



SAIB: NE-09-25R2
Date: May 19, 2016

SUBJ: Fuel – Jet Fuel Containing Fatty Acid Methyl Ester (FAME)

This is information only. Recommendations aren't mandatory.

Introduction

This Revised Special Airworthiness Information Bulletin (SAIB) advises aircraft operators, fixed base operators, certificated repair facilities, Flight Standard District Offices, Certificate Management Offices, and Foreign Civil Aviation Authorities regarding the presence of **FAME in aviation jet fuel**. An increase in the allowable concentration of FAME in aviation jet fuel from less than or equal to 5 mg/kg to less than or equal to 50 mg/kg was recently incorporated into the ASTM International aviation fuel specification D1655 for grades Jet A/Jet A-1. A provision was also added to permit up to 100 mg/kg of FAME in jet fuel on an emergency basis when authorized by airframe and engine manufacturers and managed in compliance with airframe and engine manufacturer requirements. The FAA has determined that the performance properties of aviation turbine fuel are not impacted with up to 50 mg/kg of FAME under continuous usage, and under 100 mg/kg of FAME under restricted, short-term usage. The FAA has approved data for use by aircraft and engine manufacturers (OEMs) without further review by the FAA for issuance of service information to permit operation with aviation turbine fuel containing FAME with up to 100 mg/kg under restricted, short-term usage. This revised SAIB adds operating procedures and limitations for those aircraft and engines for which OEMs have not issued service information. OEM service information regarding FAME in jet fuel takes precedence over this SAIB in all cases. The aviation fuel industry Energy Institute (EI) established a Joint Inspection Project (JIP) to study the effects of FAME levels greater than 5 mg/kg in jet fuel. The EI JIP concluded that operation with up to 100 mg/kg of FAME is acceptable. However, the industry has taken a conservative approach to the incorporation of this increased concentration level of FAME and has initially agreed to unrestricted use of jet fuel containing 50 mg/kg of FAME until sufficient service experience has been accumulated to support the use of jet fuel containing 100 mg/kg of FAME.

At this time, the airworthiness concern is not an unsafe condition that would warrant airworthiness directive (AD) action under Title 14 of the Code of Federal Regulations (14 CFR) part 39.

Background

Jet fuel is typically transported in multi-product pipelines and distribution systems. The practice is efficient, practical, and environmentally sound. Quality assurance procedures for handling interfaces between products, together with laboratory testing requirements, are well established and quality escapes are rare. However, recent environmentally-driven government mandates will result in the blending of small percentages of FAME into diesel fuel. This blended fuel, called biodiesel, will then be shipped in multi-product pipelines and create the risk of cross-contamination of jet fuel with FAME components from the biodiesel.

The bio-component in biodiesel, FAME, is a surface-active material. This means that in theory, it can adhere to pipe and tank walls as the biodiesel passes through, and then release from the walls into the following product, which might be jet fuel. Also, small amounts of biodiesel remaining within distribution manifolds, tanks, vehicles, and pipes, can result in traces of FAME getting into jet fuel transported through the same components. At high enough concentrations, FAME can impact the thermal stability of the fuel that could lead to coke deposits in the fuel system. FAME contamination

can also impact the freezing point of jet fuel resulting in gelling of the fuel. These conditions can result in engine operability problems, and possible engine flameout.

ASTM International aviation fuel specification D1655 for grades Jet A/Jet A-1 was recently revised to specify that levels of FAME in jet fuel less than or equal to 50 mg/kg are acceptable. A footnote was also added to the specification to permit up to 100 mg/kg of FAME in jet fuel on an emergency basis when authorized by airframe and engine manufacturers and managed in compliance with their requirements. Therefore, operation with jet fuel containing more than 50 mg/kg of FAME, but less than or equal to 100 mg/kg of FAME under restricted, short-term usage, is in compliance with the aircraft and engine operating limitations if the recommendations in this SAIB are followed.

