

SFR D-SOL Series Diesel Fuel Conditioners

**Lubricity/Cetane Summer Version
All Season Multi-Functional Winter Version**

APRIL 2006

SFR D-SOL Series Diesel Fuel Conditioners

o Peugeot XUD9

- -Keep Clean**
- -Clean Up**

o Cummins L10

- -Keep Clean**
- -Clean Up**
- Cummins L10-IDT Cycle**
- Steady State**

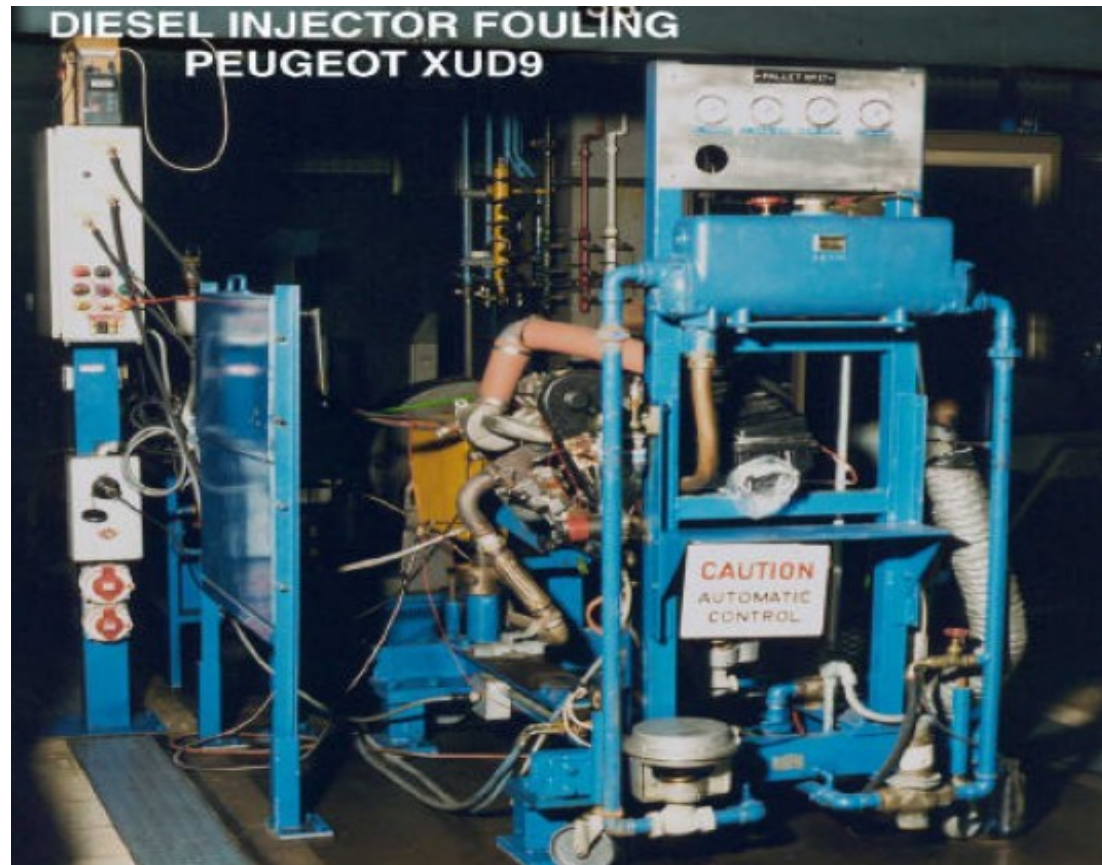
o Emissions & Fuel Economy

o Fleet Testing

SFR D-SOL Series Diesel Fuel Conditioners

Peugeot XUD9 Testing

This standard test method represents light duty, indirect injection engines.

