Eliminate Aviation Gasoline Lead Emissions Initiative (EAGLE) Stakeholder Update

Wednesday, March 22, 2023

10:00 a.m. – 12:00 p.m.

Disclaimer

It is appropriate with competitors in the room to provide a set of antitrust guidelines. It is in everyone's interest to comply with the antitrust laws. Participants in today's meeting should observe the following guidance:

- No discussion or forecasting of prices for goods or services provided by or received by a company.
- No sharing or discussing any company's confidential or proprietary information.
- No discussion of any company's specific purchasing plans, merger/divestment plans, production information, inventories, or costs.
- No sharing or discussion of specific company compliance costs, unless publicly available.
- No agreement or discussion regarding the purchase or sale of goods or services (such decisions are independent company decisions).
- No discussion of how individual companies intend to respond to potential market/economic scenarios or government action; discussion is limited to generalities.
- No disparaging remarks regarding specific vendors' products or services.
- If a discussion presents an antitrust issue, raise your concern immediately.

Welcome

Presented by:
Victor Wicklund (for Lirio Liu), Mark Baker, and Robert Olislagers

AGENDA

10:00-10:05 Welcome: Mark Baker, Victor Wicklund (for Lirio Liu), Co-chairs

10:05-10:10 Overview: Robert Olislagers, Sr. Coordinator

10:10-10:20 Pillar A – Supply Chain & Infrastructure Development: Ryan Manor

10:20-10:30 Pillar B – Research, Development & Innovation: Tim Smyth

10:30-11:10 Pillar C – Unleaded Fuels Evaluation & Authorization: Maria DiPasquantonio/Tim Owen

11:10-11:20 Pillar D – Regulation, Policy & Programmatic Activities

11:20-11:30 Senior Coordinator Report: Robert Olislagers

11:30-11:55 Q&A

11:55-12:00 Closing Comments: Mark Baker, Lirio Liu

Adjourn

EAGLE Pillars

Supply Chain Infrastructure and Deployment

Research, Development, and Innovation

Unleaded Fuel Evaluation and Authorization

Regulation, Policy, and Programmatic Activities

EAGLE Objectives

GOAL:

"Eliminate the use of leaded aviation fuels for piston-engine aircraft in the United States by the end of 2030 without adversely impacting the existing GA fleet"

- As soon as possible! – As soon as a viable replacement for 100LL is available

KEY OBJECTIVES:

1) Identify a Viable Unleaded Avgas that Can Replace 100LL

2) R&D on Technical Solutions for Aircraft Safety to Mitigate Impacts of Unleaded Fuel on the Existing GA Fleet

3) Facilitate Options for Near-Term Reduction of Lead Emissions

4) Support Regulatory & Policy Processes to Eliminate Lead Emissions

What Is a Viable Unleaded Replacement for 100LL Avgas?

- Safety
  - Components of a new fuel must be acceptable for use
  - Engines & aircraft must continue to meet FAA airworthiness safety requirements

- Production & Distribution
  - Can be produced in quantities necessary to meet U.S. need
  - Can be distributed to the airports where needed
  - Understanding of fuel components and handling requirements necessary
  - Economically reasonable to support business case for production and use

- Continued Operational Support
  - Engine & aircraft manufacturers can continue to provide customer support for products – technical, parts, repair, warranty, etc.
  - Maintenance & parts community can continue to provide customer support

Supply Chain Infrastructure and Deployment

Presented by: Ryan Manor

EAGLE Pillars – Supply Chain Infrastructure and Deployment

Supply Chain Infrastructure and Deployment

Research, Development, and Innovation

Unleaded Fuel Evaluation and Authorization

Regulation, Policy, and Programmatic Activities

Supply Chain Infrastructure and Deployment

OBJECTIVES

- **Support** policy and regulatory proposals for **maintaining 100LL availability** and airport access to **ensure safety** during the transition across the country for use by general aviation aircraft
- **Evaluate** and support program(s) that **incentivize** fuel producers and distributors, aircraft and engine manufacturers, and GA operators **to accelerate development, qualification, deployment, and use of unleaded fuels**
- **Facilitate** policy proposals at the Federal and State level **to increase production and distribution** – as well as **enable** and encourage **greater use** – of commercially viable replacement unleaded fuel
- **Facilitate** government policy, regulatory proposals and voluntary consensus standards that will support a **commercially viable supply chain** and **quality-focused infrastructure** for the deployment of unleaded fuel, including the promotion of free-market competition
- **Evaluate Environmental, Social, and Governance** (ESG) commitments to help engage additional organizations and investors in this effort

