



AVIATION



HIGHWAY



MARINE



RAILROAD



PIPELINE

Fuel Providers: Prevent DEF Jet Fuel Contamination

The problem

Diesel exhaust fluid (DEF) is a urea-based chemical that is added to ground vehicle emissions systems to reduce nitrogen oxide (NOx) emissions. **DEF is not designed, nor approved, for use in jet fuel.** If it is inadvertently added to jet fuel, as has happened in several incidents over the last 2 years, DEF will react with certain chemical components to form crystalline deposits in the fuel system. The crystalline deposits can then accumulate on filters, engine fuel nozzles, and fuel metering components and result in a loss of engine power.

- In January 2010, the Environmental Protection Agency began requiring reduced NOx emissions from on-road medium and heavy-duty diesel vehicles. In 2014, all new off-road vehicles, including airport refueling trucks, were required to meet these standards. As a result, all diesel vehicle manufacturers now use a selective catalytic reduction system and DEF to reduce harmful emissions.
- Because the use of DEF is now required for all new off-road vehicles, its presence on airport property is becoming more prevalent as refueling trucks are replaced.
- DEF can be mistaken for other clear, colorless liquids, such as fuel system icing inhibitors (FSII). Both products can be purchased in bulk and transferred to smaller containers for ease of use. Both are usually stored in milky white containers. Also, airport refueling trucks are serviced with both products.

Related events

Aviation fuel contamination is a longstanding safety issue. Inadvertent introduction of DEF into aviation fuel is the latest iteration of this problem, as shown by the following events:

- In a May 2019 incident that the NTSB is investigating, a Cessna C550 experienced a total loss of engine power to both engines while on an air medical flight. The crew diverted to a nearby airport and safely landed the airplane. The two airline transport pilots, two medical crew, and three passengers were not injured. An airport lineman later reported that the day before the incident, he had combined two partially filled containers; one contained FSII and the other contained DEF, which he had mistaken for FSII. He then added the combined fluid to the truck's FSII reservoir. The following day, the incident airplane was fueled with 480 gallons of Jet A fuel with FSII additive mixed at the time of fueling.

Analysis of fuel samples, fuel system filters, and fuel screens from the airplane indicated the presence of urea, the primary chemical found in DEF. ([ERA19IA178](#))

- Although not investigated by the NTSB, two other incidents have occurred that resulted from the inadvertent introduction of DEF into aircraft fuel tanks by way of a refueling truck FSII reservoir.
 - In November 2017, at Eppley Airfield, Omaha, Nebraska, seven aircraft had DEF directly injected and six aircraft were refueled with equipment that was exposed to DEF.
 - In August 2018, at Miami-Opa Locka Executive Airport, Opa-locka, Florida, five aircraft had DEF directly injected and nine aircraft were refueled with equipment exposed to DEF.

At both airports, all 12 aircraft that were directly exposed to DEF experienced service difficulties and unplanned diversions resulting from clogged fuel filters and fuel nozzle deposits (see the special airworthiness information bulletins [SAIBs] listed below for more information).



Figure 1. Fuel screen contaminated with DEF crystals following the 2019 fuel contamination event.

PHOTO COURTESY OF FAA



Figure 2. DEF crystals in fuel filter. PHOTO COURTESY OF FAA

What can **fuel providers** do?

Because bulk fluids and chemicals are generally stored in the same areas, use the following tips to prevent confusion:

- Do not store or temporarily place chemicals into unlabeled containers; always use containers and labels that meet OSHA requirements.
- Ensure that all containers (including bulk storage tanks and larger cube tanks) are clearly marked with 4-inch or larger stenciled letters visible from all sides. Use “DIESEL EMISSION FLUID (DEF)” for all DEF fluid and “JET FUEL SYSTEM ICIING INHIBITOR” for all FSII storage containers.
- Add a label to all DEF containers that says, “NOT FOR AVIATION USE.”
- Even when the containers are clearly marked, do not store DEF and FSII close to each other since it is hard to differentiate the clear, colorless liquids.
- All staff should be trained on the storage locations of DEF and FSII, the packaging and labeling of both chemicals, and the hazards associated with DEF fuel contamination.
- Fueling agents or operators should remove from aircraft and discard jet fuel or FSII suspected of being contaminated with DEF. Do not attempt to repurpose DEF contaminated fuel or FSII to other aircraft or vehicles.
- Review and consider implementing the recommendations contained within the June 11, 2019, *Aircraft Diesel Exhaust Fluid Contamination Working Group Report*.

