.C. 7571 to propose and issue regulatory standards for lead emissions from certain aircraft engines. The EPA must consult with the FAA on establishing aircraft engine emission standards. In the development of these standards, EPA will use the public rulemaking processes that include notice and public comment.

FAA Fuel Composition Rulemaking

With EPA's 2023 Endangerment Finding, the FAA is now obligated under statute 49 USC 44714 to prescribe "standards for the composition or chemical or physical properties of an aircraft fuel or fuel additive" and to issue regulations to carry out and enforce those standards. FAA can now regulate lead as a fuel component or as a fuel additive to control or eliminate aircraft emissions. This rulemaking would be codified in Title 14 of the Code of Federal Regulations.

FAA's Certification Standards

Once the EPA has promulgated lead emissions standards for aircraft engines, 42 U.S.C. 7572 requires the FAA to prescribe regulations to ensure compliance with the standards prescribed by EPA under 42 U.S.C. 7571. The FAA is required to implement the EPA standards through its certification process. The scope of this rule is dependent upon the requirements that may materialize in rulemaking noted under the EPA Aircraft Engine Emissions Standards and FAA Fuel Composition Rulemaking, as necessary.

INITIATION OF FAA RULEMAKING

Early in the transition, without regulatory mandates, aircraft owners and operators may lack motivation to modify their aircraft to use an unleaded fuel that might be unavailable in sufficient quantities. Similarly, airports and FBOs may lack motivation to supply unleaded fuels that do not yet have an established market.

It is anticipated that the FAA rulemaking would initiate during Phase 2 of the transition and continue to progress through most of the transition period, ultimately culminating in a final rule to support the end of 2030 target date (2032 for Alaska) to transition to unleaded AvGas. The rulemaking process generally involves initiating, proposing, receiving comments, adjudicating said comments, and then finalizing a regulation.

APPENDIX F: APPLICABLE FEDERAL STATUTES

Included in Appendix E are applicable statutes related to deployment of a new unleaded fuel.

The FAA Reauthorization Act of 2024 (P.L 118-63)
Sec. 827. EAGLE Initiative

(a) EAGLE INITIATIVE.—

(1) IN GENERAL.—The Administrator shall continue to partner with industry and other Federal Government stakeholders in carrying out the Eliminate Aviation Gasoline Lead Emissions Initiative (in this section referred to as the "EAGLE Initiative") through the end of 2030.

(2) FAA RESPONSIBILITIES.—In collaborating with industry and other Government stakeholders to carry out the EAGLE Initiative, the Administrator shall take such actions as may be necessary under the authority of the Administrator to facilitate—

(A) the safe elimination of the use of leaded aviation gasoline by piston-engine aircraft by the end of 2030 without adversely affecting the safe and efficient operation of the piston-engine aircraft fleet;

(B) the approval of the use of unleaded alternatives to leaded aviation gasoline for use in all piston-engine aircraft types and piston-engine models;

(C) the implementation of the requirements of Section 47107(a)(22) of title 49, United States Code, as added by this Act, as such requirements relate to the continued availability of aviation gasoline;

(D) efforts to make unleaded aviation gasoline that is approved for use in piston-engine aircraft and engines widely available for purchase and use at airports in the National Plan of Integrated Airport Systems; and

(E) the development of a transition plan to safely enable the transition of the piston-engine general aviation aircraft fleet to unleaded aviation gasoline by 2030, to the extent practicable.

(3) ACTIVITIES.—In carrying out the responsibilities of the Administrator pursuant to paragraph (2), the Administrator shall, at a minimum—

(A) maintain a fleet authorization process for the efficient approval or authorization of eligible piston-engine aircraft and engine models to operate safely using qualified unleaded aviation gasolines;

(B) review, update, and prioritize, as soon as practicable, certification processes and projects, as necessary, for aircraft engines and modifications to such engines to operate with unleaded aviation gasoline;

(C) seek to facilitate programs that accelerate the creation, evaluation, qualification, deployment, and use of unleaded aviation gasolines;

(D) carry out, in partnership with the general aviation community, an ongoing campaign for training and educating aircraft owners and operators on how to safely transition to unleaded aviation gasoline;

(E) evaluate aircraft and aircraft engines to ensure that such aircraft and aircraft engines can safely operate with unleaded aviation gasoline candidates during cold weather conditions; and

(F) facilitate the development of agency policies and processes, as appropriate, to support the deployment of necessary infrastructure at airports to enable the distribution and storage of unleaded aviation gasolines.