GUIDING PRINCIPLES

Approach
- Systematic | Data Driven | Coordinated

Cornerstones
- Safety
- Fuel Quality: Clean, Dry & On Spec
- Transparency
- Stakeholder Participation
- Diversity of Thought
- Collaboration
- Accountability
- Outreach, Education & Training

Key Considerations
- Mitigations
- Cost/Benefit
  - Public Health Risks
  - Environmental Impact
  - Business Impact
- 2nd and 3rd Order Impacts

Pillar Interdependencies
- Research, Development, and Innovation (Pillar B)
- Unleaded Fuel Evaluation and Authorization (Pillar C)
- Regulation, Policy, and Programmatic Activities (Pillar D)

Near Term Efforts to Reduce Lead Emissions

- Realign approach to sub team work to expedite output
  - Framework for transitioning to UL fuels
  - Education and awareness campaigns to demonstrate benefits of UL fuels
- Focus on airports with greatest lead emissions based on EPA data and airports with greatest community need, balanced with need to maintain 100LL
- Coordinate with EAGLE coalition's government affairs teams to develop regulatory and policy proposals to facilitate removal of barriers to and or incentives for UL fuel:
  - Production
  - Distribution
  - Use

Proposal for High Octane UL Demonstration Program

- Stakeholder Understanding of New Fuels
  - PAFI Process – Aircraft/Engine OEMs and Key Stakeholders involved as part of TAC
  - STC Process – Proprietary between applicant and FAA
- EAGLE Coordination with Aircraft/Engine OEMs
  - Familiarization Assessment of GAMI G100UL Fuel (Cirrus demonstration activities and next steps)
  - Planned Assessment of Swift 100R, April 2023
- Developing a Function & Reliability Demonstration Program for New High-Octane UL Fuels
  - Objective of Jumpstarting Deployment & Commercialization
  - Building Stakeholder Understanding & Confidence in Production, Distribution and Use of the New Fuel
  - Consideration of
    - High Volume Airport/Flight School/Region to create a kickstart for production
    - Aircraft/Engine OEM Assessment for Continued Product Support
  - Requires Funding and Active & Constructive Support of the Fuel Owner

Research, Development, and Innovation

Presented by: Tim Smyth

EAGLE Pillars – Research, Development, and Innovation

Supply Chain Infrastructure and Deployment

Research, Development, and Innovation

Unleaded Fuel Evaluation and Authorization

Regulation, Policy, and Programmatic Activities

Mitigate Impacts on Existing Fleet Based On Properties/Authorization of UL

- Address safety and technical challenges associated with high-performance engine use of unleaded fuels such as:
  - Octane detonation protection
  - Materials compatibility
  - Operational procedures
  - Engine monitoring (Outreach to Lycoming & Continental)
- Where necessary, potentially enable/support programs for existing engines and aircraft to safely operate using UL replacement fuel

Mitigate Impacts on Existing Fleet – Initial R&D Focus

- Aircraft / engine modifications to improve detonation protection (i.e., octane) to allow safe use of UL fuel such as:
  - Manage spark advance (retarded) / staggered ignition timing (closed loop sensing)
  - Electronic ignition (approved systems) / extended spark duration (FADEC systems, Potential "Flex Fuel" option?)
  - Higher pressure fuel injection systems (No action yet)
  - Anti-detonation injection (ADI) systems (water / methanol) (little OEM interest)
  - Manifold air temperature reduction methods (still pursuing)
  - Cylinder head temperature reduction methods (still pursuing)

- Support FAA Detonation Test Methodology Working Group certification guidance to revise/standardize detonation testing means of compliance (AC 33.47-1)

  FAA Tech Center, AIR-600 and Engine OEMs engaged

  Engine Testing Discussion

R&D effort to determine:

1. **Quantify Effective Motor Octane Number (MON) Benefits**
   - ✓ GAMI – G100UL
   - ✓ Swift – 100R
   - ✓ Afton Phillips
   - ✓ Lyondell VP Racing
2. **Assess Fleet Impacts**
3. **Assess Safety Aspects (Ongoing)**

