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

ASTM gets drawn into this through NFPA 110 Part 8.3.7: A fuel quality test shall be performed at least annually using appropriate ASTM standards.

That is simple enough, but gets a bit more complicated by the detail in the Appendix sections of the standard. Here we will review each concept

**Appendix: A8.3.7 for "Fuel Quality Test"**

**Fuel Testing:** "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."

How do we figure out the "appropriate" ASTM standard, and what is "limited" testing to be performed annually. The problem is that ASTM D975 Standard Specification of Diesel Fuel Oils covers 7 grades of fuel, 66 ASTM reference standards, and 13 detailed test requirements.

And the standard is designed for evaluation of newly refined fuels, not for evaluating fuels in long term storage. So there will be various opinions amongst generator manufacturers, testing labs, and other experts as to exactly what is required.

**Testing Fuel for Generators: Drilldown of NFPA 110 / ASTM 975 Rules., Page 2**

We breakdown the ASTM D975 tests into 2 groups:

- Test for Characteristics subject to Degradation. These should be annually tested.
- Tests for Characteristics unlikely to Change. May by excluded from annual by permission.

| **The 13 tests Included in the ASTM 975 Standard**<br>Or Newly Delivered Fuel Standards | | | |
|---|---|---|---|
| **Description** | **ASTM Standard** | **ISO** | **ASTM Standard** |
| Flash Point | D93 | 2719 | 52C |
| Water and Sediment | D2709/D1796 | 3734 | 0.05% Max |
| Distillation | D86 | 3405 | 10% at 282C(540F)Max<br>90% at 360C(680F) Max<br>90% at 350C(662F) Max (Preferred) |
| Viscosity | D445 | 3104 | 1.4CSt Min to 4.1cSt Max |
| Sulfur | D5453/D2622/D129 | 20884 | 0.05% (<500 ppm) or better<br>0.0015% (<15ppm) for Tier IV<br>Check local regulations |
| Cetane Index | D976/D4737 | | Min 40 |
| Cetane Number | D613/D6890 | | Min 40 |
| Cloud Point | D2500 | 3015 | Must not exceed lowest expected ambient temp |
| | | | |
| Tests in Standard but Characteristics not subject to Degradation. Unlikely to Change with Time and Environment. May be acceptable to confirm with Certificate of Analysis (COA) from fuel supplier, or results of prior testing. | | | |
| Ash Content | D482 | 6245 | 0.01% Max by weight |
| Copper Corrosion | D130 | 2160 | No. 3 Maximum |
| Carbon Residue | D524 | 4262 | 0.035% Max by weight |
| Lubricity | D6079 (HFRR) /D7688 | NA | 0.52 mm (0.0205 inch) Max at 60C (140F) |
| Conductivity | D2624/D4308 | NA | 25 pS/M |

**Testing Fuel for Generators: Drilldown of NFPA 110 / ASTM 975 Rules, Page 3**

Now let's look at additional tests, not included in the standard that may be recommended or required by the generator manufacturer. The reason they specify these tests is to ensure reliability. They do not want bad fuel impacting the best performance of the machine.

**Other OEM Recommended or Required Tests**
Additional Detailed Tests Critical for Generator Reliability

| Description | ASTM Standard | ISO | OEM Standard |
|---|---|---|---|
| Density | D1298 / D287 | NA | 800 KG/M3 Min |
| Aromatics | D1319 | 3837 | 35% Max |
| Thermal Stability | D6468 | NA | Min 80% Reflectance after Aging 180 minutes at 150C (302F) |
| Pour Point | D97 | 3016 | 6C (10F) Min below ambient temp |
| Gums and Resins | D381 | 6246 | 10 mg per 100 mL Max |
| Water | D1744/D6304 | NA | 0.05% Max by weight |
| Sediment | D473 | 3735 | 0.05% Max by weight |
| Cleanliness / Particulates | D5452 / D7619 | 4406 | ISO 18/16/13 or better |
| Trace Metals | D7111 | | |
| Oxidative Stability | D2274 / D4625 | 12205 | Max 25g/M3 |

Finally Here is a Summary of Tests for Microbial Contamination.

**Tests for Microbial Contamination**
Field ATP Tests are recommended. The samples are not subject to spoil during transport, and a numeric result allows tracking over time. Other test results are Pass / Fail, or Good/Bad/Severe

| Method | Standard | Brand | Acceptance |
|---|---|---|---|
| ATP Bioluminescence | ASTM D7463 (ATP) | Luminultra<br>Hy-Lite | Field Test<br><10 pg cATP/ml |
| Filtration | ASTM D6974-16 | | Lab Test<br>Interpret per ASTM D6469 |
| Growth in Nutrient Gel | ASTM D7978-14 | MicrobeMonitor2 | Field Sample + 4 Day Incubate<br><4000 cfu/liter |
| Immunoassay | ASTM D8070-16 | Fuelstat | Field Test<br>< 150ug/l fuel, <33ug/ml water |
| Growth | None | Liqui-cult | Field Sample + 3 Day Incubate<br>Color Compare |

**Testing Fuel for Generators: Drilldown of NFPA 110 / ASTM 975 Rules, Page 4**

Here is a worksheet for determining the tests needed and calculating the cost. Most testing labs have package prices for common test groups, and that is how the Annual Low and Best are estimated. The local Authority Having Jurisdiction (AHJ) for Life Safety Code Compliance may require tests in addition to the Annual Low listed items.

| Item | Test Name | All | Annual Low | Annual Best | Comment |
|---|---|---|---|---|---|
| 1 | Flash Point | X | | X | |
| 2 | Water and Sediment | X | X | X | |
| 3 | Distillation | X | X | X | |
| 4 | Viscosity | X | | X | |
| 5 | Sulfur | X | | X | |
| 6 | Cetane Index | X | X | X | |
| 7 | Cetane Number | X | | | |
| 8 | Cloud Point | X | | X | |
| | | | | | |
| 10 | Ash Content | X | | | |
| 11 | Copper Corrosion | X | | | |
| 12 | Carbon Residue | X | | | |
| 13 | Lubricity | X | | | |
| 14 | Conductivity | X | | | |
| | | | | | |
| 15 | Density / API Gravity | X | X | X | |
| 16 | Aromatics | X | | | |
| 17 | Thermal Stability | X | | X | |
| 18 | Pour Point | X | | X | |
| 19 | Gums and Resins | X | | | |
| 20 | Water | X | X | X | |
| 21 | Sediment | X | | | |
| 22 | Cleanliness / Particle Count | X | X | | |
| 23 | Trace Metals | X | | X | |
| 24 | Oxidative Stability | X | | | |
| | | | | | |
| 25 | Microbial Pass/Fail | X | X | X | |
| | Field ATP Test | | | | Add $275 |
| | | | | | |
| | **Estimated Cost** | **$1500** | **$250** | **$500** | Includes Sample and Ship |