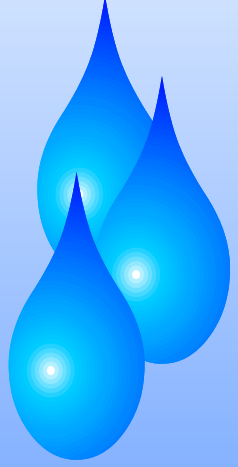
23-years of experiende

with

Unleaded AVGAS in Sweden

Lars H. Hjelmberg



BAN OF AVGAS 100 LL

Unleaded certified replacements available today:

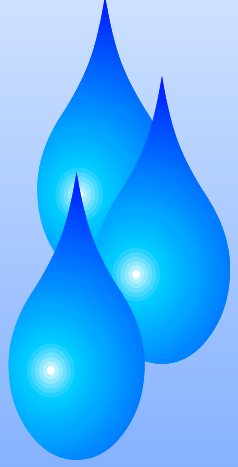
91/96 UL for all 91/96 and 80/87 octane engines

80/87 UL for all 80/87 octane engines

82 UL for certain 80/87 octane engines

Nothing for 100/130 octane engines

Automobile gasoline for certain 80/87 and 91/96 octane engines



Unleaded AVGAS from Hjelmco Oil

1 st generation launched 1981 80/87

2 nd generation launched 1991 91/96

3 rd generation in progress BUT may not be necessary.

Unleaded AVGAS from Hjelmco Oil

American AVGAS standard

ASTM D910

is the aviation gasoline standard to which Lycoming and Continental aircraft engines among others are type-certificated to.

Unleaded AVGAS from Hjelmco Oil

American AVGAS standard

ASTM D910-81

”If mutually agreed upon between the purchaser and the supplier, Grade 80 may be required to be free of tetraethyl lead. In such case, the fuel shall not contain any dye and the color as determined in accordance with ASTM Method D 156, Test for Saybolt color of Petroleum Products (Saybolt Chromo meter Method) shall not be darker than + 20”

Unleaded AVGAS from Hjelmco Oil

American AVGAS standard

ASTM D910

Regarding lead the standard does only stipulate a maximum amount.