The EI JIP analyzed jet fuel with 400 mg/kg of FAME to provide margin in the analysis. The final report provided sufficient data to support operation with up to 100 mg/kg of FAME under the procedures described below. This data was approved by the FAA and may be used by aircraft and engine manufacturers to issue service information describing operating and maintenance procedures for aircraft and engines that inadvertently operate with jet fuel containing FAME. The current specification limit of 50 mg/kg was established by industry with the understanding that it would be increased to 100 mg/kg after sufficient service experience was gained to validate the conclusions of the EI JIP report.

Recommendations

We recommend that owners and operators of turbine engine-powered aircraft who wish to operate with jet fuel containing greater than 50 mg/kg FAME, but less than or equal to 100 mg/kg FAME under restricted, short-term usage, do the following:

1. Incorporate FAA-approved service information from aircraft and engine manufacturers (OEMs), regarding FAME levels in jet fuel, into their operating specifications if issued, or
2. Obtain local FAA approval to follow the recommendations described below ONLY if OEMs have not yet issued FAA-approved service information regarding FAME in jet fuel. OEM service information regarding FAME in jet fuel takes precedence over this SAIB in all cases.
3. Report all occurrences of FAME levels in jet fuel greater than 50 mg/kg, to equipment type certificate (TC) holders and the FAA immediately upon identification of the occurrence.
4. Conduct the following tests on all batches of jet fuel with FAME levels greater than 50 mg/kg and immediately report the results to the equipment TC holders and to the FAA. Use the latest version of ASTM International aviation fuel specification D1655 for grades Jet A/Jet A-1 and associated test methods.
 - a. Specification testing to the limits of ASTM International aviation fuel specification D1655 (or equivalent TC holder document). Take immediate action in accordance with the operator's quality control procedures to address any specification limit exceedances.
 - b. FAME testing in accordance with laboratory-based methods to confirm the results from field test methods. Test methods ASTM D 7797 and IP 583 are field test methods. IP 585, IP 590, and IP 599 are acceptable laboratory test methods. IP 585 is the referee and therefore the preferred test method. Refer to ASTM International aviation fuel specification D1655, Section 2., and Table 2 of this SAIB, for test method references.
 - c. Thermal stability breakpoint temperature testing in accordance with ASTM International test method D3241 – 14b, Appendix X2, "Determination of Breakpoint".
5. Retain a 10 gallon sample (minimum) of each batch of affected jet fuel.

- a. A batch is defined as a discrete volume of fuel of known and consistent composition. In this case, it is most likely represented by the contents of a storage tank or tanks, or, as a full delivery of fuel from a single batch from the fuel supplier.
6. Suspend operations with fuel containing greater than 100 mg/kg of FAME and follow the corrective actions in Table 1 of this SAIB.
7. Continue operations with FAME levels greater than 50 mg/kg, but less than or equal to 100 mg/kg in accordance with the corrective actions in Table 1 of this SAIB.

