



Future Avgas Strategy & Transition Plan (FAST)

Presented By:
The Industry Avgas Coalition



Members of Industry Avgas Coalition

GA Aircraft Operators

- › AOPA – Aircraft Owners and Pilots Association
- › EAA – Experimental Aircraft Association
- › NBAA – National Business Aviation Association

GA Aircraft Manufacturers

- › GAMA – General Aviation Manufacturers Association

Avgas Point of Sale - Fixed Based Operators

- › NATA – National Air Transportation Association

Avgas Producers

- › API – American Petroleum Institute
- › NPRA – National Petrochemical & Refiners Association



Presenters / Representatives

- > Robert Hackman, Vice President Regulatory Affairs, AOPA
- > Doug Macnair, Vice President Government Relations, EAA
- > Walter Desrosier, Vice President Engineering & Maintenance, GAMA
- > Prentiss Searles, Marketing Issues Manager, API
- > Dan Hubbard, SVP, Communications, NBAA
- > Mike France, Director Regulatory Affairs, NATA

Problem

- > Significant uncertainty about the continued availability and use of leaded avgas (100LL)
 - Economic and environmental factors
 - GA will eventually have to transition to an unleaded avgas
 - There is no “drop-in” replacement for 100LL that meets the needs of the entire fleet of piston-engine aircraft

Path to a Solution

- > Future Avgas Strategy and Transition (FAST) Plan that:
 - Ensures continued availability of 100LL until a replacement solution is implemented
 - Minimizes potential impacts of EPA actions upon GA
 - Government-industry program for an unleaded avgas
 - FAA leadership role to ensure safety and establishment of appropriate airworthiness and lead emissions standards
 - Provides for the long-term viability and safety of GA
 - Identify the most viable unleaded solution possible to replace 100LL
 - Establish transition timeline which addresses aviation safety, technical feasibility and impact upon the GA and avgas industry

Topics for Discussion

Background

- › Clean Air Act
- › Research toward high-octane unleaded avgas

Factors Affecting Continued Availability of 100LL Avgas

- › Economic – no assurance of continued supply of 100LL
- › Environmental - EPA regulatory actions on lead (NAAQS and ANPR)
 - Why not fight EPA actions?

Examples of Potential Unleaded Avgas Options

Challenges

- › Safety
- › Transition

Future Avgas Strategy and Transition Plan (FAST)

- › Near-term: reduction of lead emissions
- › Long-term: identification and transition to unleaded avgas
 - Criteria for development of viable avgas

Next Steps

Background: Clean Air Act

1970's - 1980's

- Clean Air Act names lead as a criteria pollutant to be regulated
 - Gives authority to EPA to regulate emissions sources (including aviation)
- EPA regulations on automotive lead emissions
 - New production cut-in
 - Dual-fuel transition strategy over several years
- Aviation reduces lead content of avgas
 - 100/130 reduced from 4.24 grams of lead per gallon to 2.2 grams (100LL)
 - Durability and compatibility issues, but safety maintained

1990's

- Development of unleaded alternatives to 100LL
 - American Society for Testing and Materials (ASTM)
 - Coordinating Research Council (CRC)