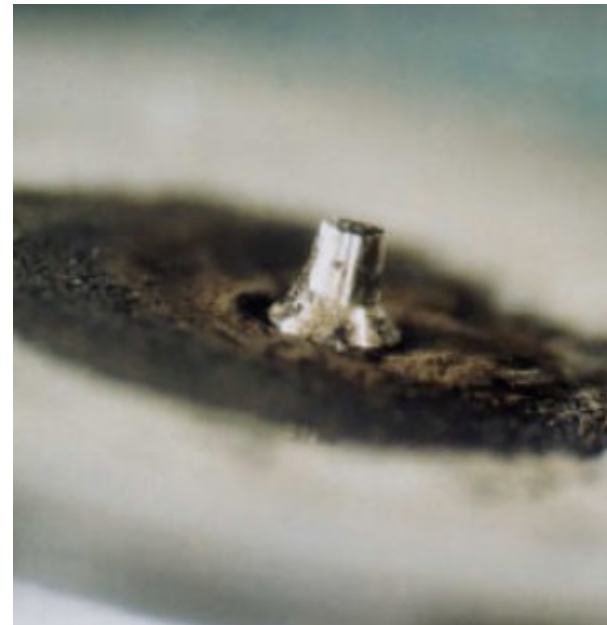


SFR D-SOL Series Diesel Fuel Conditioners

Peugeot XUD9 Testing



FAIL



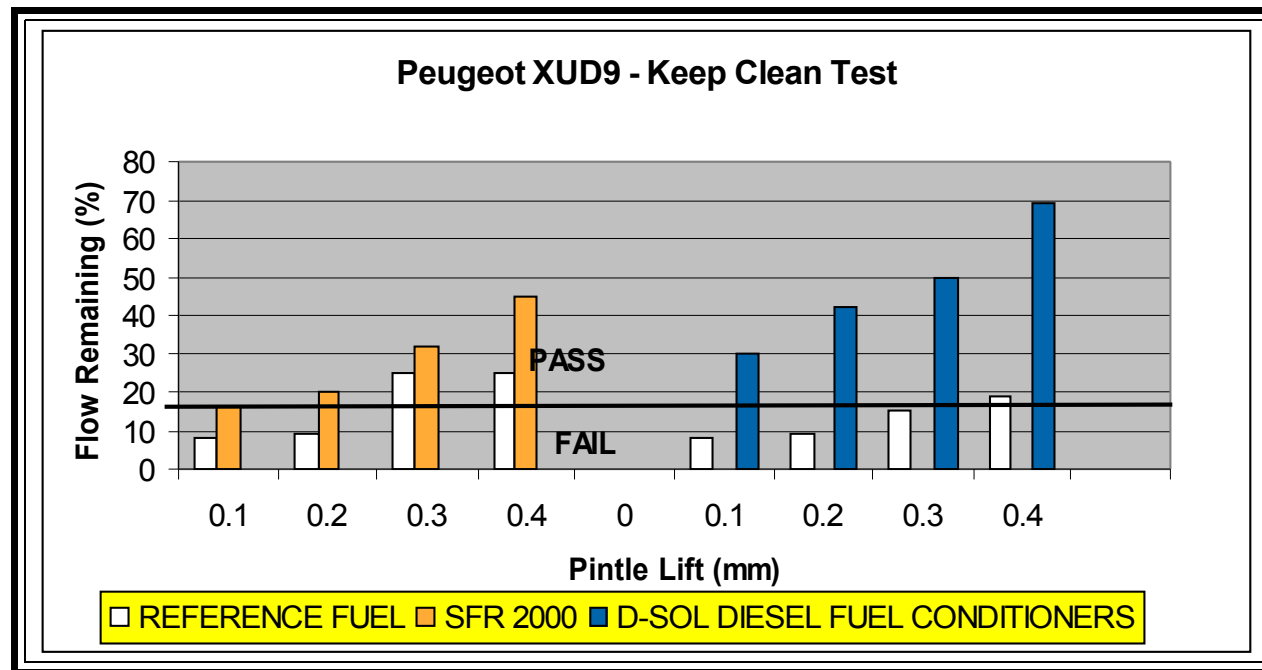
PASS

INJECTORS RUN IN THE PEUGEOT XUD9 NOZZLE COKING TEST

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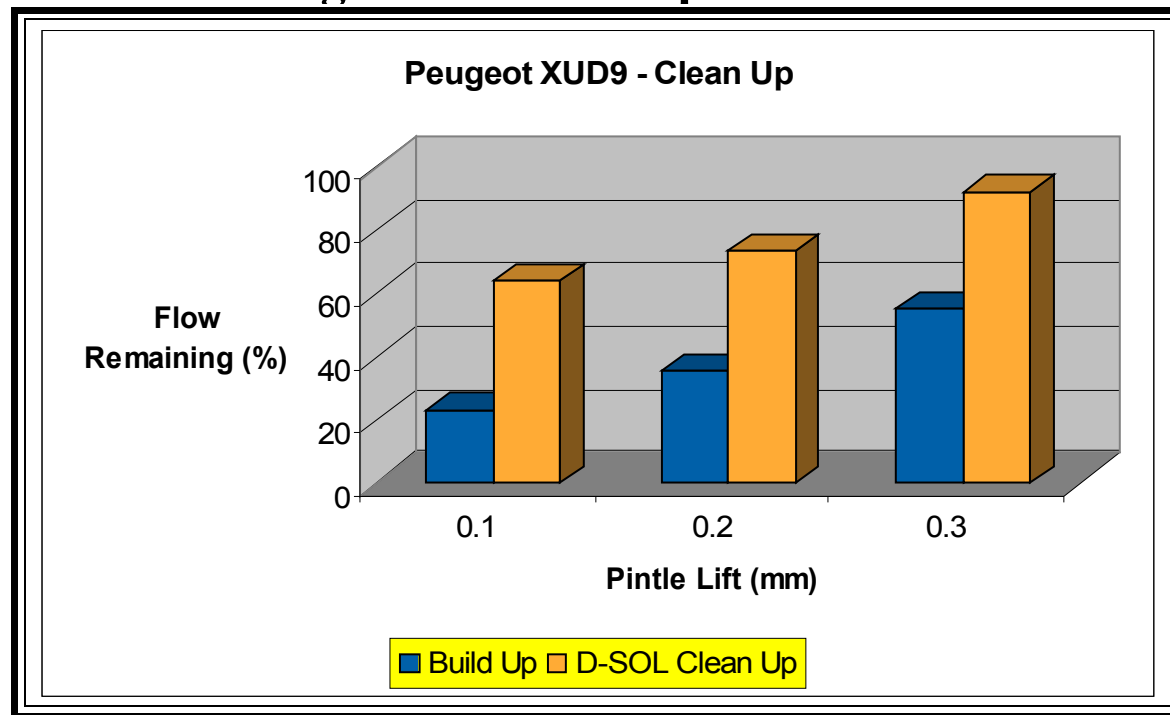
Peugeot XUD9 – Keep Clean Test

Testing in CEC RF-03-1-84 reference fuel demonstrates that D-SOL Fuel Conditioners perform at a higher level than SFR 2000 or the Reference