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Diesel Fuel Testing Explanation

Diesel fuel degrades over time due to oxidation, contamination (e.g. water), and microbial growth. As it degrades, insoluble particulates and sludge accumulate, which can clog fuel filters and foul diesel engine injectors leading to, at best, poor performance or, at worst, catastrophic fuel system damage. For this reason, the 2026 edition of NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems,* requires periodic testing of diesel fuel:

> **8.3.4.1** Diesel fuel shall be tested for degradation at least annually.
>
> **A.8.3.4.1** Biodiesel fuel might need to be tested for degradation more frequently.

The 2025 edition of NFPA 110, *Standard for Emergency and Standby Power Systems,* has a similar annual testing requirement:

> **8.3.7** A fuel quality test shall be performed at least annually using applicable ASTM standards or the manufacturer's recommendations

NFPA 25 further elaborates on the testing itself:

> **8.3.4.1.1** Fuel degradation testing shall include, at a minimum, fuel quality testing for stored fuel as specified in ASTM D975, *Standard Specification for Diesel Fuel,* or ASTM D6751, *Standard Specification for Biodiesel Fuel Blendstock (B100) for Middle Distillate Fuels*, depending on the fuel type, as approved by the engine manufacturer.

ASTM D7467, *Standard Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to B20),* should also be considered in today's market where these biodiesel blends are becoming more prevalent.

Each of these applicable ASTM standards contains an appendix providing guidance for consumers who may wish to store diesel fuel for an extended period (longer than 12 months). This guidance includes recommendations on tests for fuel quality and fuel monitoring.

Stability

Thermal stability of diesel fuel is its ability to resist degradation when exposed to high temperatures. The ultra-low sulfur (S15) diesel required today in the US is much more thermally stable than fuels of the past.

For this reason, and the growing biodiesel market a measure of oxidation stability - the diesel fuel's ability to resist degradation when exposed to oxygen- is recommended instead.

EN 15751, *Automative fuels – Fatty acid methyl ester (FAME) fuel and blends with biodiesel fuel – Determination of oxidation stability by accelerated oxidation method*, is the method currently recommended by each ASTM for evaluating oxidation stability of today's fuels. This method involves passing a stream of purified air through the fuel sample heated to 110°C. Volatile compounds, formed as the sample oxidizes, are collected and measured (conductivity) throughout the test. A rapid increase in oxidation products signals the end of the stable induction period. The amount of biodiesel present is typically inversely proportional to the duration of the induction period. The induction period requirement for the pure biodiesel blend stock (B100, used for blending) is 3 hours according to ASTM D6751 and the 6-20% (B6-B20) biodiesel blend requirement is 6 hours according to ASTM D7467. No requirement has been established for biodiesel blends of 5% or less (including pure petroleum-based fuels) in ASTM D975. The expectation is that those fuels would have a significantly long induction period.

Water and Sediment

Contamination in fuel can be significantly reduced just by keeping storage tanks free of water (regularly draining accumulated water). Appreciable amounts of water can cause corrosion of tanks and equipment and support microbiological growth at the fuel-water interface in the fuel tank. Appreciable amounts of sediment can obstruct flow and clog fuel filters.

ASTM D2709, *Standard Test Method for Water and Sediment in Middle Distillate Fuels by Centrifuge*, is used to assess the amount of water and sediment in the sample. The sample is centrifuged, forcing the separation of water and sediment from the fuel. All applicable ASTM standards require the type of diesel typically found in fire pumps and emergency generators to have a water and sediment content ≤ 0.05% by volume.

Acid Number

According to ASTM D6751, the acid value of biodiesel is one of the first property changes to occur as it degrades. Therefore, both ASTM D6751 and ASTM D7467 agree that a conscientious fuel monitoring program should include this analysis.

ASTM D664, *Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration*, is the method referenced by applicable ASTM standards. It involves titrating (dosing) alcoholic potassium hydroxide (KOH) into the sample while monitoring the reaction potentiometrically for an equivalence point (the point at which the number of molecules titrated into the solution equals the number of molecules being quantified, the acids in our case).

According to ASTM D6751, the acid number for B100 blendstock shall be ≤ 0.5 mg KOH/g. However, the more applicable ASTM D7467 (B6-B20) sets a requirement at ≤ 0.3 mg KOH/g. No requirement has been

established for biodiesel blends 5% or less (including pure petroleum-based fuels) in ASTM D975. The expectation is that those fuels would have an acid value significantly less.

Because the acid number is referenced in fuel monitoring—not in tests for fuel quality—in the ASTM annexes on stored fuel, it is technically not required under NFPA 25. Furthermore, its impact on fuel performance (e.g., degradation, increased deposits) is captured by other tests that are conducted. For these reasons, the result is evaluated as In Spec/Out of Spec rather than Pass/Fail. While not required under NFPA 25, diesel fuel with an Out of Spec acid number should still be considered for replacement due to its expected impact on both the fuel and equipment (e.g., corrosion of tanks, fuel lines, etc.).

Microbial Contamination

According to ASTM 975, uncontrolled microbial contamination can cause or contribute to a variety of problems including but not limited to increased corrosivity and decreased stability. However, because the microbes contributing to these problems are not necessarily in the fuel itself (they are at the fuel-water interface), no microbial quality criterion is recommended/completed. Simply keeping the fuel dry is critical to controlling microbial contamination.