

Bonneville Fuels Smoke Opacity Testing
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Opacity is defined as the percentage of light transmitted from a source that is prevented from reaching a light detector. In smoke opacity measurements from a diesel vehicle, a beam of light is transmitted across the exhaust plume to a light detector. High opacity may indicate engine malfunction and increased emissions of air pollutants, primarily unburned fuel hydrocarbons or soot particles. It is well-known that diesel engine malfunction or maladjustment can result in increased emissions of pollutants, and repair of high opacity emitters may therefore result in a decrease in the contribution of diesel vehicles to the pollutant inventory. The measured value of smoke opacity is highly dependent upon the test procedures, including ambient conditions, engine operating mode, measurement configuration, and instrumentation. In recent years, the SAEJ1667 test procedure has been suggested as a standard test. This test was developed specifically to identify gross emitting heavy-duty trucks and buses.

Smoke Opacity Testing. Snap-idle tests are performed with the warmed-up vehicle in neutral using a digital smoke meter. The accelerator is rapidly pushed to the floor held there for 5 seconds or until the engine reaches maximum (governed) speed, while smoke opacity is measured. The maximum opacity observed is reported. For the SAE J1667 test, three practice tests are first performed. This is followed by three real tests, which are averaged to obtain the reported value. The three tests must meet an allowable spread criterion, and the percentage of smoke opacity is corrected for stack diameter using an extinction coefficient specific to the instrument. The correction factor for ambient temperature, humidity, and barometric pressure specified in the J1667 procedure are applied.

Excessive smoke is caused by operation at a fuel/air ratio above the smoke limit, and thus repairs typically involve components that affect fuel/air ratio. Most repairs needed are to the injectors, fuel pumps, fuel pump calibration, and injection timing. Injection timing and governor adjustments are the most common repairs for pre-1991 vehicles, and injector replacement is the most common repair for 1991 and newer vehicles. In most cases repairs result in an apparent reduction in opacity, although not always to a passing level. For many vehicle owners additional repairs are needed in order to pass the opacity test, but in many cases this cannot be done because of the costs to vehicle owners.

The following opacity test was performed on a 1997 International with a 475 hp 60 Series Detroit Engine. This vehicle was in compliance with current state opacity guidelines. The owner operator said that he noticed no apparent engine problems or smoke problems. The opacity test was performed to see the before and after differences using BF Catalyst. The truck was run 712 miles after the BF Catalyst was put in the fuel tank and then retested. Below are the results.

OPACITY TEST RESULTS BEFORE BF CATALYST

Test Date: 01/29/2009

Snap#	Opacity %	Stack	Legal Limit
1	8.10	5 inch	70 %
2	8.10		70%
3	7.60		70%
AVERAGE	7.9333		

OPACITY TEST RESULTS AFTER BF CATALYST

Test Date: 02/02/2009

Snap#	Opacity%	Stack	Legal Limit
1	5.70	5 inch	70%
2	5.40		
3	5.6		
AVERAGE	5.5767		

Test Administrator Number: 0X001710

Name: Green

The test shows less smoke on the second test by 29.83%. The same test will be run in 60 days to see how they compare. By burning most of the fuel in the combustion chamber there was no black smoke left to enter the atmosphere adding pollution. Note, we do not claim to fix any problems that need attention by adjustment or good maintenance practices. The BF Catalyst will help the combustion process to complete its cycle properly, and will keep the injection system cleaner longer thus requiring less maintenance. Further testing is an ongoing process with Bonneville Fuels to insure the customer real value for the money spent.