100SF SwiftFuel: A High Octane Alternative to 100LL

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Purdue Energy Camp

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Tetraethyl Lead

\[(C_2H_5)_4 Pb\]

- Was highest during WWII.
- 115/145 avgas = 2 ½ X more lead than 100LL
- Necessary in order to obtain rated & war power
- Lead to development of larger engines, fighters, bombers, and transport aircraft to win the war.
- Started reducing lead content in late 1960’s to 100/130 max, then 100LL in 1972
Small Market, Large Problem

Total Fuel Consumption
US Transportation Fuel Production

- MoGas
- MoDiesel
- Jet
- AvGas

4,500,000
1,820,000
1,800,000
20,000

9,800,000

Avgas = Specialty Chemical

(Production in barrels / day)
(Total ~ 16,120,000)
Small Market, Large Problem

Sources of Lead Emissions - 2009

AvGas, 45%
Other, 55%
100SF is a two component, synthetic hydrocarbon fuel replacement for 100LL

- 100SF is produced from processed biomass that is then catalytically reacted into full hydrocarbons
- 100SF contains no oxygenates or lead
- 100SF has been extensively tested in aircraft engines, both on the ground and in the air
- 100SF is currently the only 102+ MON alternative to replace 100LL
ASTM D7719

- Approved May 1, 2011
- Issued Number D7719

Standard Specification for High Octane Unleaded Test Fuel

This standard is issued under the fixed designation D7719; the numerical designation indicates the year of original adoption or, in the case of revision, the year of last revision. A periodical indication is given to indicate the most recent revisions. A superscript zero (0) indicates a minor revision. A superscript one (1) indicates a major revision.

INTRODUCTION

This new test fuel specification is for a high-octane unleaded test fuel to be used for gathering data toward a commercial blend report and specification of an unleaded high-octane aviation gasoline. A new high-octane unleaded test fuel has been developed which maintains the key performance parameters of existing re-formulating aircraft engines. The two essential performance parameters of MON and VSTP are inversely related with respect to composition and the test can uniquely define a composition map of the test fuel. The volume for VSTP is a function of the limiting value of the third component. The test fuel exhibits a higher octane number (determined from a mixture deconvolution) which is of great performance interest, although not explicitly stated in Table 1. The volatility parameters reflect this change compositionally. This is an uncalibrated fuel, so the form of TEL in Table 1 is the same as it is used in Specification D3361 for oxygen and is meant to mitigate unintended chemical changes by TEL. Lastly, references to as-received or the specification so that test groups may use them as necessary.

1. Scope

1.1 This specification covers the formulation for high-octane unleaded test fuel for use as an aviation gasoline additive.

1.2 This specification defines a specific type of high-octane unleaded test fuel that may be used as an aviation gasoline additive.

1.3 The values stated in SI units are to be regarded as standard. Other units of measurement are included in this standard.

1.4 This standard shall be an as-received or the specification so that test groups may use them as necessary.

2. Referenced Documents

2.1 ASTM Standard: D38, Test Method for Density of Petroleum Products at 60°F (15.6°C) and for Water at 60°F (15.6°C); D323, Test Method for Water in Petroleum Products by Distillation Method; D4687, Practice for Manual Sampling of Petroleum and Petroleum Products; D5189, Specification for Test Fuel Sample Containers for Test Methods by Trace Contamination.

3. Keywords

3.1 Aviation fuel; binary; high-octane; unleaded.
Engine Testing on 100SF

- Lycoming TIO-540-J2BD & IO-540-K (FAA, Lycoming, & Purdue University)
- Cessna 150/Continental O-200-A (Albertson Aerodata Analytics)
- P&W R-2800-CB17 Radial (Anderson Aeromotive)
- M-14P Radial (Rick Volker Airshows)
Production Update – Lafayette Pilot Plant
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