Fuel. The passing criteria is greater than 15% flow remaining at 0.1 mm pintle lift.



SFR D-SOL Series Diesel Fuel Conditioners

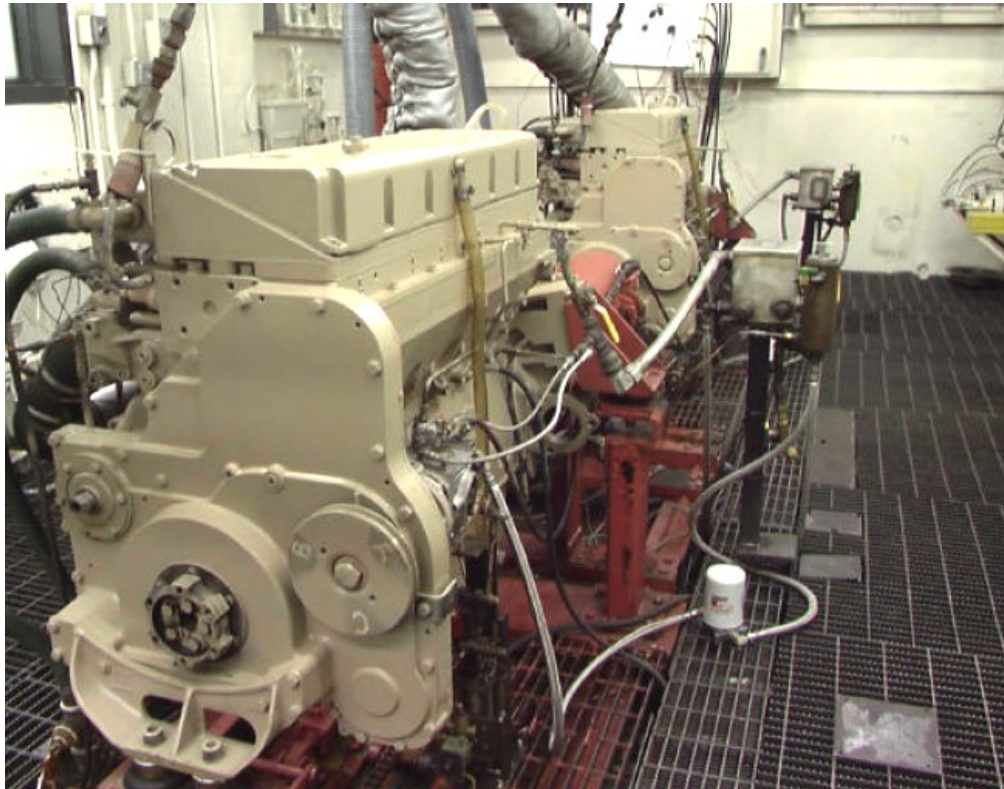
Peugeot XUD9-Keep Clean Test



The engine was operated on untreated fuel, which resulted in injector plugging. After operation on D-SOL treated fuel, these same injectors showed a 60% improvement in flow at 0.1 mm pintle lift. This performance reinforces the detergent performance of D-SOL Fuel conditioners.