Unleaded Fuel Evaluation and Authorization

Presented by: Maria DiPasquantonio and Tim Owen

EAGLE Pillars – Unleaded Fuel Evaluation and Authorization

Supply Chain Infrastructure and Deployment

Research, Development, and Innovation

Unleaded Fuel Evaluation and Authorization

Regulation, Policy, and Programmatic Activities

Unleaded Fuel Evaluation and Authorization Pillar Objectives

- **Complete test and evaluation** of candidate replacement fuels for 100 Low Lead (100LL) aviation fuel
- **Identify at least one unleaded fuel** acceptable for widespread use
- **Institutionalize fleet authorization process** for unleaded fuels
- **Include education, training, awareness, and outreach** responsibilities

Cornerstones
- Transparency / Accountability
- Stakeholder Participation / Collaboration
- Technical Excellence / Objectivity

Key Considerations
- Fuel Quality
- Safety
- Fleet Impact
- Mitigations
- Research and Development

Deliverables
- Fleet Authorization Process
- Authorizations for Fuels / Eligible Models
- Test & Evaluation Process / Test Plans
- Lessons Learned / FAQs
- Data and Reports → R&D Efforts (Pillar B)

Pillar Interdependencies
- Business (Fuel) Infrastructure and Implementation (Pillar A)
- Research, Development, and Innovation (Pillar B)
- Regulation, Policy, and Programmatic Activities (Pillar D)

EAGLE Unleaded Aviation Gasoline Roadmap Framework

Current State

Future State

Unleaded Fuel Evaluation and Authorization

No currently qualified unleaded drop in replacement for 100LL avgas

Piston Aviation Fuels Initiative (PAFI) ***UAT ARC***

Qualified drop in unleaded fuels available

Fleet Authorization process in coordination

Other than traditional process ***Section 565(a)***

Fleet Authorization process institutionalized (UL91/94...UL100)

Existing ATC and STC fuel projects for specific engines and aircraft

Traditional approval process ***Section 565(c)***

Enhanced guidance for ATC and STC fuel projects for specific engines and aircraft

Supply Chain Infrastructure and Deployment

Regulation, Policy, and Programmatic Activities

Unleaded fuels not widely available at airports

Improve fuel infrastructure ***NASEM 5.2, 5.3***

Multiple unleaded fuels available

Research, Development, and Innovation

All engines and aircraft cannot satisfactorily operate with fuels less than 100 octane

Engine/aircraft modifications ***NASEM 6.2***

Engine replacement – technology ***NASEM 6.3***

All aircraft and engines operating with unleaded fuel

UL100 Candidates (toward replacement of 100LL)