(4) CONSULTATION AND COLLABORATION WITH RELEVANT STAKEHOLDERS.—In carrying out the EAGLE Initiative, the Administrator shall continue to consult and collaborate, as appropriate, with relevant stakeholders, including—

(A) general aviation aircraft engine, aircraft propulsion, and aircraft airframe manufacturers;

(B) general aviation aircraft users, aircraft owners, aircraft pilots, and aircraft operators;

(C) airports and fixed-base operators;

(D) State, local, and Tribal aviation officials;

(E) representatives of the petroleum industry, including developers, refiners, producers, and distributors of unleaded aviation gasolines; and

(F) air carriers and commercial operators operating under part 135 of title 14, Code of Federal Regulations.

(5) REPORT TO CONGRESS.—

(A) INITIAL REPORT.—Not later than 1 year after the date of enactment of this Act, the Administrator shall submit to the appropriate committees of Congress a report that—

(i) contains an updated strategic plan for maintaining a fleet authorization process for the efficient approval and authorization of eligible piston-engine aircraft and engine models to operate using unleaded aviation gasolines in a manner that ensures safety;

(ii) describes the structure and involvement of all FAA offices that have responsibilities described in paragraph (2); and

(iii) identifies policy initiatives, regulatory initiatives, or legislative initiatives needed to improve and enhance the timely and safe transition to unleaded aviation gasoline for the piston-engine aircraft fleet.

(B) ANNUAL BRIEFING.—Not later than 1 year after the date on which the Administrator submits the initial report under subparagraph (A), and annually thereafter through 2030, the Administrator shall brief the appropriate committees of Congress on activities and progress of the EAGLE Initiative.

(C) SUNSET.—Subparagraph (B) shall cease to be effective after December 31, 2030.

(b) TRANSITION PLAN TO UNLEADED AVIATION GASOLINE.—

(1) IN GENERAL.—In developing the transition plan under subsection (a)(2)(E), the Administrator may, at a minimum, assess the following:

(A) Efforts undertaken by the EAGLE Initiative, including progress toward—

(i) safely eliminating the use of leaded aviation gasoline by piston-engine aircraft by the end of 2030 without adversely affecting the safe and efficient operation of the piston-engine aircraft fleet;

(ii) approving the use of unleaded alternatives to leaded aviation gasoline for use in all piston-engine aircraft types and piston-engine models; and

(iii) facilitating efforts to make approved unleaded aviation gasoline that is approved for use in piston-engine aircraft and engines widely available at airports for purchase and use in the National Plan of Integrated Airport Systems.

(B) The evaluation and development of necessary airport infrastructure, including fuel storage and dispensing facilities, to support the distribution and storage of unleaded aviation gasoline.

(C) The establishment of best practices for piston-engine aircraft owners and operators, airport operators and personnel, aircraft maintenance technicians, and other appropriate personnel for protecting against exposure to lead containment when—

(i) conducting fueling operations;

(ii) disposing of inspected gasoline samples;

(iii) performing aircraft maintenance; and

(iv) conducting engine run-ups.

(D) Efforts to address supply chain and other logistical barriers inhibiting the timely distribution of unleaded aviation gasoline to airports.

(E) Outreach efforts to educate and update piston-engine aircraft owners and operators, airport operators, and other members of the general aviation community on the potential benefits, availability, and safety of unleaded aviation gasoline.

(2) PUBLICATION; GUIDANCE.—Upon completion of developing such transition plan, the Administrator shall—

(A) make the plan available to the public on an appropriate website of the FAA; and

(B) provide guidance supporting the implementation of the transition plan.

(3) COLLABORATION WITH EAGLE INITIATIVE.—In supporting the development of such transition plan and issuing associated guidance pertaining to the implementation of such transition plan, the Administrator shall consult and collaborate with individuals carrying out the EAGLE Initiative.