Table 1 - Corrective Actions and Procedures*

FAME Level	I Aircraft dispatched and en route or engines operated on ground using affected fuel	II Aircraft on ground (engines not yet operated on affected fuel)	III Aircraft waiting to be fueled	IV Comments
Less than or equal to 50 mg/kg	None	None	None	FAME level within specification criteria
Greater than 50 mg/kg, but less than or equal to 100 mg/kg	Continue flight or allow dispatch and take the following actions: <ul style="list-style-type: none"> • Cease fueling operations at the airport with the affected fuel within 72 hours max. after identification of FAME contamination. • Inform TC holders and FAA that fuel containing FAME was delivered. 	Allow dispatch and take the following actions: <ul style="list-style-type: none"> • Cease fueling operations at the airport with the affected fuel within 72 hours max. after identification of FAME contamination. • Inform TC holders and FAA that fuel containing FAME was delivered. 	Allow dispatch in accordance with the following: <ul style="list-style-type: none"> • If practicable, take action to reduce FAME level below 50 mg/kg in affected fuel batch. If successful, allow dispatch. • If FAME level cannot be reduced below 50 mg/kg, permit fueling of aircraft with affected batch and follow recommendations in column II of this table "Aircraft on ground". 	FAME level within specification criteria if the recommendations of this SAIB or TC holder emergency procedures are complied with.
Greater than 100 mg/kg	For aircraft en route, divert immediately to suitable airport and conduct contaminated fuel maintenance in accordance with OEM continued airworthiness instructions. For engine operated on ground, shut down engine and conduct contaminated fuel maintenance in accordance with OEM continued airworthiness instructions.	Do not start engines or APU. De-fuel or take action to reduce FAME level in affected aircraft to 100 mg/kg or less. Continue operations in accordance with procedures described above based on resulting FAME level.	Do not fuel aircraft. Take action to reduce FAME level in affected fuel batch to 100 mg/kg or less. Continue operations in accordance with procedures described above based on resulting FAME level.	Do not operate aircraft and engines exposed to fuel containing greater than 100 mg/kg of FAME. Contact aircraft and engine TC holders to determine subsequent maintenance actions or develop a return to service maintenance program and submit for FAA approval.

* Based on operational status of aircraft at time of discovery of contamination.

Table 2 - Test Methods

Field Test Methods	Laboratory Test Methods
Energy Institute: IP 583 Determination of the Fatty Acid Methyl Esters Content of Aviation Turbine Fuel Using Flow Analysis by Fourier Transform Infrared Spectroscopy—Rapid Screening Method.	Energy Institute: IP 585 Determination of Fatty Acid Methyl Esters (FAME), Derived from Bio-diesel Fuel, in Aviation Turbine Fuel - GC-MS with Selective Ion Monitoring/Scan Detection Method.*
D7797 Test Method for Determination of the Fatty Acid Methyl Esters Content of Aviation Turbine Fuel Using Flow Analysis by Fourier Transform Infrared Spectroscopy – Rapid Screening Method.	Energy Institute: IP 590 Determination of Fatty Acid Methyl Esters (FAME) in Aviation Fuel—HPLC Evaporative Light Scattering Detector Method.
	Energy Institute: IP 599 Determination of Fatty Acid Methyl Esters (FAME) in Aviation Turbine Fuel by Gas Chromatography using Heart-cut and refocusing.

* This is the referee laboratory test method.

8. Operators should notify their jet fuel suppliers of the following:
 - a. Operators shall be informed of delivery of jet fuel with greater than 50 mg/kg of FAME.
 - b. All fueling operations with jet fuel containing greater than 100 mg/kg of FAME shall cease immediately.
 - c. Applicable quality control corrective action procedures should be followed.
 - d. For all batches of jet fuel containing greater than 50 mg/kg of FAME, but less than 100 mg/kg, the following actions should be taken:
 - Operators shall be advised that the fuel is being delivered under the agreed “Emergency Protocol” allowance provision within ASTM International aviation fuel specification D1655 for grades Jet A/Jet A-1 (or relevant OEM specification that includes such allowance) and is therefore fully compliant with the aircraft and engine operating limitations.
 - Fueling operations at the affected airport may continue subject to aircraft owner or operator agreement for a maximum of 72 hours.
 - If practical, FAME levels should be minimized by diluting with fuel that does not contain FAME, until the FAME level is equal to or less than 50 mg/kg.
 - An investigation to determine the earliest time when the affected fuel exceeded the 50 mg/kg should be carried out immediately. If it is found that the allowable 72 hours of fueling delivery has been exceeded, or, that fuel may have been delivered at greater than 100 mg/kg, then the affected operators shall be informed immediately and all fueling operations shall cease.

For Further Information Contact

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For Related Service Information Contact

The Joint Inspection Group at: <http://www.jigonline.com> and the Energy Institute at: <http://www.energyinstpubs.org.uk/>.