Afton CHEMICAL

PHILLIPS 66

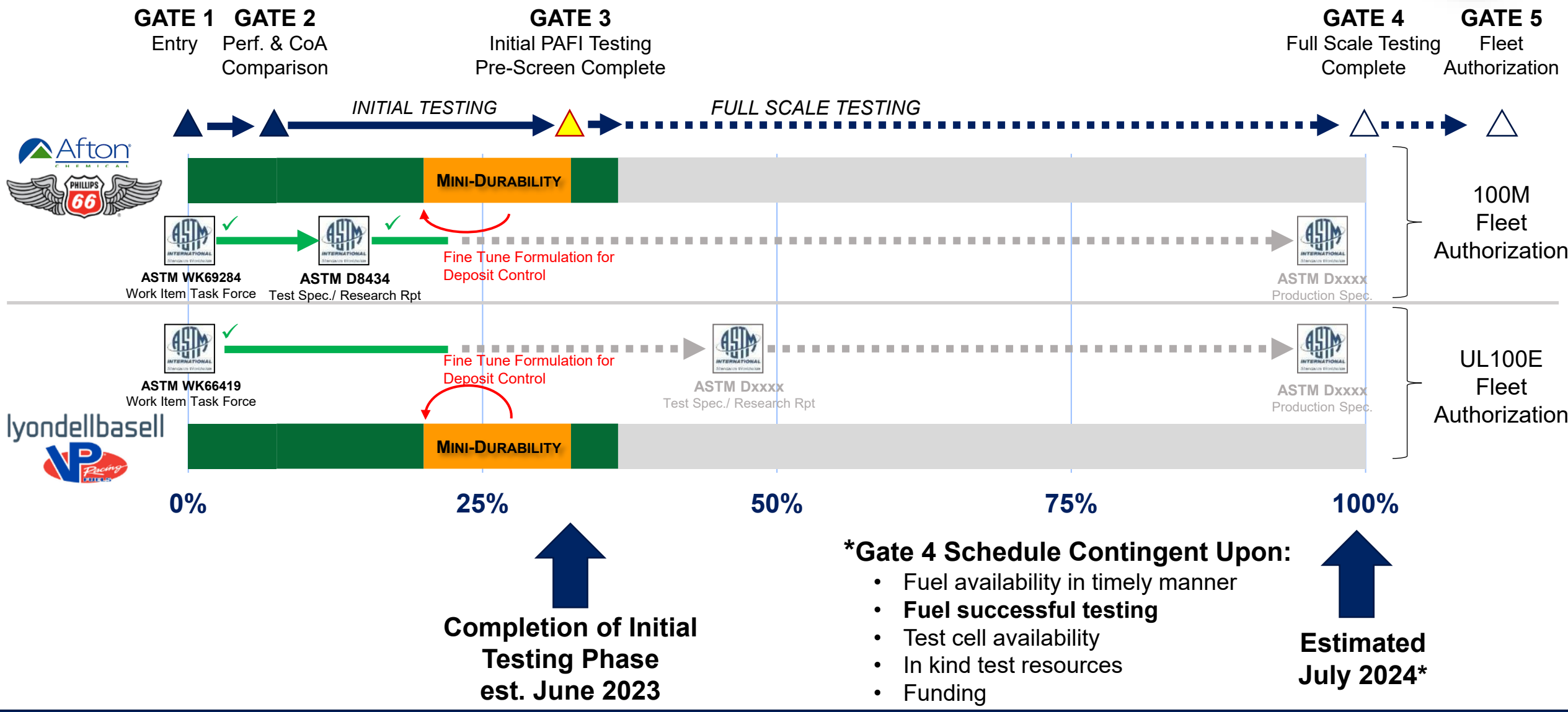
lyondellbasell

VP Racing FUELS

General Aviation Modifications, Inc. – GAMI
Engineering the Future of General Aviation

Swift FUELS

Status of Candidate UL Fuels - PAFI



Completion of Initial Testing Phase est. June 2023