No minimum amount of lead is stated

Thus: Unleaded AVGAS fits the AVGAS standard

Unleaded AVGAS from Hjelmco Oil

Unleaded AVGAS 80

Used in Sweden between 1981-1991

Nationwide distribution and use

More than 50 airports involved

More than 400 aircraft

Used by the Royal Swedish Air Force

Unleaded AVGAS from Hjelmco Oil

UNLEADED AVGAS 80

ADVANTAGES

No lead in the exhaust

No lead in the engine

Minimized valve problems

Improved TBO

Unleaded AVGAS from Hjelmco Oil

UNLEADED AVGAS 80

DISADVANTAGES

PILOTS TEND TO
RUN ENGINES RICH

Unleaded AVGAS from Hjelmco Oil

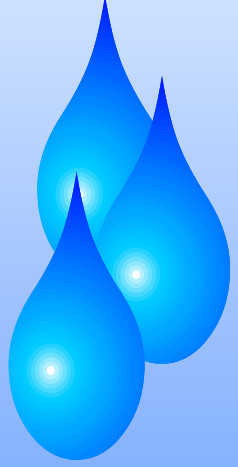
UNLEADED AVGAS 80

PROBLEMS

SOME ENGINES NEED LEAD DURING BREAK-IN

SOLUTION

USE AVGAS 100 LL DURING BREAK-IN



Unleaded AVGAS from Hjelmco Oil

UNLEADED AVGAS 80

Produced in

Czechoslovakia 1981-1985

Germany 1985-1992

for Hjelmco Oil

meeting US standard ASTM D910

Unleaded AVGAS from Hjelmco Oil

UNLEADED AVGAS 91/96

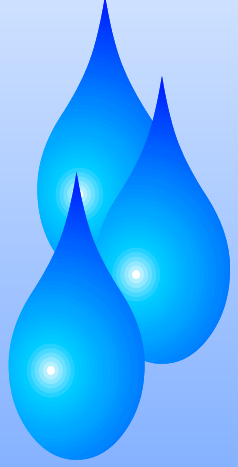
Introduced spring 1991

Nationwide distribution 1993

Listed in Lycoming SI 1070 L 1995

Available at 60+ airports

Used by 700+ aircraft



Unleaded AVGAS from Hjelmco Oil

UNLEADED AVGAS 91/96

Produced in Finland 1991-1998

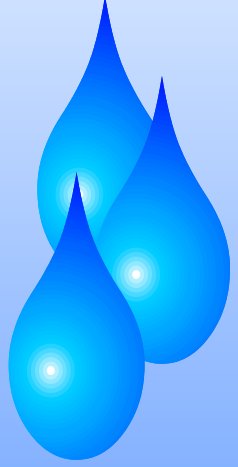
Currently produced in Sweden

Unleaded AVGAS from Hjelmco Oil

UNLEADED AVGAS 91/96

Swedish CAA operational conclusions

Reproduced from ”Alternative Aviation Gasoline seminar in Brussels” sponsored by the FAA



Unleaded AVGAS 91/96

Changing from LL to UL AVGAS may create exhaust valve wear if not performed in a controlled way

- Performance degrades in a controlled way and normally slowly.
- Still no improbable condition has been recorded so far §23.1309 b

Unleaded AVGAS 91/96

Dormant failures may be visible when changing from LL to UL AVGAS, due to decreased cooling margin,

<u>for example</u>

- **Inefficient cooling of engine and oil systems**

  a) Bad engineering

  b) Poor maintenance

- **One or two piece primary and main venturi, one piece venturi in some cases produce weak mixture.**

Unleaded AVGAS 91/96

Dormant failures may be visible when changing from LL to UL AVGAS due to decreased cooling margin, for example

- **Low fuel level in carburettor**
- **Deficiency in heat transfer between valve guide and cylinder head**
- **Mismatched exhaust systems**
- **Poor quality of PMA spare-parts.**

Unleaded AVGAS 91/96

Dormant failures may be visible when changing from LL to UL AVGAS due to decreased cooling margin, for example

- **Engine manufacturers do not want to recommend designated oils or additives for use together with UL AVGAS, but for one exception! (the only factor known so far introduced by 91/96 UL itself)**
- **Fuel systems may give incorrect fuel level due to slightly lower density of 91/96 UL**

Conclusions recorded 1999

AVGAS 91/96 UL had been used

- for more than 8 years
- and had created less than 10 technical events during this period of time
- 7 engine events in 384000 EH(FH), reliability 1,82x10E-5
- and had created less problems than 100 LL when it was introduced in the seventies.

Conclusions recorded 1999

AVGAS 91/96 UL can be used if:

- **Minimum certified engine grade AVGAS is 91/96 or lower**
- **Engine including installation and cooling is healthy**
- **High quality engine oil recommended for operation with UL fuel**
- **Oil additive is used**

⇨ SAFE OPERATION

Engines suitable for Avgas 91/96 UL

Basically all aircraft engines up to 180 hp and between 230-260 hp. (see type-certificate)

Twin engine aircraft:

Twin-Comanche, Aztec, Cougar, Seminole

Single engine aircraft:

Piper Cherokee, Warrior, Archer, Cherokee six, Robin 100, Rockwell 114, Cessna 150, 172, 182 (exceptions exist) Socata Trinidad, Tobago etc.

NEW TECHNOLOGY

General Aviation Modifications Inc. (GAMI) is in FAA certification of its PRISM Ignition System.