Interested in more information?

The Federal Aviation Administration (FAA) released SAIBs [HQ-18-08R1](#) and [HQ-18-28](#), which cite the DEF contamination events from 2017 and 2018 discussed above and provide more information on the hazards of DEF fuel contamination.

The National Air Transportation Association's [Safety 1st DEF Contamination Prevention Training](#) for line personnel, fixed-based operator general managers, and customer service representatives reviews storage, handling, and personnel training procedures to prevent fuel contamination.

The FAA released [Safety Alert for Operators 18015](#) in November 2018, which discusses the safety concerns for aircraft serviced with jet fuel contaminated with DEF and highlights its hazards.

WARNING
CHEMICALS IN UNLABELED CONTAINERS
IN THE AIRPORT FUELING ENVIRONMENT
ARE A THREAT TO SAFETY!

Don't foul the fuel

Fuelers have confused **DIESEL EXHAUST FLUID (DEF)** with aircraft **FUEL SYSTEM ICING INHIBITORS (FSII)**, which has resulted in serious fuel contamination events.

DO YOUR PART TO PREVENT A POTENTIALLY CATASTROPHIC AVIATION ACCIDENT

DON'T STORE CHEMICALS IN UNLABELED CONTAINERS		DISCARD CONTAINERS WHEN CONTAMINATION IS SUSPECTED
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WHEN IN DOUBT, THROW IT OUT!

Store DEF and FSII containers AWAY FROM EACH OTHER , even when they are clearly labeled	Learn about the differences in packaging and labeling of chemicals and the hazards of CROSS-CONTAMINATION
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SAFETY ALERT For more information, see [NTSB Safety Alert SA-79](#), Fuel Providers: Prevent DEF Jet Fuel Contamination, or visit www.ntsbt.gov/air

NTSB National Transportation Safety Board

Figure 3. The NTSB developed this Safety Alert flyer to warn fuel providers of DEF's threat to fuel contamination. It's available for download from the [Aviation Safety Alerts](#) page at www.ntsbt.gov.

The NTSB's Aviation Information Resources web page, www.ntsbt.gov/air, provides convenient access to NTSB aviation safety products. This Safety Alert and others can be accessed from the [Aviation Safety Alerts](#) link at www.ntsbt.gov.

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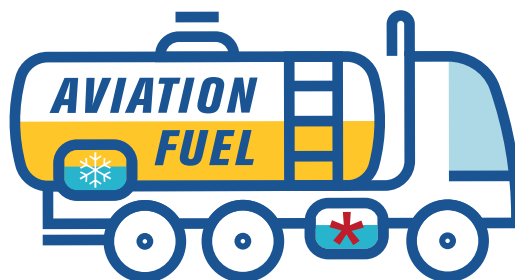


The NTSB is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant accidents in other modes of transportation—highway, marine, railroad, and pipeline. The NTSB determines the probable cause of the accidents and issues safety recommendations aimed at preventing future accidents. For more information, visit www.ntsbt.gov.

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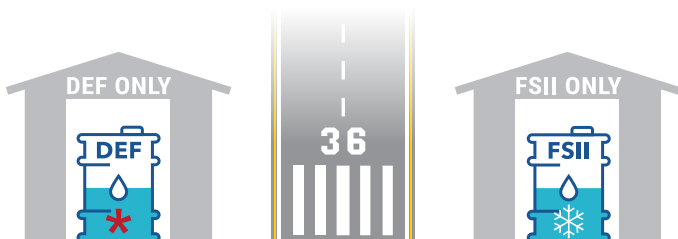
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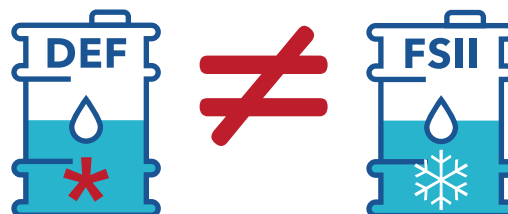
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