

Unleaded Aviation Gasoline Meeting
CAA, Gatwick, UK 25th September 2012

Action Summary	Owner
<i>To raise current allocation of Avgas dyes at ASTM to assist high octane unleaded initiative.</i>	<i>Air BP</i>
<i>To propose a universally applicable wing decal design for unleaded Avgas.</i>	<i>GAMA</i>
<i>Consider options to improve understanding of fleet fuel usage.</i>	<i>EASA / Industry</i>
<i>Contact Teledyne Continental and request if a Service Instruction could be prepared regarding D7547 unleaded Avgas.</i>	<i>Air BP</i>
<i>Consider inclusion of unleaded Avgas Grades in aircraft flight manuals in preparation for future market.</i>	<i>OEMs</i>
<i>MoD/Industry review of possible unleaded Avgas Defence Standard.</i>	<i>MoD/All</i>
<i>Seek options to pool unleaded Avgas approval knowledge across Europe/US to Industry benefit.</i>	<i>EASA/CAA/FAA</i>
<i>Examine fiscal lobbying opportunities to mitigate potential hardship of unleaded Avgas introduction for commercial operators.</i>	<i>AOPA</i>
<i>Seek UL91 supply possibilities for US OEMs to promote technical assessment/approval.</i>	<i>European UL Avgas producers</i>

1. Introduction

A significant amount of work has been undertaken by the Aviation Industry to evaluate unleaded aviation gasoline (Avgas) formulations as possible replacements for Grade 100LL. At this time, three recognised unleaded Avgas specifications are available:

- Hjelmcø Unleaded Avgas
- ASTM D6227: UL82 and UL87
- ASTM D7547: UL91

with product being available/becoming available in various European regions.

To help the Industry successfully manage these changes with respect to specifications, engine/aircraft approvals and misfuelling avoidance, a further technical meeting of European Industry members involved in unleaded Avgas has been proposed following an earlier successful meeting in 2011. The meeting was to review progress in the development, management and approval of unleaded Avgas in the region. Topics for discussion:

- Introduction
- Industry Up-date
 - CRC/ASTM/European HSE
- Avoidance of Misfuelling
 - Grades.
 - Industry standard labels/wing decals.
 - Refuelling nozzle colour.
 - Managing mixed fleet (e.g. 100LL / UL91) airfields.
- Approvals
 - Engine manufacturer.
 - Aircraft manufacturer.
 - EASA / FAA.
 - EASA European GA fleet data.
- Defence Standard 91-90

- Possible inclusion of one or more unleaded Grades.
- Grade name(s)/abbreviation(s).
- Tele-Conference 15:00 – 16:00 BST (10:00 – 11:00 Eastern Time US):
 - Summary for tele-conference delegates
 - ARC transition plan
 - Future strategy

2. Present

2.1 CAA, Gatwick

Thomas Albuzat	Swift	Lars Hjelmberg	Hjelmco Oil
Mark Baker	CAA	Paul Johnston	Cirrus Aircraft
Stanislaw Bartus	OBR	Tewfiq Kazi	Cessna
Alisdair Clark	BP	David Medina	Piper
Brian Davey	GAMA	Rob Midgley	Shell
Pascale Demoment	TOTAL	Michelle Parker	UK MoD
Stefan Ebert	EASA	Barry Plumb	Light Aircraft Assoc.
Ken Fontaine	CAA	Phil Sampson	UK MoD
Christoph Genster	Diamond	Jerry Tucker	UK MoD
Robert Hjelmberg	Hjelmco Oil	Magdalena Sulkowska	OBR

2.2 Teleconference Line

Philip (PJ) Catania	Swift	Randy Jenson	Lycoming
Nathan Diedrich	Cessna	Mark Rumizen	FAA
Roger Gaughan	ExxonMobil	Lionel Tauszig	EASA
Rob. Hackman	AOPA	Melanie Thom	Baere Aerospace

3. Discussions

Delegates were welcomed to the CAA, advised of site facilities, alarms and meeting arrangements, Annex 1. Following introductions, discussions commenced and are reported below for each Agenda item.