- **Uses fiber optic based pressure transducers to measure internal combustion pressures in real time.**
- **This unique technology allows the system to fully control peak cylinder combustion pressures and eliminate any tendency to detonate or pre-ignite.**

NEW TECHNOLOGY

- In March, 2002, observed by AOPA US staff, GAMI´s PRISM system successfully operated a Lycoming TI0-540J2BD (Piper 31 – Chieftain) turbocharged 350 HP engine :

  - on unleaded HJELMCO OIL AVGAS 91/96 UL

  - at rated power (350 HP);

  - with the CHTs at redline (500° F);

  - at maximum induction air temperature

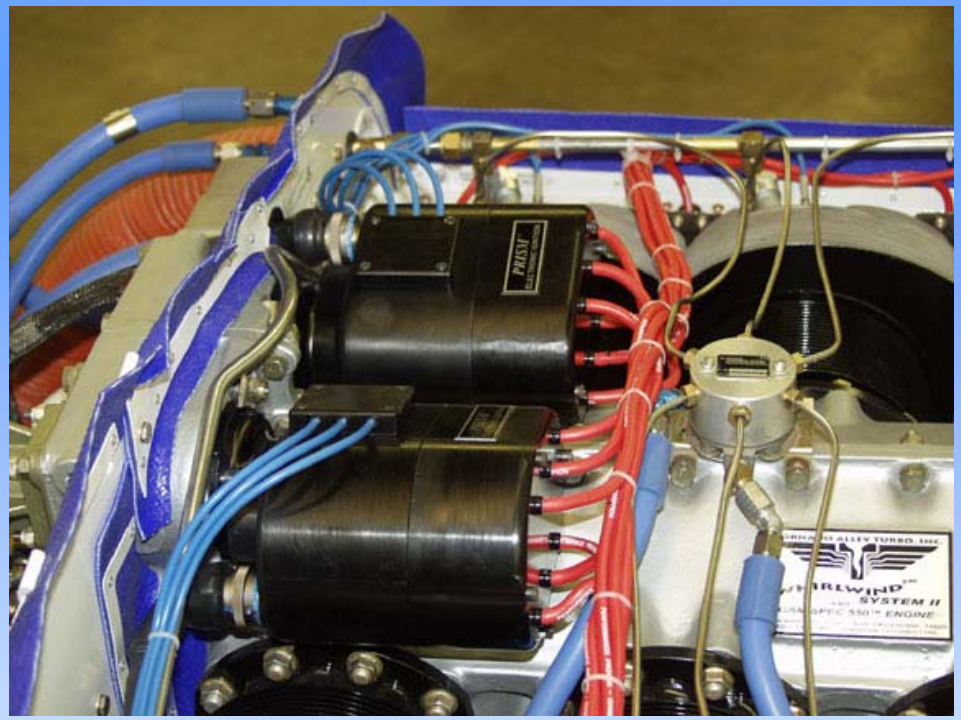
  - free of harmful detonation or pre-ignition