***Gate 4 Schedule Contingent Upon:**

- Fuel availability in timely manner
- **Fuel successful testing**
- Test cell availability
- In kind test resources
- Funding

Estimated July 2024*

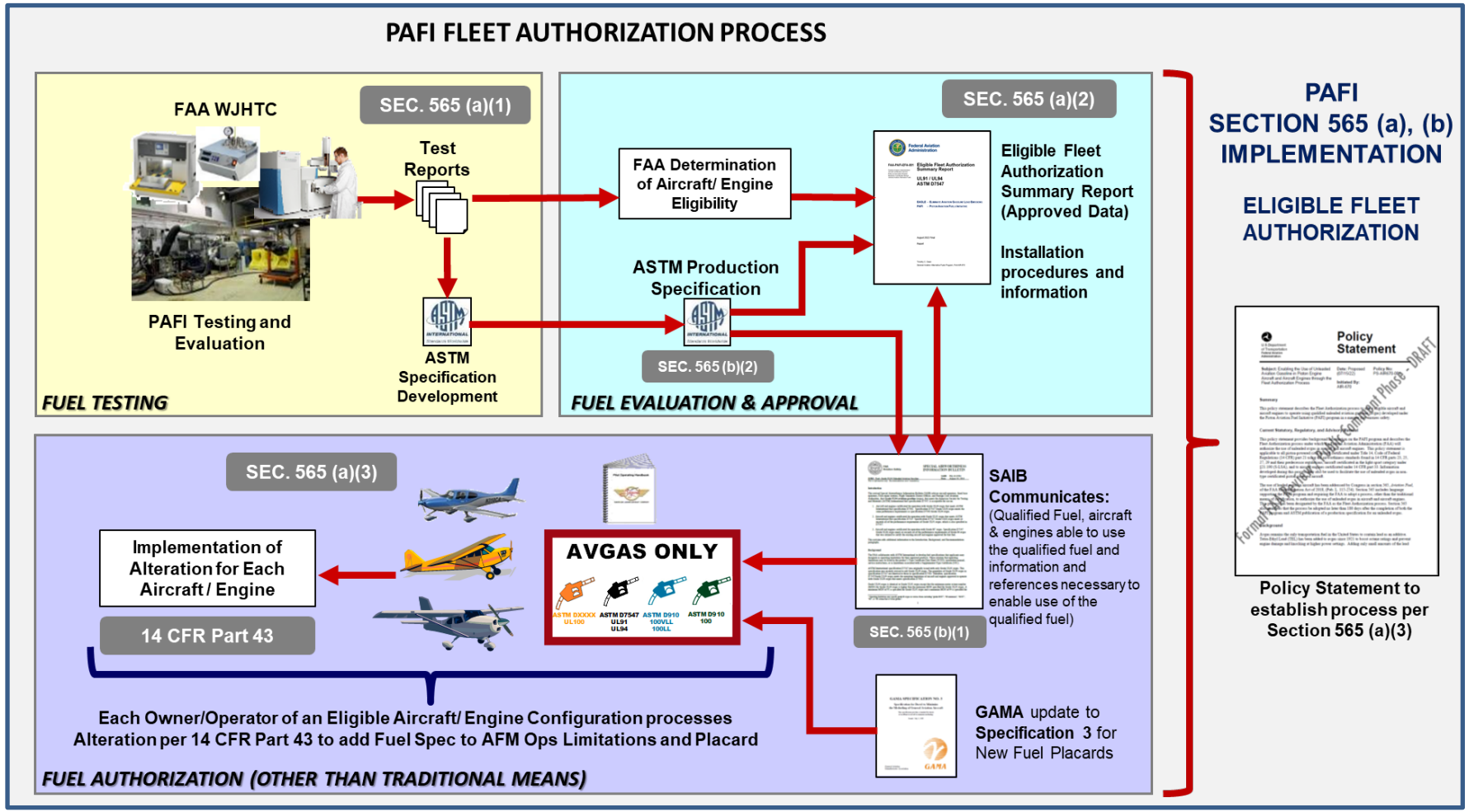
EAGLE UL Fuel Evaluation and Authorization Pillar C Objectives FY 2023