3.1 Introduction

Hjelmco Oil provided an introduction to unleaded Avgas and possible transition routes:

- Dual Fuel (100LL / 91 unleaded)
- Single Mid Octane (91 unleaded)
- Single High Octane ('100' unleaded)

Each option resulted in additional costs for the Industry which challenged progress. At this time Europe had entered a 'dual fuel' transition driven by customer demand with both 100LL and 91 unleaded Avgas being available at various airfields in Sweden, France and the UK with further interest expressed by Germany and Switzerland. While the 91 unleaded Grade was lower in octane quality than standard 100LL a large number of customer aircraft in the region (estimate 90%) were already compatible with the product. Various engineering solutions were also available to assist engines with higher octane requirement, for example:

- Changes to engine design/capacity.
- Electronically controlled ignition systems.
- Anti-detonation injection systems.

The history of unleaded Avgas use in Sweden was then provided. Product has been available and successfully used for over 30 years, the market commencing with an unleaded Grade 80 and then transitioning to unleaded 91/96 'Hjelmco 91/96UL'TM. Tanks feature distinctive Hjelmco logos and clear labelling - white letters on a green background. Hazard warnings were also colour coded:

- Red – 100LL
- Green - Hjelmco 91/96ULTM

The unleaded fuel was colourless, in agreement with historical Industry practice, and emissions tests had shown reduced particulate content versus leaded Avgas. With the introduction of UL91 by TOTAL the ability to cross Europe using an unleaded Grade was now a reality. A copy of the presentation is provided in Annex 2 together with a map of unleaded Avgas availability in Sweden.

Items raised in delegate discussions:

91 Unleaded / 100LL Compatibility

Unleaded 91 Avgas is completely compatible with 100LL should an aircraft with Grade 91 approval need to use standard Avgas or a mixture of the two fuels.

Engine Oil

Engines using unleaded Avgas can benefit from 15W/50 oils. This is due to the different balance between the lubricate/deposit management attributes of the oil versus other types. Some further optimisation of oil might be possible. In addition, some engines which were designed in the expectation of using unleaded automotive gasoline may recommend oils which are challenged when Avgas is selected.

Valve Seats

Appropriate valve seat metallurgy was important for unleaded Avgas use. For engines swapping between leaded/unleaded fuels, there was the risk of a 'freeze/thaw' type degradation which needed consideration/correct metal selection.

3.3 Industry Up-Date

Air BP provided an up-date of recent Industry Avgas activity covering ASTM, CRC and European legislation, Annex 3. Environmental concern in the US has resulted in a greater focus on lead emissions related to general aviation. The Industry have taken a pro-active response with a concerted effort to expedite transition to an unleaded Avgas:

- Very Low Lead Grade 100 now included in ASTM D910 standards.
- CRC research into a potentially 'Ultra Low Lead' Grade.
- 2 ASTM unleaded Avgas commercial specifications: D6227 (Grades UL82, UL87), D7547 (Grade UL91).
- Development of Swift / GAMI high octane unleaded Avgas.
- ASTM engine testing protocols.
- ASTM Avgas / Avgas Additives approval protocol.
- Aviation Rulemaking Committee (see Section 3.7)

Similar environmental pressure seems imminent in Europe with a 3rd September 2012 publication by the European Chemicals Agency citing tetraethyl lead as a 'substance of very high concern'.

3.4 Avoidance of Misfuelling

An overview of world Avgas Grades, use of dyes and labelling to avoid misfuelling was provided by Air BP, Annex 4. About 16 Grades of Avgas, 11 leaded, 5 unleaded, were potentially available in the world today. However, in terms of 'market reality' for the global regions being discussed this rationalised to 3 colour types:

- Grade 100LL : Blue
- Grade 100 : Green
- Unleaded (Hjelmco / ASTM D7547) : Colourless.