Background: Research Toward High-Octane Unleaded Avgas

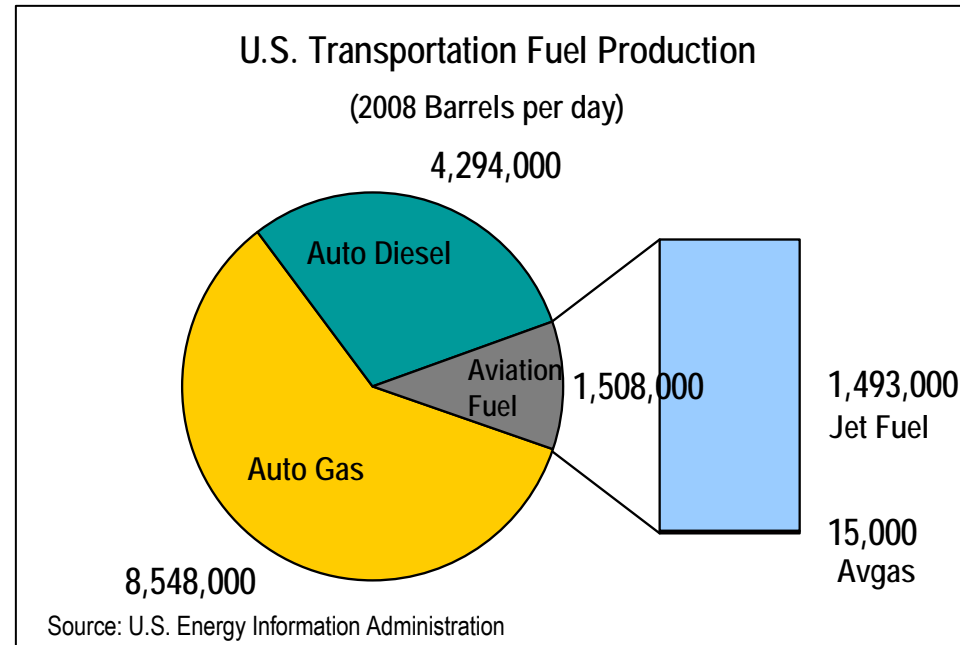
- > Significant research and development activity toward a “drop-in” high-octane unleaded fuel to replace 100LL
 - Drop-in: does not require any modification or FAA approval for each aircraft
- > Coordinating Research Council (CRC) unleaded avgas group
 - Collaborative research and testing among fuel producers, GA manufacturers, FAA, AOPA and EAA
 - Major milestones
 - Defined octane correlation between leaded and unleaded fuels
 - Laboratory tests on more than 200 unleaded fuel blends
 - Full-scale engine tests on 45 high-octane unleaded blends
 - Final engine test report issued by FAA Tech Center (Sept. 2008)
 - CRC Compilation report of all avgas research (June 2010)
- > Findings
 - There is no clear “drop-in” unleaded replacement for 100LL

Factors Affecting Continued Availability of 100LL Avgas

Economic

- There is no assurance of continued supply of leaded avgas
 - Currently a single supplier of tetra-ethyl-lead (TEL) additive
 - Global demand for leaded automotive gasoline is in decline

- Avgas is specialty or niche fuel: very low volume
 - Accounts for 0.1% of all transportation fuel
 - Significant burden on refineries to produce avgas
 - ◆ Small batches run for very short periods of time
 - ◆ Dedicated infrastructure to prevent lead contamination and maintain aviation quality controls
 - ◆ Large storage inventory



Factors Affecting Continued Availability of 100LL Avgas

Environmental

- ▶ Significant reductions by all other sources of lead
 - Aviation is now largest source of lead emissions (45%+)
- ▶ 2006 petition by *Friends of the Earth* to regulate GA lead emissions under the Clean Air Act
- ▶ EPA regulatory actions on lead
 - Update to National Ambient Air Quality Standards (NAAQS) for lead
 - ANPR on piston-engine aircraft lead emissions
 - ◆ Public statements that EPA is moving toward the removal of lead from avgas

Source Sectors of Lead Emissions in the U.S.

