Meeting Summary

A workshop was held on March 18, 2014 in Ottawa, Canada at the National Research Council Canada (NRC). The purpose of the workshop was to gather the main stakeholders (e.g. government agencies, users, fuel manufacturers, aircraft/engine manufacturers, etc.) to discuss the Canadian perspective on the challenges, issues, and solutions regarding the transition to replacement unleaded fuels for 100LL aviation gasoline. There were 32 participants present representing 19 organizations.

A tour of several NRC facilities (engine test cells, tribology lab, altitude test facility, and aircraft hangar) was conducted on March 19, 2014.

The following is a summary of the meeting:

- 100LL is the only remaining transportation fuel in widespread use that still contains the additive tetraethyl lead (TEL).
- Numerous heath organizations are now indicating that there are no safe levels to humans from lead exposure.
- Approximately 70 million litres are used annually in Canada by roughly 30,000 aircraft.
- Private aircraft are by far the largest portion to the Canadian fleet and are increasing both in numbers and as a percentage of the fleet.
- The uncertainty surrounding a replacement fuel to 100LL has been a major driver of stress to the personal aviation industry. As a result, aircraft values have been decreasing.
- A safe unleaded alternative to 100LL avgas is essential for the continued operational safety of the general aviation fleet.
- The US FAA has developed a joint program with industry known as the Piston Aviation Fuels Initiative (PAFI) that has a mission to facilitate the development and deployment of an unleaded avgas with the least impact on the existing piston engine aircraft fleet. The goal is to identify a replacement fuel by 2018 with full implementation by 2025.
- TC and NRC have initiated a project to gather experimental data (via ground engine testing and flight testing) to assist in qualification and certification of 100LL avgas replacement fuels. Currently, this project is only partially funded and TC/NRC are looking for additional partners to support this work.
- It is intended to coordinate the TC/NRC project with the US efforts.
- It was decided that email communications periodically sent to the stakeholders is the preferred method of keeping them informed of progress on this topic.

The workshop agenda, list of participating organizations, and a summary of the breakout sessions are given below.

Alternative Fuels to 100LL Aviation Gasoline

Transport Canada and National Research Council Canada

NRC·CNRC

Workshop Agenda

March 18, 2014

9:00am - 9:15am	Welcome/Opening *Malcolm Imray, Flight Research, National Research Council Canada*
9:15am - 10:00am	Keynote Speaker 1: **Transport Canada** *Aaron McCrorie, Director of Standards* *Ted McDonald, Senior Aviation Environmental Protection Specialist*
10:00am - 10:30am	Coffee Break
10:30am - 11:00am	Keynote Speaker 2: **USA Federal Aviation Administration (FAA)** *Monica Merritt, Fuels Program Office* *Dave Atwood, William J. Hughes Technical Center*
11:00am - 11:30am	Keynote Speaker 3: **Canadian Owners and Pilots Association (COPA)** *Kevin Psutka, President*
11:30am - 12:00pm	National Research Council Presentation *Wajid Chishty, Program Lead, National Research Council Canada* *Pervez Canteenwalla, Researcher, National Research Council Canada*
12:00pm - 1:00pm	Lunch
1:00pm – 1:30pm	European Presentation: Avgas Usage in Europe *EASA – "European Piston Engine Fleet"* *Hjelmco – "Unleaded Aviation Gasoline in Sweden"* *Total – "Unleaded Avgas in Europe"* *Alisdair Clark – "Def Stan 91-90 and EI 1542"*
1:30pm - 3:30pm	Breakout Sessions
3:30pm - 4:00pm	Coffee Break
4:00pm - 5:00pm	Group Discussion and Closing

List of Invited Organizations

Air Transport Association of Canada (ATAC)*
Applied Research and Associates (ARA)
BP *
Canadian General Standards Board (CGSB)
Canadian Fuels Association*
Canadian Owner and Pilot Association (COPA)*
Cessna
Continental Motors
Department of National Defence (DND)*
Diamond Aircraft
European Aviation Safety Agency (EASA)*
Environment Canada*
ExxonMobil
Federal Aviation Administration (FAA)*
Found Aircraft
General Aviation Modifications, Inc. (GAMI)*
Government of Nunavut – Petroleum Division*
Health Canada*
Hjelmco Oil*
Lycoming Engines*
National Research Council Canada (NRC)*
Northern Air Transportation Association (NATA)
Piper*
Shell*
Strategic Combustion Solutions (SCS)
Swift Fuels
Total*
Transport Canada (TC)*
UK Civil Aviation Authority (CAA)*

* - indicates organizations in attendance (either in person or via teleconference)