Given this situation the Industry might consider if some optimisation of available dyes/colours could be made to help up-coming unleaded Grades. Guidance regarding pipe-line identification in EI 1542 was presented. General protocol was:

- Black – Jet
- Red – Avgas

with Avgas Grade shown in white lettering and a coloured band to match the dye colour. Various Avgas wing decals had been noted in the market and an example featuring a red decal / white lettering presented with possible variations featuring green for unleaded Grades.

GAMA recommendations for manufacturing the decal were highlighted to ensure sufficient ruggedness in use. In addition, coloured hoses / nozzles could be considered to assist Grade identification at wing.

EASA presented the minimum fixed wing aircraft decal recommendations under CS 23.1557 for Avgas, Annex 5:

- The word 'Avgas' and
- Declare minimum acceptable Grade.

It was noted in rotorcraft recommendations CS 27.1557 the word 'Fuel' could be improved by changing to 'Avgas' or 'Jet'.

Items raised in delegate discussions:

Grades

While the market reality of Avgas Grades was reasonable, the proliferation was challenging given the drive for global standardisation/rationalisation in aviation. The Industry could benefit from looking to rationalise redundant products.

Dyes / Colours

The use of dye in fuel was reviewed:

- No dye = beneficial to engine/fuel system by eliminating high-boiling additive.
- Dye = beneficial to leak detection as leaves stain on aircraft/easier to see water interface.

Experience in Sweden had not found any issues with using colourless unleaded Avgas and any water interface was easy to detect. Given unleaded 91 products were colourless in Europe/supported by recent ASTM D7547 vote, options for high octane unleaded Grades were considered where a dye might be advantageously used. Green (as associated with 'unleaded') or Purple (Grade UL82, not seen in the market) were suggested. This could be raised at ASTM.

ACTION: To raise current allocation of Avgas dyes at ASTM to assist high octane unleaded initiative – Air BP.

Line Labels

Traditionally Avgas has a red label to denote a low flash point product versus Jet / sign of additional danger. On this basis the EI 1542 system remained appropriate.

Refuelling Hose/Nozzle

A green banding on the refuelling hose has been successfully used in Sweden. In addition, green nozzles are available or could be manufactured for easy retro-fit.

Avgas Wing Decals

A clear wing decal denoting an aircraft as unleaded Avgas compatible/minimum Grade would be beneficial to help prevent misfuelling. To meet aircraft requirements regarding sunlight/localised wing heating, a design with following features was seen as preferable:

- Largely white background.
- Feature both Red (to denote Avgas/low flash point hazard) and Green (to denote unleaded compatible) colouration.
- Possible 'metallised'/gloss finish to reflect heat / give eye-catching look versus standard decals.

This was noted as an item of high importance for the Industry and GAMA offered to consider options/propose a suitable design.

ACTION: To propose a universally applicable wing decal design for unleaded Avgas – GAMA.

3.5 Approvals

Industry moves to approve unleaded 91 Avgas were noted, for example recent service Instructions/letters from Lycoming, Rotax and Cessna.

The CAA presented unleaded Avgas approval for aircraft covered by Generic Concession 7, Annex 6. Essentially this allows UL91 use where the engine is approved to use UL91 / aircraft approved for 100LL, or for aircraft with unleaded Mogas / 80/87 approval or where specific CAA approval is given. This will be published in October 2012 - CAP 747 and CAP 562.

EASA reported on progress regarding an action from the 2011 Avgas Workshop - to determine the number of aircraft potentially compatible with unleaded 91 Avgas in Europe. Results for engines installed in aircraft registered in EU member states (except I, GR, CZ), Iceland, Norway, Switzerland are provided in Annex 7:

- Fleet mainly Lycoming, Continental and Rotax with long 'tail' of historical/other makes.
- Total Fleet: 54109 engines
- Estimate of compatibility split:
 - 26039 ASTM D7547 UL91
 - 26039 + additional 4826 Hjelmsco 91/96UL™
 - 15830 Grade 100LL
 - 7414 undetermined.

While additional information is being sought, this suggests 2/3rds of the fleet is potentially compatible on an octane basis. A specific EASA web-site is being considered to hold Avgas SIB data for ease of reference.

