



Clean Fuel for Generators: Drilldown of NFPA 110 Rules

For those of you who just don't like to read, or have only a moderate tolerance for reading codes and regulations, we have done the dirty work for you.

NFPA 110 "Standard for Emergency and Standby Power Systems" is the standard for people who own and operate buildings with emergency generators. It's the starting point of what a building owner should consider as good practice, and may go further toward a legal requirement since it is referenced in building codes.

Within NFPA 110 there are 3 simple requirements with regard to clean fuel for generators:

- **7.9.1.2** Fuel system design shall provide for a supply of clean fuel to the prime mover.
- **7.9.1.3** Tanks shall be sized so that the fuel is consumed within the storage life, or provisions shall be made to remediate fuel that is stale or contaminated or to replace stale or contaminated fuel with clean fuel.
- **8.3.7** A fuel quality test shall be performed at least annually using appropriate ASTM standards.

Those are all simple enough, but they are explained in detail in the Appendix sections of the standard. Here we will review each concept

Appendix: A7.9.1.2 for "Supply of Clean Fuel"

Fuel Degradation: "To optimize the long term storage of fuels for prime movers, the fuel tanks should be kept cool and dry, and the tank as full as possible. Tanks that are subject to temperature variations can experience accelerated fuel degradation, especially if the tanks are outside and above ground or close to an extreme heat source if stored inside a structure. The more constant and cooler the tank temperatures, the less likely temperature related fuel degradation will occur."

Yes most generator sub-base tanks are outside and aboveground and would be subject to accelerated fuel degradation.

And all generator applications, inside or out, create very high temperature variations as fuel passes through the engine fuel system and returns hot (maybe up to 160 F) from the engine circulation. Fuel degradation is tough to avoid.

The result of this fuel degradation is experienced as particulates coming out of solution. This “dirt” will cause excessive wear on engine components, can clog filters, and can accumulate as sludge on the tank bottom requiring costly removal.

GenApp fuel cleaning on a regular schedule takes care of the problem with its 5 stage particulate filtration to restore cleanliness to ISO standards for new fuel.

Fuel Tank Top-Off: “Tank ullage (air space) should be kept to a minimum. Excess air space allows for warm, humid air to enter the tank and condense moisture during the cool evening. Also, prolonged exposure to ambient air, which is 20% oxygen, can facilitate oxidative degradation of the fuel.”

Tanks are sized as a minimum to allow for the required run time at full load based on a 75% full tank. However, they may be oversized to allow for a less frequent and larger fuel re-order volume.

In normal practice, fuel is consumed in testing until the tank level is about 75%, then fuel is ordered. Since the tank can only be filled to 90-95%, fuel deliveries are usually small top-off volumes, in this case 15-20 gallons for a 100 gallon generator tank.

NFPA 110 is saying that even though these small volume deliveries can be a problem to schedule and receive, they are really important to fuel quality and generator reliability

GenApp has fuel carts and transfer pumps specifically designed to deliver small top-off volumes to generators in and around buildings.

Water and Bio in Fuel: “Fuel storage tanks should be kept as dry as possible, and have provisions for water drainage on a regular basis. The presence of water can lead to microbial contamination and growth, which in turn can lead to general or pitting corrosion of steel tanks and components, possibly resulting in filter plugging, operational issues, or a hydrocarbon release to the environment.”

Where does the water come from? As noted in Fuel Tank Top-Off comments: “humid air enters the tank and condenses moisture during the cool evening”. This is often referred to as **diurnal breathing** as a tank fuel warms and expands during the higher day temperature it pushes vapor out through the tank vent. Then as the tank fuel cools and contracts during the lower night temperature it draws air in through the tank vent.

When water naturally accumulates in the tank it collects at the bottom of the tank, because it is heavier (higher specific gravity) than water. Especially with generator sub-base tanks this creates a very large surface area of water – fuel interface that is ideal for microbe growth.

It’s a huge problem now that Ultra Low Sulfur Diesel (ULSD) is becoming prominent, because the sulfur in the fuel used to offer some, resistance against microbial growth.

GenApp Fuel Services includes a high-suction pump system to remove even thin layers of water from tank bottoms. And fuel is treated with a biocide dose for microbial resistance over time.

Regularly Scheduled Maintenance: “Regularly scheduled surveillance of the fuel allows the operator(s) to evaluate the condition of the fuel and make important decisions regarding the quality of the fuel dedicated to the reliable operation of the prime mover. Fuel maintenance and testing should begin the

day of installation and first fill in order to establish a benchmark guideline for future comparison. Laboratory testing services should always be sought from a qualified or certified petroleum laboratory.”

What would be “Regularly Scheduled”, particularly when setting a standard of professional conduct or care. Generators are run tested regularly – typically weekly, monthly or quarterly. However the fuel condition is not readily assessed since it is stored in the tank.

As noted in Part 8.3.7, annual testing is required, but is that often enough. Part 7.9.1.3 requires remediation of fuel beyond its storage life.

Most often the Oil Refineries and other experts will cite 6-12 months as the storage life of diesel in cool and dry conditions. Less than perfect storage might bring that to 3-6 months. But that is the start of a slow process of degradation. Lets settle on this:

Standard: Fuel Clean and Treat every **12 months**

Conservative: Fuel Clean and Treat every **6 months**

Paranoid: Fuel Clean and Treat every **3 months**

Fuel Testing: “A fuel quality test shall be performed at least annually using appropriate ASTM standards. Limited fuel quality testing performed annually using appropriate ASTM test methods is recommended as a means to determine that existing fuel inventories are suitable for continued long term storage. Special attention should be paid to sampling the bottom of the storage tank to verify that the stored fuel is as clean and dry as practicable and that water, sediment, or microbial growth on the tank bottom is minimized. ASTM D975 Standard Specification for Diesel Fuel Oils, contains test methods for existing diesel fuel.”

I hate this part where they reference another long detailed standard for us to slog through. But it is likely necessary to figure out what “limited fuel quality testing” is exactly, when the standard D975 covers 13 different types of tests.

See the companion whitepaper:

Testing Fuel for Generators: Drilldown of NFPA 110 / ASTM 975.