- Finalize Fleet Authorization Policy Statement and Publish
- Execute UL 91 (ASTM D7547) Fleet Authorization Process, including Eligible Fleet Authorization Summary Report and SAIB
- Finalize FY 2023 Program Execution Plan
- Complete PAFI Initial Testing Phase
- Enter Full Scale PAFI Testing of one or more fuels, after success in Initial Phase
- Finalize Revised PAFI Process Description Document / Criteria
- Support Pillar A, B, and D Objectives
  - Research and Development Activities in coordination with Pillar B
  - Regulations, Policy and Programmatic Activity Pillar on rulemaking implementation for Statute 44714

Unleaded Fuel Evaluation and Authorization Pillar Accomplishments

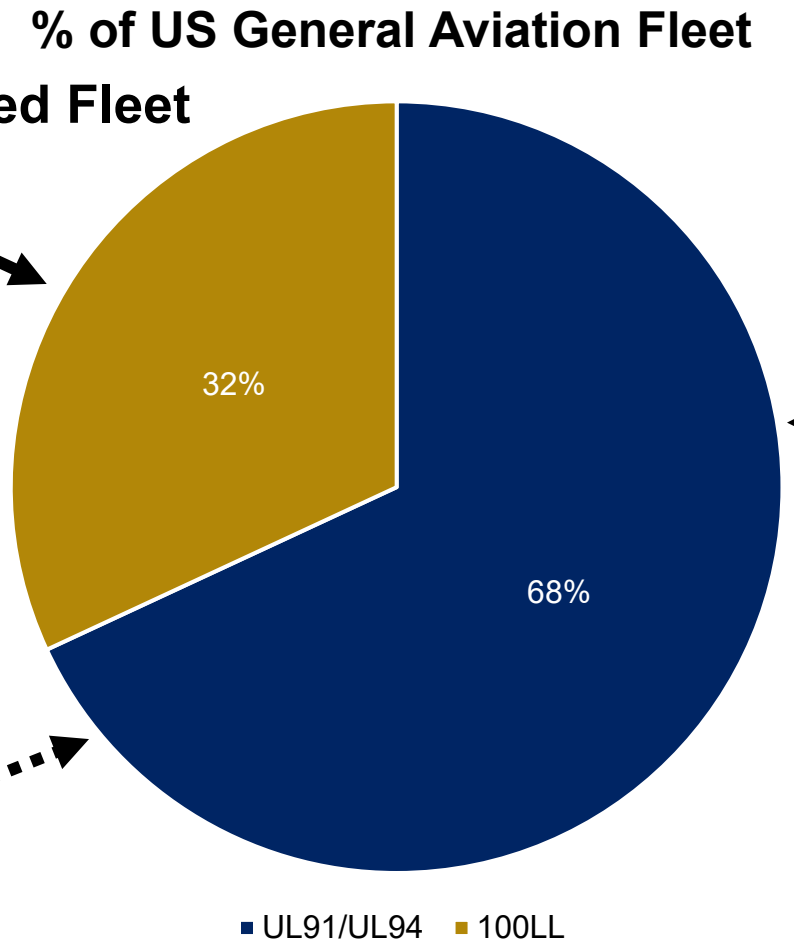
PAFI Fleet Authorization Process

- **PS-AIR-600-20-01** Policy Statement
  - NOTICE published in Federal Register for public comment 10/5/2022
  - 60-day public comment period ended 12/5/2022
  - Comments dispositioned
  - **Signed by AIR 600 on 3/21/23**
  - To be formally issued in FAA Dynamic Regulatory System (DRS) (est. 3/31/2023)
- UL91 Fleet Authorization to follow (est. 5/15/2023)



Initial PAFI Fleet Authorization of UL91 to Enable UL Operation by 68% of Fleet

PAFI Target → 100LL-Required Fleet
High Octane Unleaded
32% of Fleet
2023 thru 2025



Fleet Authorization 1
ASTM D7547 (UL91, UL94)
68% of Fleet by end of FY23

ASTM D7547 **is** 100LL without the lead

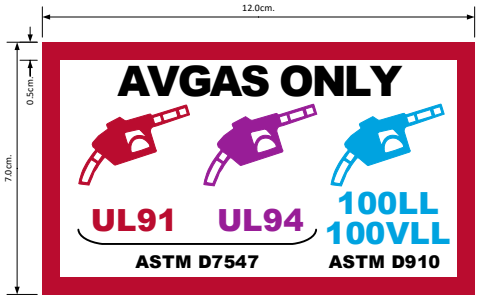
Note: Additional aircraft may be authorized for **UL91/UL94** pending planned testing.

Additional Unleaded Fuel Pillar Efforts Underway

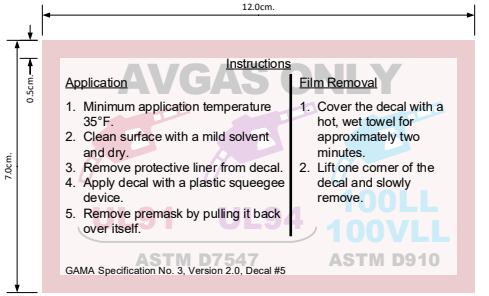
- **Add dye colors to D7547 UL91 and UL94 fuels (currently "colorless")**
  - Reasons
    - Help to prevent mis-fueling of aircraft
    - Aid to assess proper fuel loaded during fuel sump ramp check
    - Provide clarity for new fuel placards per AC 20-116 and AC 20-122A
  - Engagement with ASTM D02 Petroleum Products, Liquid Fuels, and Lubricants Committee
    - ASTM Dyes and Markings Task Force Meetings / ASTM D02 Meeting in Orlando, Dec. 6, 2022
    - Research Report generated (Swift Fuels was instrumental in this effort)
    - Ballot to revise D7547 to add Red Dye to UL91 and Purple Dye to UL94 in progress
- **Update Fuel Placard Design for D7547 UL91 and UL94 fuels**
  - Part of Fleet Authorization Process
  - Worked with GAMA to update GAMA Specification No. 3
  - Release of GAMA Specification No. 3, Version 2.0 is imminent
  - Alignment with AC 20-116 and AC 20-122A
- **Detonation Test Methodology Working Group**
  - FAA and Engine OEMs engaged
  - Goal to standardize detonation test methods across industry
  - Evaluating methods for update to AC 33.47-1, ASTM D6424, and ASTM D6812
  - Engine testing to support these goals