(4) UNLEADED AVIATION GASOLINE COMMUNICATION MATERIALS.—The Administrator may collaborate with individuals carrying out the EAGLE Initiative to jointly develop and continuously update websites, brochures, and other communication materials associated with such transition plan to clearly convey the availability of unleaded aviation gasoline at airports.

(5) BRIEFING TO CONGRESS.—Not later than 60 days after the publication of such transition plan, the Administrator shall brief the appropriate committees of Congress on such transition plan and any agency efforts or actions pertaining to the implementation of such transition plan.

(6) SAVINGS CLAUSE.—Nothing in this section shall be construed to delay or alter the ongoing work of the EAGLE Initiative established by the Administrator in 2022.

The FAA Reauthorization Act of 2024 (P.L 118-63)

Sec. 770. Grant Assurances.

(a) GENERAL WRITTEN ASSURANCES. —Section 47107(a) of title 49, United States Code, is amended—

(1) in paragraph (20) by striking "and" at the end;

(2) in paragraph (21) by striking the period at the end and inserting "; and"; and

(3) by adding at the end the following:

(22) the airport owner or operator may not restrict or prohibit the sale or self-fueling of any 100-octane low lead aviation gasoline for purchase or use by operators of general aviation aircraft if such aviation gasoline was available at such airport at any time during calendar year 2022, until the earlier of—

(A) December 31, 2030; or

(B) the date on which the airport or any retail fuel seller at such airport makes available an unleaded aviation gasoline that—

(i) has been authorized for use by the Administrator of the Federal Aviation Administration as a replacement for 100-octane low lead aviation gasoline for use in nearly all piston-engine aircraft and engine models; and

(ii) meets either an industry consensus standard or other standard that facilitates the safe use, production, and distribution of such unleaded aviation gasoline, as determined appropriate by the Administrator.

(b) CIVIL PENALTIES FOR GRANT ASSURANCES VIOLATIONS. —Section 46301(a) of title 49, United States Code, is further amended—

(1) in paragraph (1)(A) by inserting "Section 47107(a)(22) (including any assurance made under such section)," after "chapter 451,"; and

(2) by adding at the end the following:

(8) FAILURE TO CONTINUE OFFERING AVIATION FUEL.—Notwithstanding paragraph (1), the maximum civil penalty for a violation of section 47107(a)(22) (including any assurance made under such section) committed by a person, including if the person is an individual or a small business concern, shall be $5,000 for each day that the person is in violation of that section.

The FAA Reauthorization Act Of 2024 (P.L 118-63)
Sec. 771. Aviation Fuel in Alaska.

(a) IN GENERAL.—

(1) PROHIBITION ON RESTRICTION OF FUEL USAGE OR AVAILABILITY.—The Administrator of the Federal Aviation Administration and the Administrator of the Environmental Protection Agency shall not restrict the continued use or availability of 100-octane low lead aviation gasoline in the State of Alaska until the earlier of—

(A) December 31, 2032; or

(B) 6 months after the date on which the Administrator of the Federal Aviation Administration finds that an unleaded aviation fuel is widely commercially available at airports throughout the State of Alaska that—

(i) has been authorized for use by the Administrator of the Federal Aviation Administration as a replacement for 100-octane low lead aviation gasoline; and

(ii) meets either an industry consensus standard or other standard that facilitates and ensures the safe use, production, and distribution of such unleaded aviation fuel.

(2) SAVINGS CLAUSE.—Nothing in this section shall limit the authority of the Administrator of the Federal Aviation Administration or the Administrator of the Environmental Protection Agency to address the endangerment to public health and welfare posed by lead emissions—

(A) in the United States outside of the State of Alaska; or

(B) within the State of Alaska after the date specified in paragraph (1).

(b) GAO REPORT ON TRANSITIONING TO UNLEADED AVIATION FUEL IN THE STATE OF ALASKA.—

(1) EVALUATION.—The Comptroller General of the United States shall conduct an evaluation of the following:

(A) The aircraft, routes, and supply chains in the State of Alaska utilizing leaded aviation gasoline, including identification of remote and rural communities that rely upon leaded aviation gasoline.

