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of Transportation
Federal Aviation
Administration**

SAFO

Safety Alert for Operators

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Flight Standards Service
Washington, DC

http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo

A SAFO contains important safety information and may include recommended action. Besides the specific action recommended in a SAFO, an alternative action may be as effective in addressing the safety issue named in the SAFO. The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide clarity to the public regarding existing requirements under the law or agency policies.

Subject: Jet Fuel Contaminated with Diesel Exhaust Fluid (DEF).

Purpose: This SAFO alerts and advises aircraft operators, Fixed-Base Operators (FBO), certificated repair stations, and foreign civil aviation authorities of events in which aircraft were fueled with jet fuel contaminated with DEF.

Background: The FAA has identified four cases of DEF contamination affecting multiple turbine engine aircraft. Three of those events occurred in the United States and one in Brazil. In all cases, the affected aircraft experienced in-flight operational malfunctions, such as uncommanded inflight engine shutdown, resulting in emergency landings. In these cases, DEF was inadvertently confused with fuel system icing inhibitor (FSII) when servicing refueling vehicles. The documented events are summarized as follows:

- a. Eppley Air Field Airport (OMA) in Omaha, NE, November 18-21, 2017. During the period between November 18 and November 21, 2017, seven airplanes were fueled with jet fuel containing DEF at OMA. During the same time period, an additional six airplanes were fueled using refueling equipment that had been exposed to DEF. The DEF was inadvertently used (instead of FSII) on two refueling vehicles at OMA and injected into the fuel with each truck's FSII injection system. On December 26, 2017, the FAA published a Special Airworthiness Information Bulletin (SAIB) HQ-18-08R1, Engine Fuel and Control – Operation with Contaminated Jet Fuel, to address the events of the DEF contamination at OMA.
- b. Miami-Opa Locka Executive Airport (OPF) in Miami, FL, August 12-16, 2018. Between August 12 and August 16, 2018, five aircraft were identified as being fueled with jet fuel containing DEF at OPF. During the same time period, nine other aircraft were identified as being fueled using refueling equipment that had been exposed to DEF. An investigation revealed that DEF was inadvertently used instead of FSII on a refueling vehicle at OPF, and was injected into the fuel with the truck's FSII injection system. This affected both the aircraft receiving the contaminated fuel and the aircraft that were fueled with the refueling equipment that had been exposed to DEF. To address the events at OPF, the FAA issued SAIB HQ-18-28, Engine Fuel and Control – Operation with Contaminated Jet Fuel, dated September 13, 2018.
- c. Punta Gorda Airport (PGD) in Punta Gorda, FL, May 9, 2019. Two Cessna Citation 550s were fueled with fuel contaminated with DEF. The first Cessna Citation 550 experienced an engine flameout at 35,000 feet, then experienced the second engine flameout at 8,000 feet on approach to

Savannah Hilton Head International Airport (SAV). The flight crew landed at SAV with both engines inoperative. There was no other damage or injuries. The second Cessna Citation 550 experienced an engine flameout at 36,000 feet and landed with one engine inoperative at Louisville International Airport (SDF). There were no other damage or injuries.

The FBO at PGD fueled a total of seven aircraft, which is the only day the FBO used the refueling vehicle with DEF-contaminated fuel. Of the seven aircraft, only three were fueled from the vehicle's "front" meter, which is where the FSII injection line was located. To address the event, the FAA issued SAIB AIR-21-08, Engine Fuel and Control – Operation with Contaminated Jet Fuel, dated April 20, 2021.

- d. Brasilia International Airport (BSB), Brasília, Brazil, on October 9, 2014. Four aircraft had DEF injected; one of those aircraft returned to the airport due to having dual engine filter impending bypass warnings.

Discussion: In each of the four events, DEF was confused with FSII. The FBO inadvertently put DEF into the FSII tank on the refueling vehicles. All the aircraft identified had documented cases of clogged fuel filters and fuel nozzle deposits from DEF that led to service difficulties and emergency landings. Other aircraft that were fueled with the contaminated refueling equipment were exposed to trace amounts of DEF from residual fuel in the refueling hoses and equipment.