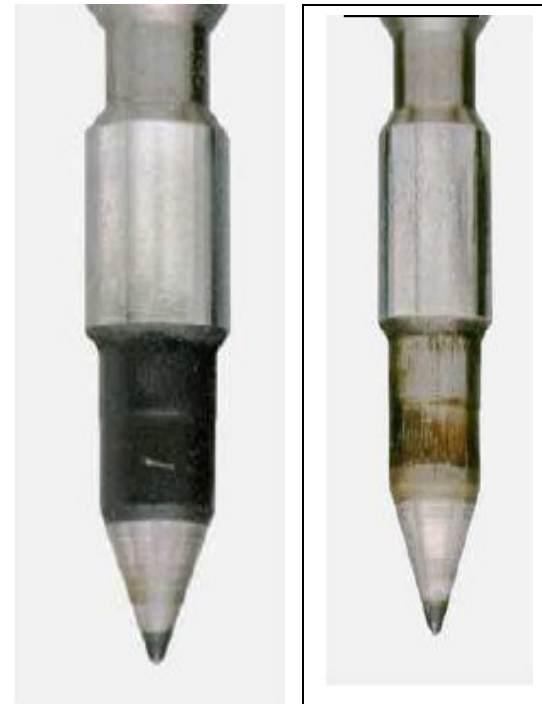
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Cummins L10-IDT Testing



FAIL

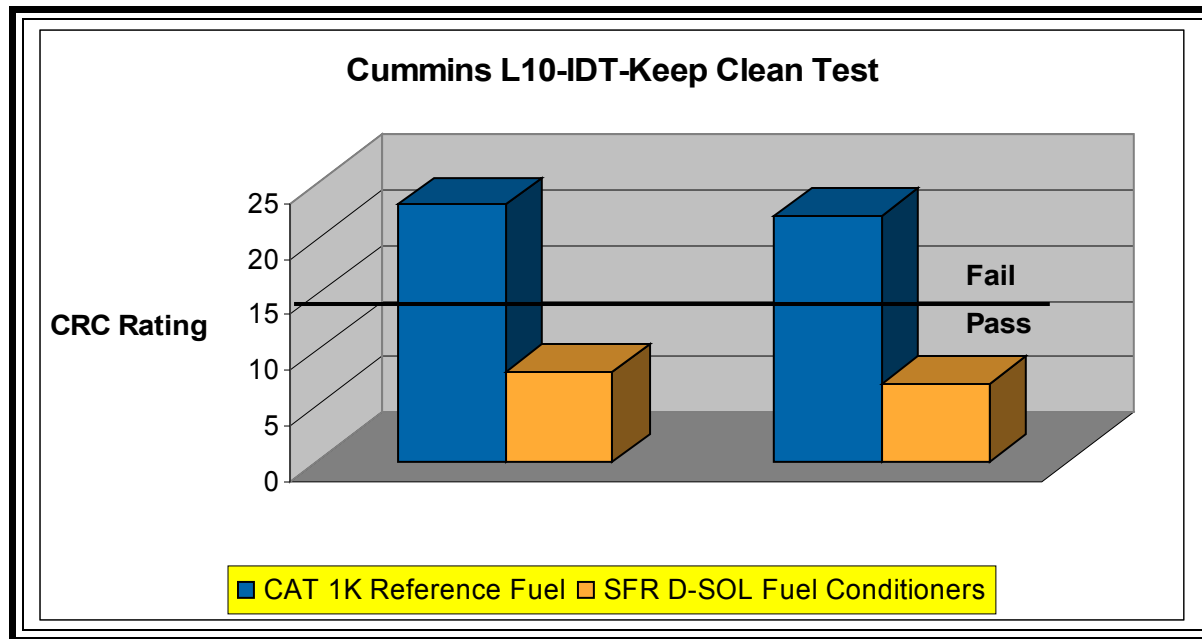
PASS



This standard test method represents performance in Direct Injection Heavy Duty Engines