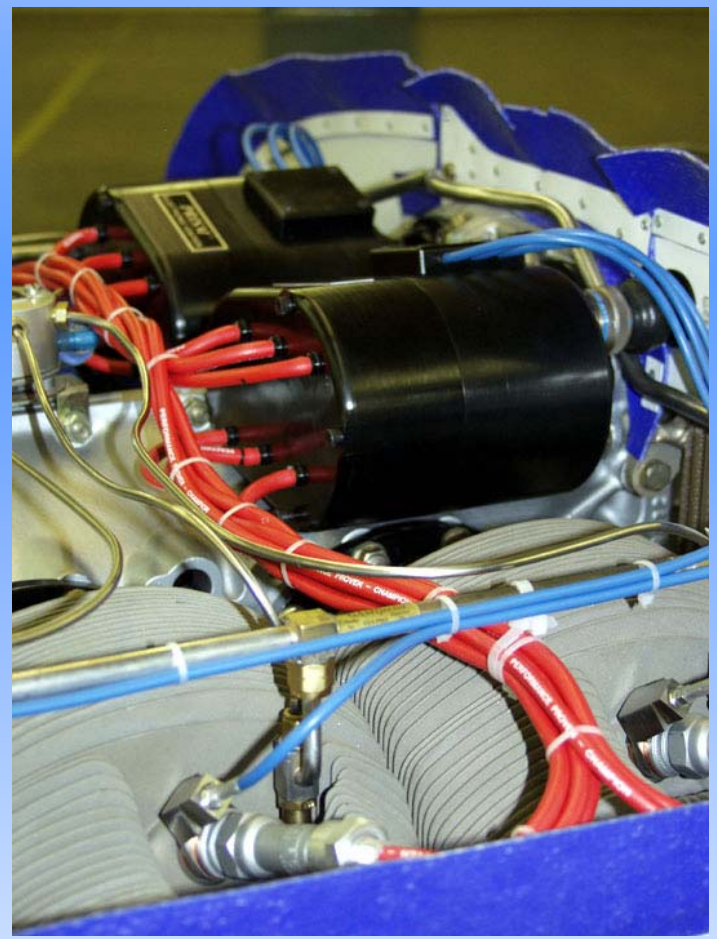
- This is a major milestone - as it demonstrates a known path to guarantee that even the most difficult general aviation piston engines can continue to fly when 100LL is no longer available.