Items raised in delegate discussions:

Fuel Usage

The fleet engine distribution may not necessarily be a reflection of fuel usage as commercial operators tend to select performance aircraft/burn more 100LL versus other sectors. A route to address this would be useful, possibly via engine over-haul interval, market research/flight hours.

ACTION: Consider options to improve understanding of fleet fuel usage – EASA / Industry.

Approval Knowledge

In practical terms, approval to use unleaded 91 Avgas tends to be held by the operator of the aircraft through attention to Industry documentation as no standard decal has been designed/displayed.

Continental Engines

Some clarification regarding ASTM D7547 unleaded Avgas approval in 80/87 Continental engines was sought.

ACTION: Contact Teledyne Continental and request if a Service Instruction could be prepared regarding D7547 unleaded Avgas – Air BP.

Aircraft Flight Manual

Listing of approved unleaded Avgas Grades in aircraft flight manuals was seen a potentially beneficial for the Industry.

ACTION: Consider inclusion of unleaded Avgas Grades in aircraft flight manuals in preparation for future market – OEMs.

3.6 Defence Standard 91-90

A number of unleaded Avgas Grades are now listed in ASTM specifications. Industry members were aware the MoD had not up-dated Def Stan 91-90 to include an unleaded Avgas, this being of note given the reality of such fuels in the European region. A forum was offered to discuss this item with 2 introductory slides being provided by Air BP, Annex 8.

Items raised in delegate discussions:

- *MoD Avgas Requirement*
Avgas is no longer a major fuel requirement for the MoD but some use does remain, notably for unmanned aerial vehicles.
- *ASTM*
Members of the Aviation Fuels Committee are also present at ASTM, and given the role of this group/piston engine OEM participation, current specification development may already be well placed.
- *ARC*
ARC focus had been on a high octane 100LL replacement fuel, potentially missing the European initiative and knowledge base being developed which could be included in a Defence Standard to benefit the Industry.
- *IP Test Methods*
Defence Standards feature both ASTM and IP (Energy Institute) test methods and are often more familiar to the Industry outside the US.
- *Environment*
An unleaded Avgas Defence Standard would demonstrate a pro-active approach by the AFC to environmental concern/benefit European Industry.
- *ETBE*
A European specification may be able to more readily accept ETBE to help with a potential higher octane unleaded Grade.

No simple resolution was identified and an action was taken to consider the situation/discuss with the MoD to develop a forward plan.

ACTION: MoD/Industry review of possible unleaded Avgas Defence Standard – MoD/All.

BY TELEPHONE CONFERENCE

3.7 Aviation Rulemaking Committee (ARC)

ExxonMobil/FAA provided a combined overview of the ARC report released January 31st 2012. This sets out a road map of how the Industry might transition to an unleaded Avgas and the challenges of such a transition, Annex 9.

A good cross-section of the parties involved were represented:

- engine/aircraft manufacturers
- fuel producers
- Regulators
- pilot/commercial associations
- environmental legislators

The transition was noted as particularly challenging for Avgas as no 'drop in' high octane unleaded fuel equivalent to 100LL has been identified. In addition, items beyond operational performance such as environmental impact/toxicology must also be considered adding complexity. The interaction between the Environmental Protection Agency and the FAA was examined, an item of particular importance given the differences between aviation/flight safety and ground fuels legislation. A time-line of between 5 to 11 years for fuel deployment was suggested with first steps being formation of the Piston Aviation Fuels Initiative and creation of a specific FAA office in Boston.

3.8 Future

An open debate regarding unleaded Avgas future development was held. Notable points raised:

100LL / Commercial Operators

AOPA customer discussions in the US had noted particular concern from commercial aircraft operators if no equivalent unleaded Grade to 100LL could be supplied. A similar situation has not yet been seen in Europe but it was observed that both 100LL and unleaded Avgas are both still available.