		Grade UL91	Grade UL94	ASTM Test Method[B]
Property				
COMBUSTION				
Net heat of combustion, MJ/kg[B,C]	min	43.5	43.5	D4529 or D3338
Octane Rating[C,D]				
Knock value, Motor Octane Number[E]	min	91.0	94.0	D2700
COMPOSITION				
Sulfur, mass percent	max	0.05	0.05	D2622, D4294, D5453, or D7220[F] D3237 or D5059
Tetraethyl lead, g Pb/L	max	0.0130	0.0130	
COLOR[G]		Red	Purple	D2392
Dye content[H], mg/L				
Red dye	max	2.3	0.9	
Blue dye	max	0.2[I]	1.2	
…				

[A] For compliance of test results against the requirements of Table 1, see 6.2.
[B] The test methods indicated in this table are referred to in Section 10.
[C] ~~If mutually agreed upon between the purchaser and supplier, a minimum 98 octane requirement as per Test Method D909 may be specified.~~
[D,C] For all grades use either Eq 1 or Table 1 in Test Method D4529 or Eq 2 in Test Method D3338. Test Method D4809 may be used as an alternative. In case of dispute, test method D4809 shall be used.
[D] If mutually agreed upon between the purchaser and supplier, a minimum 98 octane requirement as per Test Method D909 may be specified.
[E] Knock ratings shall be reported to the nearest 0.1 octane/performance number.
[F] Test Method D2622 shall be the referee sulfur detection method.
[G] A two-year transition to this new standard has been agreed to assist producers of aviation gasoline, ending December 31, 2024. During this period batches of grade UL91 or UL94 are permitted to be colorless or have significantly reduced color while fully meeting the requirements of D7547. Supporting data on the use of dyes in these fuel grades has been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D02-xxxx. Contact ASTM Customer Service at service@astm.org.



Decal #5



EAGLE Pillars – Regulation, Policy, and Programmatic Activities

Supply Chain Infrastructure and Deployment

Research, Development, and Innovation

Unleaded Fuel Evaluation and Authorization

Regulation, Policy, and Programmatic Activities

Pillar D Objectives and Overview

Work is focused on government efforts:

- **Regulatory processes** for EPA and FAA
- Policies that affect funding for airport fueling infrastructure
- Programmatic activities that **reduce or eliminate reliance** upon leaded aviation fuels
  - Lead emissions from piston-engine aircraft
  - Leaded aviation gasoline
- Includes **education, training, awareness, and outreach** responsibilities

- Key Interdependencies with Other Pillars (not exhaustive)
  - To Pillar A:
    - Potential to offer programs that are complementary solutions sets to unleaded fuel (e.g., engine retrofits)
    - Potential to offer programs that are additional solution sets to unleaded fuel (e.g., engine swaps)
  - From Pillar B:
    - Potential to provide proven lead-free technologies for integration into policies
  - From Pillar C:
    - Potential to provide candidate unleaded fuels for integration into policies

Cornerstones

- Safety
- Transparency
- Stakeholder Participation
- Collaboration
- Accountability