In each of the three events in the United States discussed above, DEF was confused with FSII, which is more commonly known by brand names "Prist®" and "Dice®," and is also referred to as DiEGME. DEF is a clear fluid that looks similar to FSII. FSII is used to address the potential for water within jet fuel to freeze when the aircraft is at altitude. FSII also prevents microbial growth in aircraft fuel tanks.

DEF is not a fuel additive and should never come into contact with diesel or any other fuel. On vehicles, it is stored in a separate tank, typically identified by a blue filler cap, as seen in Figure 1.

Figure 1: Example of a Blue Filler Cap Identifying DEF

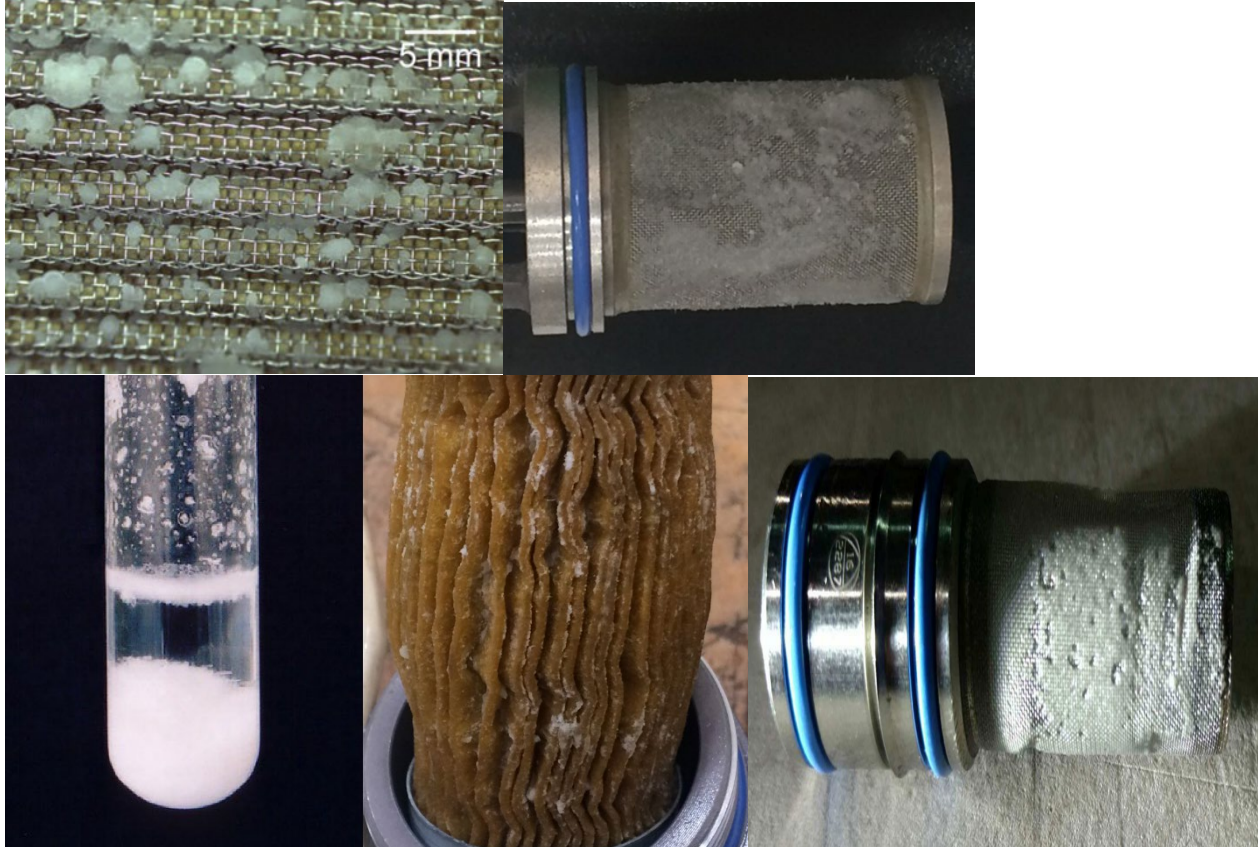


The FAA has been working with the Aircraft Diesel Exhaust Fluid Contamination Working Group, hosted by the National Business Aviation Association (NBAA), along with an FAA Safety Risk Management (SRM) team, to develop procedures to improve labeling and container identification and improve process control. The FAA Aircraft Certification Service (AIR), Aircraft Evaluation Division (AED), and other Flight Standards Service (FS) organizations are developing guidance for FAA inspectors for evaluating operators' processes for controlling DEF and other potential fuel contaminants. DEF is a urea-based chemical and is not approved for use in any aviation application. When mixed with jet fuel, DEF will chemically react with the jet fuel to form crystalline deposits in the fuel system. These deposits will flow