Engineering Solutions

Various engineering solutions were available to help the Industry transition to a mid-octane unleaded Avgas if necessary. For example a recent Continental engine has been tested on UL94. However, cost and time-scale were important considerations. Ideally, sufficient time should be available to allow financial planning / engine modification when overhaul limits are reached.

CAA / EASA / FAA Exchange of Information

With a proportion of the European fleet approved and operating on unleaded Avgas, an exchange of information between EASA/CAA and the FAA could be beneficial for the new Boston office. In addition, the new office could help OEM discussions/understanding.

ACTION: Seek options to pool unleaded Avgas approval knowledge across Europe/US to Industry benefit: EASA/CAA/FAA.

Taxation

In agreement with the AOPA's observations, the European Industry were aware that total transition to an unleaded Avgas could have major commercial consequences for some operators. Given this, and the environmental drive, a reduction in the tax burden on the Industry might offer important assistance. Support for such an initiative was sought from Industry groups and the AOPA offered to consider options.

ACTION: Examine fiscal lobbying opportunities to mitigate potential hardship of unleaded Avgas introduction for commercial operators in US/Europe – AOPA.

Aircraft / Engine / Fuel Approval

Cessna observed that while unleaded 91 Grade Avgas was available in Europe this was not the case in the US which constrained OEM testing / development. The Industry needs to examine ways to address this issue to gain progress.

ACTION: Seek UL91 supply possibilities for US OEMs to promote technical assessment/approval – European UL Avgas producers.

3.9 Close

The meeting closed at 16:15 hrs.

4. Acknowledgement

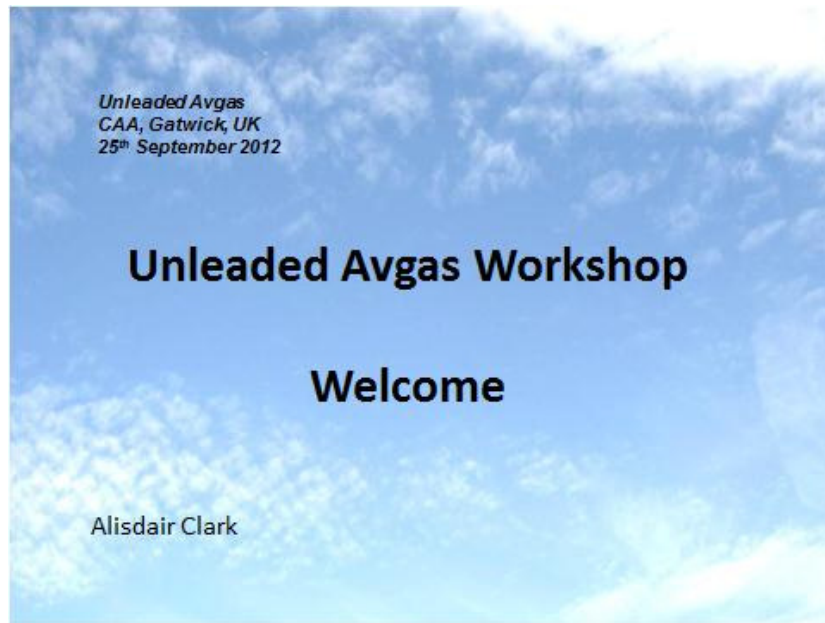
Thanks is expressed by all present to the meeting host, Ken Fontaine/CAA, for provision of the conference facilities, coffee, lunch and tea. This gave an excellent environment for the workshop and productive discussions.



A Clark
27/9/12

Annex 1

Welcome



*Unleaded Avgas
CAA, Gatwick, UK
25th September 2012*

Unleaded Avgas Workshop

Welcome

Alisdair Clark



Agenda

- Welcome
- Introduction
- Industry Up-date
- *Coffee*
- Avoidance of Misfuelling
- *Lunch*
- Approvals
- Defence Standard 91-90
- *Tea*
- Tele-Conference
 - ARC Transition Plan / Future
- Close

Welcome

- Safety – Fire Alarm / Exits
- Technical Meeting
- Attendance Sheet
- Introduction of Delegates