



## **Introduction**

This revised Special Airworthiness Information Bulletin (SAIB) advises airplane operators, fixed base operators (FBOs), FAA repair stations, Flight Standards District Offices (FSDOs), and foreign civil aviation authorities that jet fuel suppliers may be experiencing difficulties in conducting key fuel property tests required for compliance with FAA approved jet fuel operating limitations. These operating limitations require the measurement of aromatic hydrocarbon concentration and the net heat of combustion in accordance with methods specified by the type certificate (TC) holder. The FAA has not received any reports of jet fuel being delivered to aircraft without the measurement of these properties, but owners and operators of turbine engine-powered aircraft should advise jet fuel suppliers that they cannot use fuel that has not had these properties measured in accordance with the specified ASTM methods.

At this time, the airworthiness concern is not considered an unsafe condition that would warrant airworthiness directive (AD) action under Title 14 of the Code of Federal Aviation Regulations (14 CFR) part 39. This revision clarifies that jet fuel supplies not meeting FAA approved operating limitations have not been reported, and that operators should continue to operate within their existing fuel handling procedures.

## **Background**

The FAA relies on ASTM International to develop aviation fuel specifications and test methods that TC holders may designate as operating limitations for their approved products. The TC holders may also use these ASTM specifications and test methods to develop their own documents, such as company specifications, service bulletins and instructions, or other company documents, they designate as jet fuel operating limitations. These aviation fuel operating limitations may be listed in the product's type certificate data sheet (TCDS), installation manual, service instructions, or as limitations associated with a supplemental type certificate (STC).

Aircraft and jet engine TC holders almost exclusively designate ASTM Standard Specification D1655, "Standard Specification for Aviation Turbine Fuels," or company documents based on this specification, as a jet fuel operating limitation. ASTM D1655, and the associated company documents, specifies a maximum allowable concentration of aromatics of 25 volume percent measured by the ASTM Standard Test Method D1319<sup>1</sup>, "Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption." However, the availability of a dye necessary to conduct the ASTM D1319 test is limited because the dye is no longer manufactured and current supplies are being consumed. In addition, previously delivered supplies of that dye with lot numbers 3000000975 and above were produced with an incorrect dye and will not provide an accurate measurement of the aromatic concentration. ASTM D1655 also references test

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<sup>1</sup> The information and recommendations of this SAIB also apply to test method IP 156, "Determination of Hydrocarbon Types in Petroleum Products - Fluorescent indicator adsorption method," available from the Energy Institute, 61 New Cavendish Street, London, W1G 7AR, UK. IP 156 is specified in ASTM D1655 as an equivalent test method for measurement of aromatics.

method ASTM D6379<sup>2</sup>, “Standard Test Method for Determination of Aromatic Hydrocarbon Types in Aviation Fuels and Petroleum Distillates—High Performance Liquid Chromatography Method with Refractive Index Detection,” which specifies a maximum allowable concentration of aromatics of 26.5 volume percent, but this method is rarely used, is not widely available, and is expensive to run.

ASTM D5186, “Standard Test Method for Determination of the Aromatic Content and Polynuclear Aromatic Content of Diesel Fuels and Aviation Turbine Fuels by Supercritical Fluid Chromatography,” is another test method available from ASTM to measure the aromatic concentration of jet fuel. However, the ASTM D5186 test method has not yet been incorporated into the ASTM D1655 jet fuel specification, nor the TC holder’s documents based on ASTM D1655, because it reports aromatics in mass percent, not volume percent. At present, the ASTM D5186 test method cannot be used for compliance with the jet fuel operating limitations, unless approved by the TC holder as a change to their FAA approved operating limitations. This change would need to either specify a new limit in terms of mass percent or include a method to convert mass percent to volume percent for comparison with the current limit.

Aromatic hydrocarbons are limited in jet fuel because they emit more radiant energy during combustion than paraffinic hydrocarbons. At high concentrations, this can have an adverse effect on turbine engine combustor durability. They also produce more smoke and harmful particulate emissions than paraffinic hydrocarbons and are limited due to environmental concerns.

Jet fuel that has not been tested for aromatics concentration in accordance with ASTM D1319, with alternative test methods ASTM D6379 or ASTM D5186 (requires TC holder approval), or with ASTM D1319 with a dye from lot number 3000000975 and above, no longer meets the aviation fuel operating limitations of airplanes certificated to operate on Jet A or Jet A-1 fuel, and therefore, cannot be used on those airplanes.

ASTM D1655, and the associated company documents, also specify a minimum allowable net heat of combustion requirement of 42.8 MJ/kg as calculated by one of two methods; ASTM D3338, “Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels”, or ASTM D4529, “Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels”, or obtained by testing using ASTM D4809, “Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)”. A minimum value for the net heat of combustion is required in jet fuel to ensure the fuel has sufficient energy content to meet the aircraft’s range requirements. The calculation of the net heat of combustion utilizing the ASTM D3338 test method cannot be accomplished without the aromatics concentration. Fuel suppliers will need to either use the alternative calculation method, ASTM D4529, or will need to conduct the bomb calorimeter test in accordance with ASTM D4809. Jet fuel for which the net heat of combustion has not been determined by calculation using ASTM D3338 or ASTM D4529, or by test using ASTM D4809, no longer meets the aviation fuel operating limitations of airplanes certificated to operate on Jet A or Jet A-1 fuel, and therefore, cannot be used on those airplanes.

The FAA has received reports that refiners and other fuel handlers are finding it difficult to locate testing facilities that can conduct the ASTM D1319 test due to the dye shortage. However, we anticipate that the existing quality control procedures in the jet fuel supply chain will prevent untested fuel from being supplied to aircraft. Operators should continue to operate within their

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<sup>2</sup> The information and recommendations of this SAIB also apply to test method IP 436, “Determination of Aromatic Hydrocarbon Types in Aviation Fuels and Petroleum Distillates - High Performance Liquid Chromatography Method with Refractive Index Detection,” available from the Energy Institute, 61 New Cavendish Street, London, W1G 7AR, UK. IP 436 is specified in ASTM D1655 as an equivalent test method for measurement of aromatics.

existing aviation fuel handling procedures unless advised by their fuel supplier that the fuel does not meet the specification requirements.

## **Recommendations**

The FAA recommends the following:

1. Owners and operators of turbine engine-powered aircraft advise fuel suppliers that operators may only use jet fuel that has been tested for aromatics concentration in accordance with one of the following methods:
  - a. ASTM D1319 with a dye from lot number lower than 3000000975, or
  - b. ASTM D6379, or
  - c. ASTM 5186, but only if the TC holder has approved the use of that method, and the aromatic concentration complies with the specified limit in the operating limitations.
2. Owners and operators of turbine engine-powered aircraft advise fuel suppliers that operators may only use jet fuel that has had the net heat of combustion determined using one of the following methods:
  - a. ASTM D3338, or
  - b. ASTM D4529, or
  - c. ASTM D4809.

## **For Further Information Contact**

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