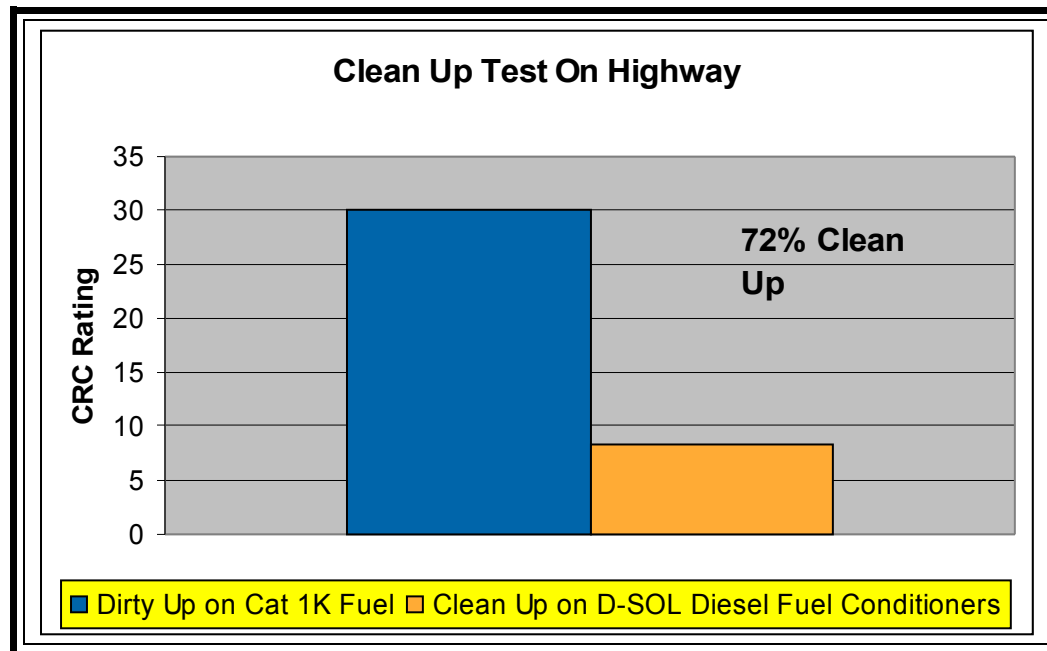
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Cummins L10-IDT – Keep Clean Test



SFR D-SOL Fuel Conditioners show strong performance with Cummins Superior ratings in repeat testing using several batches of the CAT 1K reference fuel.

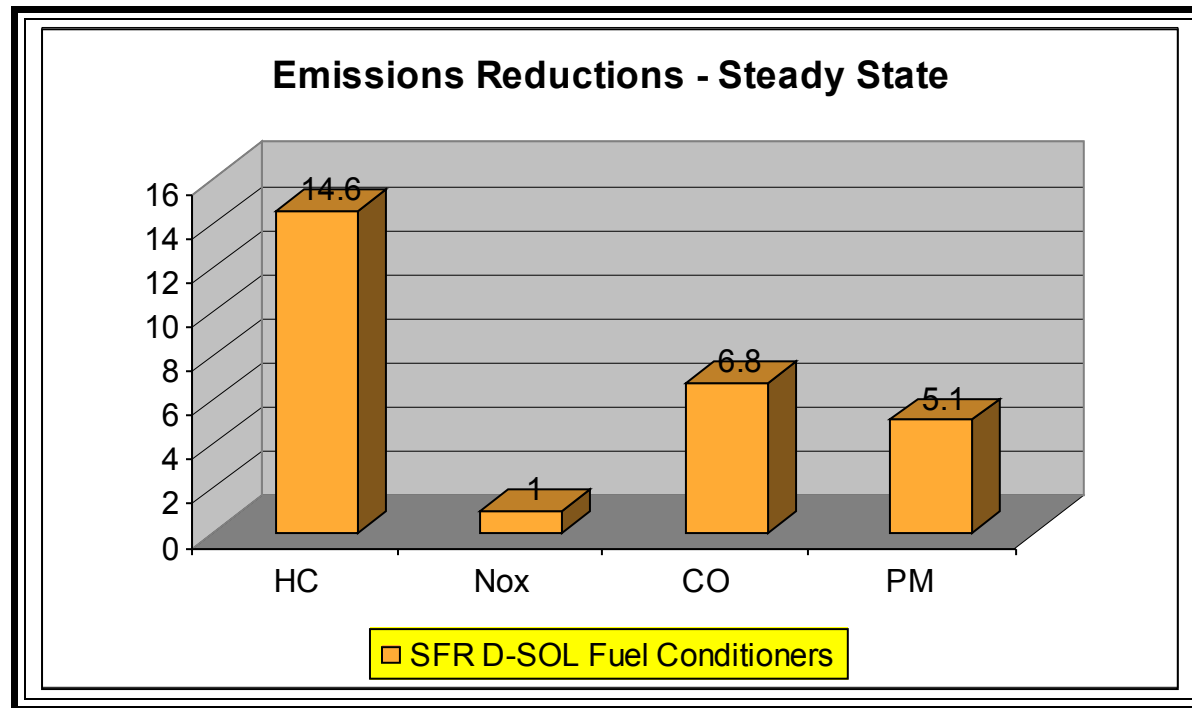
SFR D-SOL Series Diesel Fuel Conditioners Clean Up Test – Steady State (On Highway)