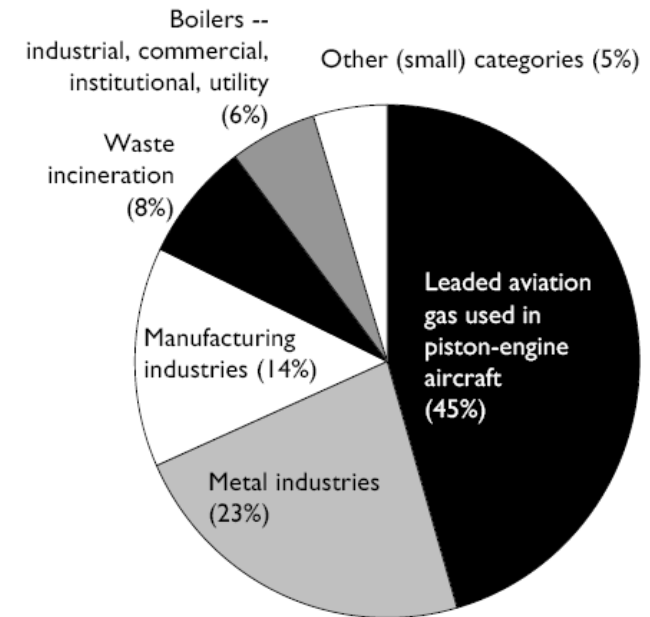


Chart based on EPA's 2002 National Emission Inventory (NEI) with modifications documented in Tom Pace's 05/01/08 memorandum and Marion Hoyer's 05/12/08 and 05/14/08 memoranda to the docket.

EPA Regulatory Actions on Lead

National Ambient Air Quality Standards (NAAQS) for Lead

- > Final rule issued October 2008
 - In response to court order mandating update
 - 10x increase in stringency (from 1,500 ng/m³ to 150 ng/m³)
 - Monitoring required near:
 - Major sources – over 1 ton per year
 - ◆ Additional NPRM issued December 2009 proposed .5 ton per year in order to include more GA airports
 - Populated areas – over 500,000 people
 - Compliance schedule
 - 2010 State monitoring/measurement equipment in place
 - 2012 Designation of attainment/non-attainment areas
 - 2013 State plans to reduce lead emissions approved by EPA
 - 2017 State must comply with NAAQS for lead standard

EPA Regulatory Actions on Lead

National Ambient Air Quality Standards (NAAQS) for Lead (cont.)

- > Each state will look to reduce all sources of lead in non-attainment areas
 - Increased stringency on stationary source standards
 - Lead smelting, battery recycling, metal processing, etc.
 - Actions to address the largest source of lead, which is GA
 - Request EPA/FAA standard for lead emissions from aircraft
 - ◆ If not, states may consider other approaches

- > Raises significant concerns for GA
 - Affect availability of avgas at airports
 - Restrictions on piston airplane operations or access
 - Sway public/political support to maintain GA airports

EPA Regulatory Actions on Lead

Advanced Notice of Proposed Rulemaking (ANPR)

- > EPA issued ANPR on lead emissions from GA aircraft on April 28, 2010
 - In response to *Friends of the Earth* petition
 - Completely independent and separate from NAAQS for lead

- > Beginning of “endangerment finding” process
 - NPRM expected in approximately 6-18 months
 - Final finding expected in approximately 12-24 months
 - Determine whether lead emissions from aircraft “cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare”

- > Clean Air Act requirements for aviation emissions
 - Required steps in rulemaking will take several years to complete
 - EPA endangerment finding
 - EPA regulation setting emission standard (must consult FAA for safety & noise)
 - FAA regulation implementing emission standard

EPA Regulatory Actions on Lead

Advanced Notice of Proposed Rulemaking (ANPR) (cont.)

- > ANPR recognizes significant technical and logistical challenges
 - No replacement available for high-octane fuel
 - Size of existing fleet and potential safety implications
 - Specialty fuel production and distribution requirements
- > ANPR requests comments
 - Piston-engine aircraft operations and lead emissions
 - Approaches to transitioning to an unleaded avgas
- > Comment period extended 60-days to August 27, 2010
- > EPA “endangerment finding” on lead from GA raises concerns about other possible impacts
 - Restrictions on piston airplane operations or airport access
 - Sway public/political support to maintain GA airports

EPA Regulatory Actions on Lead

Advanced Notice of Proposed Rulemaking (ANPR) (cont.)