through the aircraft fuel system and may accumulate on filters, fuel metering components, other fuel system components, or engine fuel nozzles. The deposits may also settle in the aircraft fuel tanks or other areas of the aircraft fuel system where they may dislodge over time and accumulate downstream in the fuel system.

DEF forms crystalline deposits that are not soluble in fuel, so they cannot be removed by flushing the aircraft fuel system with jet fuel. Although the deposits are soluble in water and other polar solvents, use of these chemicals may have adverse consequences on aircraft and engine fuel system materials. Operators should contact Original Equipment Manufacturers (OEM) to develop inspection techniques and maintenance actions appropriate for each specific aircraft model type and its level of exposure.

Figure 2: Examples of Filter Deposits



Jet fuel that has been contaminated with DEF no longer meets the aviation fuel operating limitations of aircraft certificated to operate on Jet fuel, and therefore, cannot be used on those aircraft. Operators should ensure appropriate processes are applied to discard contaminated jet fuel removed from affected aircraft to ensure it is not used on aircraft.

The FAA has evaluated the system risk and has determined issuing an airworthiness directive (AD) is not warranted.

Further Reading:

- a. **SAIBs.** Subject: Engine Fuel and Control – Operation with Contaminated Jet Fuel. The following SAIBs, along with others, can be downloaded or viewed online at: [Link](#).
 - SAIB HQ-18-08, as revised.
 - SAIB HQ-18-28, as revised.

- SAIB AIR-21-08, as revised.
- b. FAA Advisory Circular, as revised.** FAA AC 150-5230-4 Aircraft Fuel Storage, Handling, Training, and Dispensing on Airports. This AC is available online at: [Link](#).
- c. NTSB Safety Alert, dated July 2019.** NTSB Safety Alert for Fuel Providers: Prevent DEF Jet Fuel Contamination. This NTSB Safety Alert is available online at: [Link](#).
- d. Industry Report, dated June 11, 2019.** Aircraft Diesel Exhaust Fluid Contamination Working Group Collaborative Industry Report on the Hazard of Diesel Exhaust Fluid Contamination of Aircraft Fuel. This report was generated by aviation industry representatives, the FAA, and was chaired by the NBAA. The paper covers many DEF-related subjects, including the following subjects:
 - DEF contamination safety analysis
 - DEF contamination mitigation strategies
 - Short- and long-term recommendations
 - Additional background, notices, and recommendations

This industry report is available online at: [Link](#).

- e. Energy Institute Video for Fuel Operators.** Educational video on the control of fuel system icing inhibitor and diesel exhaust fluid at airports: [Link](#).

Recommended Action: The FAA recommends that owners or operators of aircraft affected by jet fuel contaminated with DEF do the following:

- a.** Contact their aircraft, engine, and auxiliary power unit (APU) OEMs to determine the appropriate inspections and maintenance actions to remove urea-based crystalline deposits from the fuel system. This action may include removing and replacing fuel system parts or components affected by exposure to these deposits.
- b.** On discovering a fuel contamination event, immediately inform the fueler so they can advise other owner/operators of the contamination. In past cases, fueling vehicles fueled multiple aircraft with the contaminated fuel. However, the operators of those aircraft were not informed until review of the fueling records.
- c.** Discard any jet fuel that has been removed from an affected aircraft because it is suspected of being contaminated with DEF. The contaminated fuel should not be used on aircraft or other vehicles.
- d.** Discuss fueling procedures with your fuel providers to address risks from fuel contamination.

Contact: Questions or comments regarding this SAFO should be directed to the AED at: 9-AVS-AFS-100@faa.gov (attention Propulsion Systems).