(B) The estimated costs and benefits of transitioning aircraft and the supply chain in the State of Alaska to aviation fuel that meets the requirements described in clauses (i) and (ii) of Section 47107(a)(22)(B) of title 49, United States Code, as added by Section 770, including direct costs of new aircraft and equipment and indirect costs, including transportation from refineries to markets, foreign imports, and changes in leaded aviation gasoline prices as a result of reduced supply.

(C) The programs of the Environmental Protection Agency, the Federal Aviation Administration, and other government agencies that can be utilized to assist individuals, communities, industries, and the State of Alaska with the costs described in subparagraph (B).

(D) A reasonable time frame to permit any limitation on 100-octane low-lead aviation gasoline in the State of Alaska.

(E) Other logistical considerations associated with the transition described in subparagraph (B).

(2) REPORT.—Not later than 3 years after the date of enactment of this section, the Comptroller General shall submit a report containing the results of the evaluation conducted under paragraph (1) to—

(A) the Committee on Commerce, Science, and Transportation of the Senate;
(B) the Committee on Environment and Public Works of the Senate;
(C) the Committee on Transportation and Infrastructure of the House of Representatives; and
(D) the Committee on Energy and Commerce of the House of Representatives.

42 U.S. Code § 7571. Establishment of Standards

(a) Study; proposed standards; hearings; issuance of regulations

(1) Within 90 days after December 31, 1970, the Administrator shall commence a study and investigation of emissions of air pollutants from aircraft to determine—

(A) the extent to which such emissions affect air quality in air quality control regions throughout the United States, and

(B) the technological feasibility of controlling such emissions.

(2)

(A) The Administrator shall, from time to time, issue proposed emission standards applicable to the emission of any air pollutant from any class or classes of aircraft engines which in his judgment causes, or contributes to, air pollution which may reasonably be anticipated to endanger public health or welfare.

(B)

(i) The Administrator shall consult with the Administrator of the Federal Aviation Administration on aircraft engine emission standards.

(ii) The Administrator shall not change the aircraft engine emission standards if such change would significantly increase noise and adversely affect safety.

(3) The Administrator shall hold public hearings with respect to such proposed standards. Such hearings shall, to the extent practicable, be held in air quality control regions which are most seriously affected by aircraft emissions. Within 90 days after the issuance of such proposed regulations, he shall issue such regulations with such modifications as he deems appropriate. Such regulations may be revised from time to time.

(b) Effective date of regulations

Any regulation prescribed under this section (and any revision thereof) shall take effect after such period as the Administrator finds necessary (after consultation with the Secretary of Transportation) to permit the development and application of the requisite technology, considering the cost of compliance within such period.

(c) Regulations which create hazards to aircraft safety

Any regulations in effect under this section on August 7, 1977, or proposed or promulgated thereafter, or amendments thereto, with respect to aircraft shall not apply if disapproved by the President, after notice and opportunity for public hearing, on the basis of a finding by the Secretary of Transportation that any such regulation would create a hazard to aircraft safety. Any such finding shall include a reasonably specific statement of the basis upon which the finding was made.

42 U.S. Code § 7572 - Enforcement Of Standards

(a)Regulations to ensure compliance with standards

The Secretary of Transportation, after consultation with the Administrator, shall prescribe regulations to insure compliance with all standards prescribed under Section 7571 of this title by the Administrator. The regulations of the Secretary of Transportation shall include provisions making such standards applicable in the issuance, amendment, modification, suspension, or revocation of any certificate authorized by part A of subtitle VII of title 49 or the Department of Transportation Act. Such Secretary shall insure that all necessary inspections are accomplished, and, [1] may execute any power or duty vested in him by any other provision of law in the execution of all powers and duties vested in him under this section.

(b)Notice and appeal rights

In any action to amend, modify, suspend, or revoke a certificate in which violation of an emission standard prescribed under Section 7571 of this title or of a regulation prescribed under subsection (a) is at issue, the certificate holder shall have the same notice and appeal rights as are prescribed for such holders in part A of subtitle VII of title 49 or the Department of Transportation Act, except that in any appeal to the National Transportation Safety Board, the Board may amend, modify, or revoke the order of the Secretary of Transportation only if it finds no violation of such standard or regulation and that such amendment, modification, or revocation is consistent with safety in air transportation.