- > Strong basis exists for EPA regulation of lead emissions from GA aircraft
 - Clean Air Act provides legislative mandate
 - NAAQS provides technical science regarding lead impact on human health
 - No drop-in replacement of 100LL identified after 20 years of research since lead banned from automotive fuel
 - *Friends of the Earth* petitioned EPA to remove lead from avgas

Future Avgas Strategy and Transition Plan (FAST)

Why not fight EPA actions?

- > Lead is harmful to human health
 - Science on effects of lead are well established
 - Mandate for regulatory action under Clean Air Act
 - Impact on public/political perception and support for GA
 - Risk of restrictions on GA operations and support for GA airports

- > There is no assurance of continued supply of leaded avgas
 - Currently a single supplier of tetra-ethyl-lead (TEL) additive
 - Global demand for leaded automotive gasoline is in decline

- > Industry must ensure long-term viability and safety of GA
 - Minimize impact of transition to unleaded avgas
 - Ensure long-term availability of avgas at affordable price
 - Engine developments bring new technologies
 - Ease of operation, improved reliability, reduced costs, etc.

Examples of Potential Unleaded Avgas Options

FUEL	AIRCRAFT perspective	AVAILABILITY perspective
<p>UL-91/94 (100LL “no-lead” ASTM specification)</p>	<ul style="list-style-type: none"> ▪ Significant impact for about 30% of fleet of high-performance aircraft that consume about 70% of avgas <ul style="list-style-type: none"> ▪ Modifications would allow most to operate, but would affect performance ▪ Some aircraft could not be economically modified ▪ Drop-in for about 70% of fleet 	<ul style="list-style-type: none"> ▪ Limited changes for producers, distributors, FBOs ▪ ASTM specification in place ▪ Similar economics as 100LL
<p>High-Octane Unleaded Blends</p>	<ul style="list-style-type: none"> ▪ High-octane (95-98) detonation performance possibility based on CRC R&D and engine testing by FAA Tech Center <ul style="list-style-type: none"> ▪ Some octane additives such as ethers not environmentally acceptable ▪ Not drop-in, characteristics different from 100LL (D-910) requires FAA certification 	<ul style="list-style-type: none"> ▪ Limited R&D activity toward development of this type of fuel
<p>Swift 702 (private research cooperative located at Purdue University)</p> <p>GAMI G100UL (engine mod company located in Ada, OK)</p>	<ul style="list-style-type: none"> ▪ High-octane (100+) detonation performance based on R&D and company tests ▪ Not drop-in, characteristics different from 100LL (D-910) requires FAA certification <ul style="list-style-type: none"> ▪ Limited technical information known as they are in development 	<ul style="list-style-type: none"> ▪ In research and development phase <ul style="list-style-type: none"> ▪ Unknown production capacity ▪ Unknown distribution needs ▪ Unknown cost/economics ▪ Proprietary and patented

Note: Automotive gasoline not considered a potentially viable option because aviation does not control performance and content long-term

Challenges - Safety

- > Each piston engine and aircraft designed and certified to a known fuel
 - High performance engines/aircraft require 100 octane fuel for detonation (“knock”) protection
 - 100LL ASTM D-910 standard includes many performance requirements necessary for safety
 - Octane, vapor pressure, distillation curve (cold/hot/altitude start), freeze point, water separation, stability, etc.

- > FAA safety standards, certification requirements and policy based on known fuel
 - Requires continued support for unleaded avgas development activities (CRC, ASTM)
 - Unprecedented to approve/certify a new fuel to be used by a large number of existing aircraft
 - Certification of aircraft limitations, modifications and performance changes

Challenges - Transition

- > Identification of future unleaded avgas specification
 - Development of criteria and performance requirements
 - Independent assessment of all potential candidates

- > Dual-fuel approach not viable
 - Automobile transition to unleaded was implemented by phase-in of unleaded fuel
 - Significant impact on avgas production and distribution
 - Avgas is a “niche” fuel – very low volume
 - ◆ ~230M gallons avgas versus more than 131B gallons automotive fuel (2008)
 - Investment in additional infrastructure for dual fuel unlikely
 - ◆ Tanks at refinery, terminal, and airport delivery systems

Future Avgas Strategy and Transition Plan (FAST)

Resolution

General aviation industry stakeholders shall work proactively to recommend that EPA and FAA promulgate regulations to reduce lead emissions from GA aircraft along a transition timeline which balances environmental benefit with aviation safety, technical feasibility and impact upon the GA industry.