Key Considerations

- Mitigation options
- Enabling other pillars / removing obstacles

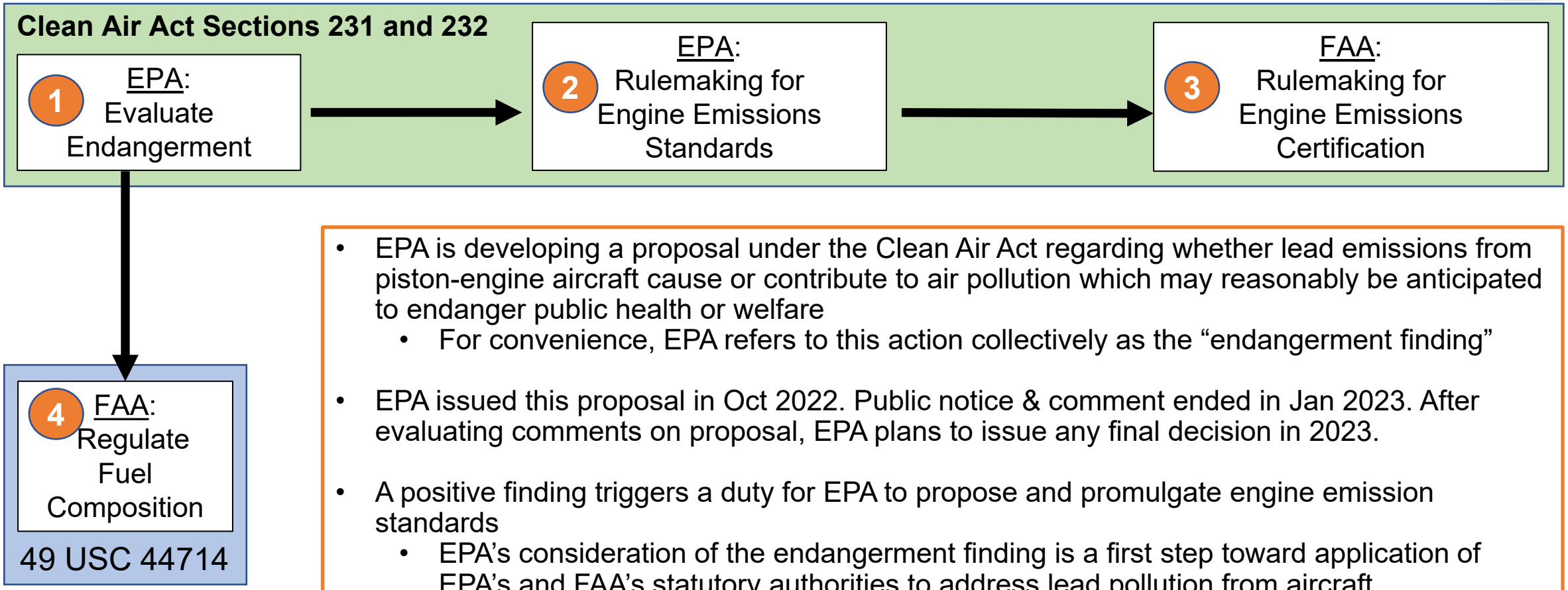
Deliverables

- Updates on the regulatory processes (deliberative)
- Guidance documents

Pillar Interdependencies

- Business (Fuel) Infrastructure and Implementation (Pillar A)
- Research, Development, and Innovation (Pillar B)
- Unleaded Fuel Evaluation and Authorization (Pillar C)

EPA & FAA Authorities Regarding Aircraft Lead (Pb) Emissions



- EPA is developing a proposal under the Clean Air Act regarding whether lead emissions from piston-engine aircraft cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare
  - For convenience, EPA refers to this action collectively as the "endangerment finding"
- EPA issued this proposal in Oct 2022. Public notice & comment ended in Jan 2023. After evaluating comments on proposal, EPA plans to issue any final decision in 2023.
- A positive finding triggers a duty for EPA to propose and promulgate engine emission standards
  - EPA's consideration of the endangerment finding is a first step toward application of EPA's and FAA's statutory authorities to address lead pollution from aircraft.

Any subsequent regulatory action would involve EPA and FAA working together and carefully considering technology, safety, noise, and economic impacts, including effects on small businesses (2 & 4).

Airport Areas of Focus

Immediate actions (in alignment with NAS recommendations)

- Airport owners/operators, service providers, and users can implement mitigation measures
  - Work to offer additional fuel types to facilitate transition
    - ✓ Include transition to unleaded fuels in airport planning initiatives and identify in Airport Capital Improvement Plans
  - Increase distance between pre-flight/maintenance run-up locations and people on/off airport
  - Consider wind direction in run-up area choice
  - Minimize engine idle time and run-up time
  - Post “exhaust fume” warning signs
  - Promote airport and pilot awareness

Airport Areas of Focus, Continued

Supporting transition-enabling infrastructure

- The FAA is authorized to provide limited grant funding for aircraft fueling systems (fuel farms) through AIP.
  - Help certain Non-Primary (General Aviation) airports become self-sufficient through fuel sales
  - Increase efficiency at certain commercial service airports and reduce fuel truck emissions.
- Bipartisan Infrastructure Law (BIL) Airport Infrastructure Grant (AIG) allocated funds can be used on sponsor-owned revenue producing aeronautical support facilities such as fuel farms.
  - For additional information see BIL FAQs: https://www.faa.gov/general/bipartisan-infrastructure-law-faqs

Include transition to unleaded fuels in airport planning initiatives and identify in Airport Capital Improvement Plans

EAGLE Senior Coordinator Report

Presented by: Robert Olislagers

Senior Coordinator Report

Website Development

- Soft rollout in March following the ESG review
- Resources & Links to Coalition Websites
- Listing ExComm Leadership

Public Outreach

- EAGLE recognizes the need to eliminate lead emissions sooner rather than later

Next ExCom/Stakeholder Meetings

- July 2023 (TBD)

EAGLE Stakeholder Discussion