49 U.S. Code § 44714. Aviation Fuel Standards

The Administrator of the Federal Aviation Administration shall prescribe—

(1) standards for the composition or chemical or physical properties of an aircraft fuel or fuel additive to control or eliminate aircraft emissions the Administrator of the Environmental Protection Agency decides under Section 231 of the Clean Air Act (42 U.S.C. 7571) endanger the public health or welfare; and

(2) regulations providing for carrying out and enforcing those standards.

APPENDIX G: NASEM REPORT AND RECOMMENDATIONS

Section 10.2 addresses specific actions EAGLE members have taken to address specific NASEM recommendations. This appendix is provided as a reference to the actual NASEM recommendations.

In the "Options for Reducing Lead Emissions from Piston-Engine Aircraft" report referenced earlier in this document, NASEM highlighted a need for the FAA to partner with prominent organizations within the GA community to initiate **an ongoing and continuous education, training, and awareness campaign** throughout the entire transition period. This is true regardless of the phase of the transition. As stated in the study,

"There is evidence, …that many pilots and airport personnel may not fully appreciate the extent to which their own actions and behaviors are contributing to lead exposures, including their own exposure. Aircraft technicians and pilots performing repairs and maintenance may be exposed unknowingly to lead deposited on aircraft components, including spark plugs and other engine parts. Lead residue and dust can concentrate in shops where maintenance is performed, exposing the technicians to lead and potentially their families as a result of lead deposits brought home on clothing. Pilots and line personnel may be exposed to evaporative emissions that are not captured during refueling and when fuel is spilled or improperly discarded after sampling. Finally, when conducting their pre-takeoff checks, pilots may not fully appreciate how their decisions about where and how long to perform these operations can affect concentrations of lead at airports."

NASEM provided several recommendations for increasing awareness about lead exposure throughout the GA community:

- Review and update FAA manuals and handbooks pertaining to flight training, aircraft maintenance, and airport management to underscore the environmental risk and health hazard of lead exposure.
- Ensure safe disposal of inspected fuel and reduce exposures to lead deposits when performing aircraft maintenance and repairs.
- Coordinate FAA efforts to reduce lead pollution and exposures at airports with those of other federal agencies that have responsibilities for protecting public health, safety, and the environment, including OSHA as well as EPA.
- FAA, in partnership with prominent organizations within the GA community, should initiate an ongoing campaign for education, training, and awareness of AvGas lead exposure that is targeted to GA pilots, aircraft technicians, and others who work at airports. Informed by research on the most effective approaches for reaching these audiences, the campaign should be multi-pronged by ensuring that information on lead risks and mitigation practices is prominent in relevant manuals, guidelines, training materials, and handbooks for pilots, airport management, and aircraft technicians. Where appropriate, it should also be covered in relevant certification and licensure examinations.
- Information should also be featured on FAA and GA organization websites and included in written materials distributed at GA industry conferences, trade shows, and fly-ins.
- FAA should update its guidance on the location of run-ups to reduce people's exposure to lead while also accounting for other concerns including safety and aircraft noise.

**Aircraft Owners and Pilots Association (AOPA), Experimental Aircraft Association (EAA), General Aviation Manufacturers Association (GAMA), National Air Transportation Association (NATA), National Business Aviation Association (NBAA)*