- ▶ Establish a process to develop the most viable unleaded solution to replace 100LL
- ▶ Incentivize development of high-octane unleaded avgas
- ▶ Recommend defined dates for transition to unleaded fuel
- ▶ Minimize impact of EPA NAAQS for lead and endangerment finding under the Clean Air Act

Future Avgas Strategy and Transition Plan (FAST)

Near-Term: Reductions of lead emissions

Objective: provide near-term reduction of lead emissions from GA to support NAAQS compliance

Now: Assessment of lower-lead content in 100LL fuel

- CRC research report due September 2010
 - Determine how much reduction in maximum TEL content is possible
 - Completely drop-in. No actions needed by operators

1-2 Years: ASTM change to current 100LL fuel specification (D-910) to incorporate lower-lead level

2013-2015: Introduction of lower-lead content 100LL Fuel

- EPA/FAA regulation to mandate introduction of lower-lead fuel

Future Avgas Strategy and Transition Plan (FAST)

Long-Term: Identification and transition to unleaded avgas

Phase 1 Establish public-private partnership/structure to develop the most viable unleaded solution to replace 100LL avgas and appropriate airworthiness and emissions regulatory standards

- › FAA leadership and integrated avgas program
- › Identify criteria for development of viable unleaded avgas specification
- › Support research and development of high octane unleaded avgas

Phase 2 Develop unleaded avgas specification (ASTM)

Phase 3 New production aircraft certified for unleaded fuel capability

Phase 4 EPA/FAA mandate transition to unleaded avgas

- › Transition timeline dependent upon level of impact
 - Aircraft and FAA approvals/certification necessary for safety
 - Avgas production and distribution infrastructure

Criteria for Development of Viable Avgas Specification

- > Fuel safety and performance
 - Octane, vapor pressure, distillation (hot/cold start), water separation, storage stability, freeze point, energy content, weight, etc.
- > Aircraft safety and performance
 - Rated power (i.e. climb, single engine, high altitude, hot temperature, payload), range, etc.
 - Materials compatibility (tanks, bladders, seals, etc)
- > Environment and health
 - Emissions must be environmentally acceptable (CO₂, NO_x, VOCs, carcinogens)
 - Human health (toxicity, handling, water solubility)
- > Fuel production and distribution
 - Impact on existing infrastructure
 - Need for new infrastructure
 - Can it be made available when and where needed
- > Cost Impact
 - Upfront - aircraft and infrastructure
 - Operating – fuel and maintenance

Next Steps

- > Comments to ANPR due August 27, 2010
 - Submitted Request for extension to develop additional data
 - CRC report on reduced lead assessment and recommendation for implementation
 - Comprehensive Fleet Impact Assessment of Existing ASTM Unleaded Avgas Specification (UL 91/94)
 - ◆ Provides baseline data on economic impact of aircraft operation (# of aircraft, type of operations and economic activity, cost of modifications, performance reduction, etc) with fuels other than 100LL
 - ◆ Baseline data then provides insight on economic impact from various other proposed fuels
- > Establishment of public-private partnership/structure led by FAA
 - FAA leadership and integrated avgas program
 - Process to develop the most viable unleaded solution to replace 100LL avgas
 - Support research and development of high octane unleaded avgas
 - Development of appropriate airworthiness and emissions regulatory standards



Questions / Discussion