



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 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.

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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 be excluded from annual by permission.

The 13 tests Included in the ASTM 975 Standard 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 90% at 360C(680F) Max 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 0.0015% (<15ppm) for Tier IV 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

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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 Hy-Lite	Field Test <10 pg cATP/ml
Filtration	ASTM D6974-16		Lab Test Interpret per ASTM D6469
Growth in Nutrient Gel	ASTM D7978-14	MicrobeMonitor2	Field Sample + 4 Day Incubate <4000 cfu/liter
Immunoassay	ASTM D8070-16	Fuelstat	Field Test < 150ug/l fuel, <33ug/ml water
Growth	None	Liqui-cult	Field Sample + 3 Day Incubate Color Compare

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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