NEW TECHNOLOGY

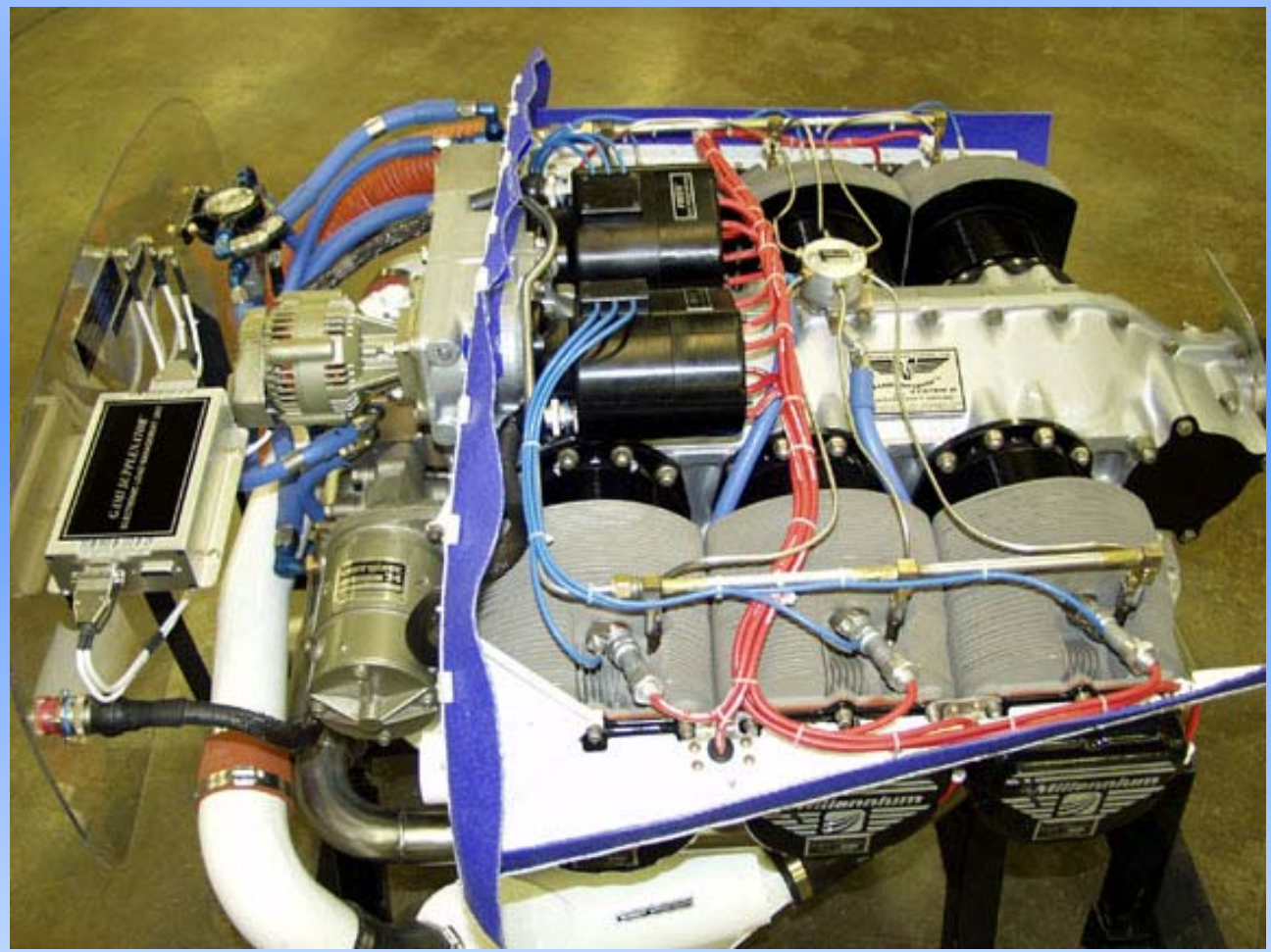
Using Hjelmco unleaded AVGAS 91/96 UL

GAMI´s PRISM System:





NEW TECHNOLOGY



AN EASY REPLACEMENT FOR EXISTING MAGNETOS

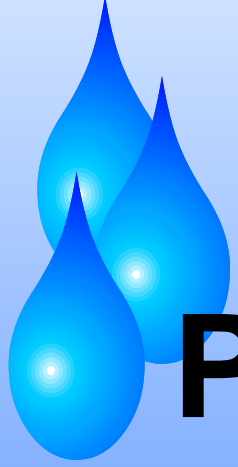
Unleaded Hjelmco 91/96 UL

YEAR 2004

Existing, certified unleaded AVGAS 91/96 UL

Extensive > 13 years flight-experience

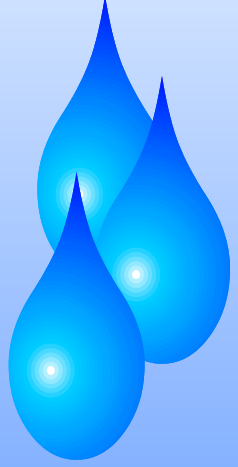
Recognized by Lycoming in 1995



Unleaded Hjelmco 91/96 UL

Pure hydrocarbon fuel

Made from current low-cost, environmentally sound aviation gasoline components



Bio-alkylate Avgas

SYNTHETIC FUEL COMPONENTS CAN BE USED TO OBTAIN NON-TOXIC UNLEADED HIGH OCTANE AVGAS

Bio-alkylate Avgas

In nature	Photosynthesis	Enzymes
Carbon dioxide ➡ ➡ sugar ➡➡		Oil, Fat
Water + sunlight		
Sugar and	Fischer-Tropsch synthesis	F/T oils e.g
Other bio-	➡ ➡ ➡ ➡	vegetable
pulps	imitates natural processes	oils

Bio-alkylate Avgas

- low toxicity
- price competitive in the EU
- can meet ASTM D910
- from renewable sources

Bio-alkylate Avgas

- high octane numbers
- no aromatics,<1 weight %
- no sulphur, < 1 ppm
- no olefins

The friendly PA-28 Warrior

- operates on unleaded AVGAS 91/96 UL
- overall noise reduced by > 65 %
- reduced fuel consumption 7- 8 %
- maintains 75% power at 11000 feet
- no performance degradation


The friendly Piper Warrior II
on unleaded AVGAS Hjelmco
91/96 UL since 1991
SE-KEI

Thank you for your attention

Lars H. Hjelmberg