Breakout Session Questions and Summary of Reponses

1) **What aspect of 100LL replacement is of primary importance to your organization?**
   - Health Canada has concerns from recent data showing effects at very low exposure to lead and looking for a fuel replacement as soon as possible. Committed to support efforts to remove lead from AVGAS; performance measurement report on this required for auditor general.
   - Environment Canada may want to propose a regulation, however, currently the timing is not right.
   - Transport Canada has a strong interest from the perspective of safety, environment, and supporting aviation. TC does not certify fuels. Also, they currently do not have a mandated requirement like US to remove lead.
   - DND has an interest in sustaining their air cadet fleet (own these aircraft) and air force training fleet (do not own these aircraft).
   - Single fuel transparent solution desired for fleet that is compatible with existing fueling infrastructure.
   - Single fuel will minimize risk of mis-fueling at airfields.
   - Many of the lower power aircraft are used in flight schools which are very cost sensitive. Also, large safety issue for flight schools.
   - Higher power users consume most of the fuel so solution needs to be cost effective for them as well.
   - Want smooth transition, disciplined approach to finding alternative fuel.
   - It would be desirable for any of the fleet that has been granted approval on lower octane fuel to still be able to transition back to replacement of 100LL.
   - Fuel needs to be available and cost neutral (or less) to give boost to industry.
   - Harmonize regulatory approaches with FAA and EASA where possible.
   - Continued existence of high-octane replacement.
   - Single solution with minimum aircraft/engine modification requirement.
   - Need to be compatible/harmonized with US on standards; e.g. Canada/US presently not harmonized on ethanol content in automotive fuels.

2) **This morning we presented a multi-stage project relating to 100LL replacements. Do you generally agree with proposed approach? Is there something to add or change?**
   - Okay as long as the process is open and transparent.
   - There will always be people that object to anything new so need enough scientific evidence to prove that the new solution will work.

- Look at projects that have been done and don't duplicate work or go contrary to existing work by FAA, ASTM, CRC, etc. Find knowledge gaps and conduct research in those areas.
- It was identified that Canada needs to complement the FAA PAFI program but remain independent so that it may address unique Canadian requirements.
- Harmonize with FAA/EASA and remain open to all good ideas.
- Need definite timeline of our project and Canada's goal to fleet-wide certification.
- A single transparent fuel will streamline certification process so should make that the goal.
- Detonation testing can be challenging, should consult with engine manufacturer on this.
- Light aircraft are currently not regulated for emissions. New data will likely become available through this process and regulators and industry may have to work together to address any issues that arise.
- Need to look at maintenance effects. e.g. switching between 100LL and replacement fuel to see wear effects on the engine. Or use used engine that has been running for many years on 100LL and determine effects of switching.
    - Effects from switching back and forth with different fuels on the wear of engine and materials may be fuel dependent , e.g. high aromatic fuel could react differently than mogas.
    - For relatively new engines, the lead memory effect can be lost after running for some short duration. Don't know if same is true for engines that have run 1000's of hours.
- Need to maintain engines rated power (i.e. can not de-rate them) – and some engines do require 100 octane to achieve rated power.
- Radial engines are an area that needs to be explored further.
- Material compatibility is an area that needs to be explored further.
- Infrastructure/supply chain compatibility could be explored.
- UAV aircraft applications could be explored.
- Fungibility studies could be undertaken.
- Application of 100LL for turbine engines under exceptional circumstances could be explored.
- Long term effects on the engine/aircraft; may require follow on phase to assess.
- Need clarification on how the project complies with ASTM D7826.

3) **Are there interim measures you consider viable (e.g. use 100VLL, UL94 with no ethanol, etc.)?**
    - There are some indications that most 100LL sold today actually meets the 100VLL lead content specifications but is not sold that way in North America as fuel manufacturers would then be held accountable to that level if they labeled it 100VLL.
    - If EPA issues endangerment finding, then switching to 100VLL could show the industry is trying to make progress.
    - Modifications to the aircraft could allow switching to different fuels. However, this presents challenges as the aircraft/engine manufacturers want to know what the next fuel will be so that modifications made today will not be incompatible with the future fuel.
    - Fuel suppliers indicated there should not be any interim measures that require supporting multiple fuels.

4) **Transport Canada and NRC are committed to supporting this project. Additional partners are being sought. Is your organization interested in being a partner and supporting this work? If so, what form of support do you envision (e.g. direct funding, in-kind contribution, advocacy)?**
    - Advisory
        - GAMI
    - Advocacy
        - COPA, ATAC, Lycoming, DND (through NATO)
    - Funding
        - COPA
        - Shell maybe but on material compatibility and supplying fuel
        - Air BP may contribute fuel
        - Maybe some program funding from Environment Canada or Health Canada available but programs cuts are underway (the representatives will confirm this)
        - Explore FAA funding possibilities
        - DND-QETE could support specific fuel testing issues.
        - Canadian Fuels Association – already funding 50% of CGSB petroleum committee activities; technical assistance in peer review could be possible.
    - Knowledge sharing
        - FAA
        - Lycoming

5) Any other comments?

- Keep stakeholders apprised of progress (e.g. some stakeholders get calls from the public and would like to have visibility on this project).
- List the aircraft/engine materials of concern.
- The CAN CGSB fuel standards were cancelled in favour of ASTM D 910 – there was an inquiry to whether there is any intent to raise a new CGSB standard to address unique Canadian operational requirements.