Figure 11 – NASEM Recommendation

APPENDIX H: GUIDANCE MATERIAL AND STANDARD PRACTICES

AMERICAN PETROLEUM INSTITUTE (API)	
DOC NO.	**DESCRIPTION**
API 652	Linings of Aboveground Petroleum Storage Tank Bottoms
API 653	Tank Inspection, Repair, Alteration
API 1543	Documentation, Monitoring and Laboratory Testing of Aviation Fuel During Shipment from Refinery to Airport - Recommended Practice
API/IP 1595	Design, Construction, Operation, Maintenance and Inspection of Aviation Pre-Airfield Storage Terminals - Recommended Practice
API 1543	Documentation, Monitoring and Laboratory Testing of Aviation Fuel During Shipment from Refinery to Airport
API 2610	Design, Construction, Operation, Maintenance, and Inspection of Terminal & Tank Facilities
API 2003RP	Protection Against Ignitions Arising out of Static, Lightning, and Stray Currents
AMERICAN SOCIETY TESTING AND MATERIALS (ASTM)	
DOC NO.	**DESCRIPTION**
ASTM MNL 1	Significance of Tests for Petroleum Products
ASTM MNL 5	Aviation Fuel Quality Control Procedures
ASTM D7826	Standard Guide for Evaluation of New Aviation Gasolines and New Aviation Gasoline Additives
COORDINATING RESEARCH COUNCIL (CRC)	
DOC NO.	**DESCRIPTION**
None	CRC Handbook of Aviation Fuel Properties
ENERGY INSTITUTE (EI)	
DOC NO.	**DESCRIPTION**
EI 1529	Aviation Fueling Hose and Hose Assemblies
EI 1530	Quality Assurance Requirements for the Manufacture Storage and Distribution of Aviation Fuel to Airports
EI 1540	Design, Construction, Operation and Maintenance of Aviation Fueling Facilities - Recommended Practice
EI 1541	Performance Requirements for Protective Coating Systems Used in Aviation Fuel Storage Tanks and Piping
EI 1542	Identification Markings for Aviation Fuel Distribution Facilities, Airport Storage and Mobile Fueling Equipment
EI 1550	Handbook on Equipment Used for the Maintenance and Delivery of Clean Aviation Fuel
EI 1581	Specifications and Qualification Procedures for Aviation Jet Fuel Filter/Separators
EI 1582	Specification for Similarity for API/IP 1581 Aviation Jet Fuel Filter/Separators
EI 1583	Laboratory Tests and Minimum Performance Levels for Aviation Fuel Filter Monitors
EI 1587	Single Stool Filtration Systems for Low Flow Rate Applications
EI 1588	Water Barrier Filter
EI 1590	Specifications and Qualification Procedures for Aviation Fuel Microfilters

EI 1592	Bulk Water Detector
EI 1597	Procedures for Overwing Fueling to Ensure Delivery of the Correct Fuel Grade to an Aircraft RP)
EI 1598	Quantitative Water Sensor
EI 1599	Dirt Defence Filter
FEDERAL AVIATION ADMINISTRATION (FAA)	
DOC NO.	**DESCRIPTION**
AC20-122A	Anti-Misfueling Devices: Their Availability and Use
AC 150	Aircraft Fuel Storage, Handling, and Dispensing on Airports
FAA Advisory Circular AC 150/5230-4B	"Aircraft Fuel Storage, Handling, Training, and Dispensing on Airports." The FAA uses the standards contained in the most recent edition of National Fire Prevention Association (NFP) 407, Standards for Aircraft Fuel Servicing.
INTERNATIONAL FIRE CODE (IFC)	
DOC NO.	**DESCRIPTION**
ICC IFC-2018	International Fire Code
JOINT INSPECTION GROUP (JIG)	
DOC NO.	**DESCRIPTION**
JIG 1	Guidelines for Aviation Fuel Quality Control and Operating Procedures for Joint Into-Plane Fuelling Services
JIG 4	Guidelines for Aviation Fuel Quality Control and Operating Procedures for Smaller Airports
NATIONAL AVIATION TRANSPORTATION ASSOCIATION (NATA)	
DOC NO.	**DESCRIPTION**
Manual	Refueling and Quality Control Procedures for Airport Service and Support Operations
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
DOC NO.	**DESCRIPTION**
NFPA 30	Flammable and Combustible Liquids Code
NFPA 77	Recommended Practice on Static Electricity
NFPA 385	Standard for Tank Vehicles for Flammable and Combustible Liquids
NFPA 407	Standard for Aircraft Fuel Servicing
SOCIETY AUTOMOTIVE ENGINEERS (SAE)	
DOC NO.	**DESCRIPTION**
SAE ARP 5818	Recommended Practice - Design and Operation of Aircraft Refueling Tanker Vehicles
U.S. DEPARTMENT OF THE INTERIOR	
DOC NO.	**DESCRIPTION**
None	Aviation Fuel Handling Handbook

