Executive Summary

Workshop on Aviation Fuels Thermal Stability

Results of a Workshop

held at the University of Sheffield (USFD), UK, on 28 - 29 September 2005

AERONET

1 Objectives

This workshop formed part of the work programme of AERONET III Work Package 2, Aircraft and Engine Technology Aspects of Emission Reduction. It is the third workshop held by AERONET in the field of aviation fuels. Its objectives were:

- To asses the current state of play with respect to aviation fuel thermal stability.
- To asses the impact on aviation emissions of improving aviation fuel thermal stability
- To identify work required to facilitate these emission improvements

2 Current status

There are many test methods available to assess the fuel thermal stability. These range from simplistic laboratory tests to full scale engine simulators. The fuel specification calls for aviation kerosene to have a breakpoint > 260C.

The current test to measure thermal stability, JFTOT, is a go/no go test, which proves that the breakpoint is greater than 260 but will not give you the final breakpoint. Pioneering work by SWRI has produced a methodology for evaluating the fuel fuel breakpoint from the JFTOT samples.

Various fuel treatments exist in the way of refinery techniques, fuel additives or synthetic kerosene to improve the breakpoint value up to 320C.

Engine manufacturers have no control over the fuel being supplied to airlines and as such design combustion chambers with a safety margin on the 260C breakpoint fuel.

3 Impact of improved fuels

The fuel thermal stability is becoming more important as engine pressure ratios increase to improve fuel consumption. The increase in engine pressure ratio results in an increase in engine temperatures enhancing the heat transfer into the fuel. Improving fuel thermal stability will enable significant improvements in whole engine performance and reduction in emissions by improvements heat management and/ort he use of advance low emission injector systems which are currently excluded.

The impact is difficult to quantify and needs to be assessed on a specific airframe/engine combination. One study undertaken has suggested that a 20C improvement in breakpoint may lead to a 0.1% improvement in SFC.

Problems exist in designing an engine for operation on improved thermal stability fuels as the supply of such fuels need to be guaranteed or expensive and complex intercooling will need to be designed into the engine architecture, which will result in increased emissions.

Improved fuels may have ground level emission implications during the production and could result in a multiple fuel standards arising, or a base fuel may need to be doped with specific additives to improve the thermal stability. Which ever route is chosen additional approval processes are required.

4 Recommendation

Several recommendations were forthcoming from the workshop including:

A “well to wing” study addressing the full CO2 budget should be performed. This should be used to rank the relative alternative ways of producing high thermal stability aviation fuels. The study should build on the methodology of the “well to wheel” study conducted for the automotive industry.

A pilot study should be undertaken to assess the range in breakpoints currently being supplied by airlines. It was proposed that this could form part of the existing survey of jet fuel undertaken on behalf of the MoD by QinetiQ on an annual basis.

New approval processes need to be developed along with appropriate test methodology to ensure that future, non conventionally sourced kerosene’s and fuel additives meet the “spirit” of the current specification for aviation jet fuel.