APPENDIX I: EARLY FAA RESEARCH ACTIVITIES RELATED TO UNLEADED FUELS

REPORT ID NUMBER	TITLE	PUBLICATION YEAR
DOT/FAA/CT-93/65	*Unleaded AVGAS Program Interim Report*	*1994*
DOT/FAA/AR-99/70	*Evaluation of Reciprocating Aircraft Engines with Unleaded Fuels*	*1999*
DOT/FAA/AR-04/25	*Full-Scale Engine Knock Tests of 30 Unleaded, High-Octane Blends*	*2004*
DOT/FAA/AR-06/27	*Spark Ignition Aircraft Engine Tests of Ethyl Tertiary Butyl Ether*	*2006*
DOT/FAA/AR-TN07/5	*High-Octane and Mid-Octane Detonation Performance of Leaded and Unleaded Fuels in Naturally Aspirated, Piston, Spark Ignition Aircraft Engines*	*2007*
DOT/FAA/AR-08/40	*Full-Scale Engine Detonation Tests of 47 Unleaded, High-Octane Blends*	*2008*
DOT/FAA/AR-08/53	*Full-Scale Engine Detonation and Power Performance Evaluation of Swift Enterprises 702 Fuel*	*2009*
DOT/FAA/AR-10/13	*Full-Scale Engine Endurance Test of Swift Enterprises UL102 Fuel*	*2010*
DOT/FAA/AR-TN11/22	*Aviation Fuels Research Reciprocating Engine Aircraft Fleet Fuel Distribution Report*	*2011*
DOT/FAA/TC-12/31	*Lead Deposit Effects on Unleaded Aviation Fuel Antiknock Performance*	*2012*
DOT/FAA/TC-14/10	*Anti-Knock Performance of Reduced Lead Aviation Gasoline in a Full-Scale Engine*	*2014*
DOT/FAA/TC-14/11	*General Aviation Engine Fleet Assessment for Octane Requirement*	*2014*
DOT/FAA/TC-14/51	*Anti-Knock and Power Performance Evaluation of Swift Fuels 100SF Fuel Blended with Commercial 100 Low-Lead Aviation Gasoline in a Full-Scale Engine*	*2015*
DOT/FAA/TC-14/21	*Anti-Knock Performance of Unleaded 94 Aviation Gasoline in High-Octane Demand Full-Scale Engines*	*2015*

APPENDIX J: OUTREACH AND COORDINATION WITH GOVERNMENT ENTITIES (LOCAL, STATE, TRIBAL, INTERNATIONAL)

Throughout the transition to unleaded AvGas, the FAA aims to provide consistent and comprehensive information about the unleaded AvGas transition to all interested or impacted local, state, Tribal, and international government entities. This communication is in the interest of safety and transparency, and FAA anticipates it will strengthen government-to-government relationships.

FAA has held informational briefs and provided informational handouts on unleaded AvGas at various aviation events. Some examples include the following:

- 2023
  - Tribal Aviation Symposium
  - National Tribal and Indigenous Climate Conference (NTICC)
  - AirVenture at Oshkosh, WI
  - Periodic EAGLE Stakeholder meetings
- 2024
  - Tribal Aviation Symposium
  - National Transportation in Indian Country Conference
  - Tribal Consultation Committee Meeting
  - AirVenture at Oshkosh, WI
  - Periodic EAGLE Stakeholder meetings
- 2025
  - Alaska Airmen Association's Annual Conference
  - Federal Aviation Administration Safety Team (FAASTeam) educational outreach
  - AirVenture at Oshkosh, WI
  - Periodic EAGLE Stakeholder meetings
  - National Transportation in Indian Country Conference (NTICC)

As evident throughout this transition plan, continued education, guidance, and communications will be essential throughout all phases of the transition to ensure the safe and orderly replacement of leaded AvGas.

Federal Aviation
Administration