Clean up tests on Cummins L10 injectors deposited while running Cat 1K fuel were conducted to demonstrate the ability of these detergents to clean up injectors under steady state conditions. The conditions (1800 RPM, 600 ft-lbs torque) simulate a heavy duty truck cruising at normal road speed. After consuming 600 gallons of treated fuel, D-SOL showed high levels of clean up.

SFR D-SOL Series Diesel Fuel Conditioners

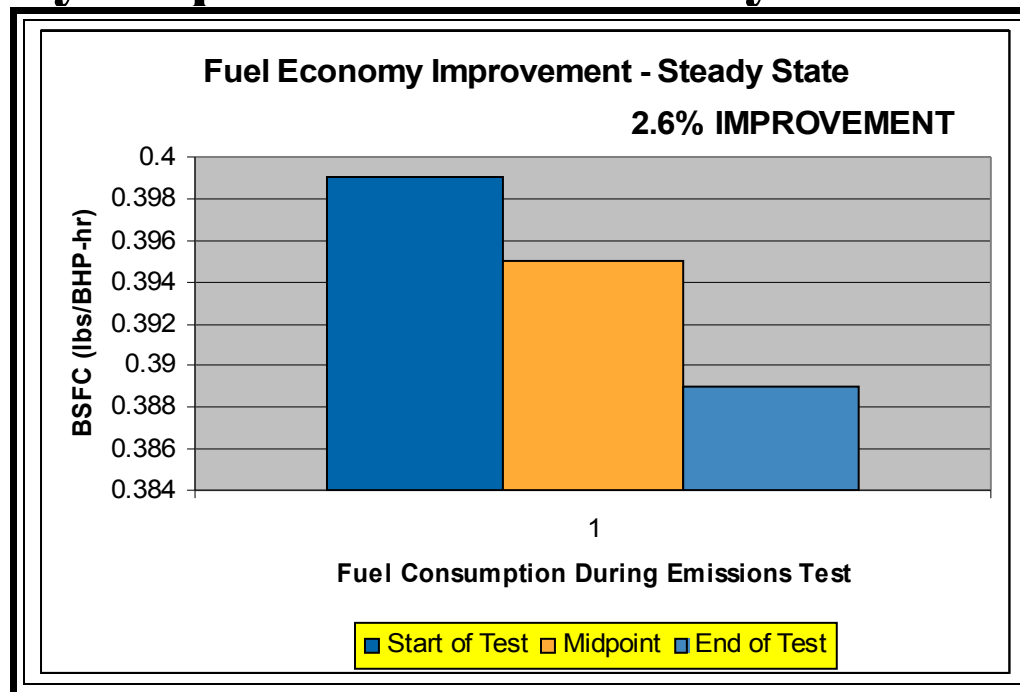
Emissions Reductions – Steady State



This graph summarizes the reduction in emissions caused by the injector clean up with D-SOL Fuel Conditioners from the start of the test (dirty injectors) to the end of test (cleaned up injectors)

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Fuel Economy Improvement – Steady State



Fuel economy was monitored during transient emissions testing at the start, midpoint and end of test. After the injectors were cleaned by fuel containing SFR D-SOL Fuel Conditioners, fuel economy had increased by 2.6%

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Fuel Economy Test

Equipment: Three (3) Freightliner trucks equipped with Detroit DD60 engines from an in-use fleet

- **Unit 27 – Test Truck, starting mileage of 337,000 miles**
- **Unit 28 – Test Truck, starting mileage of 603,000 miles**
- **Unit 31 – Control Truck, starting mileage of 322,000 miles**

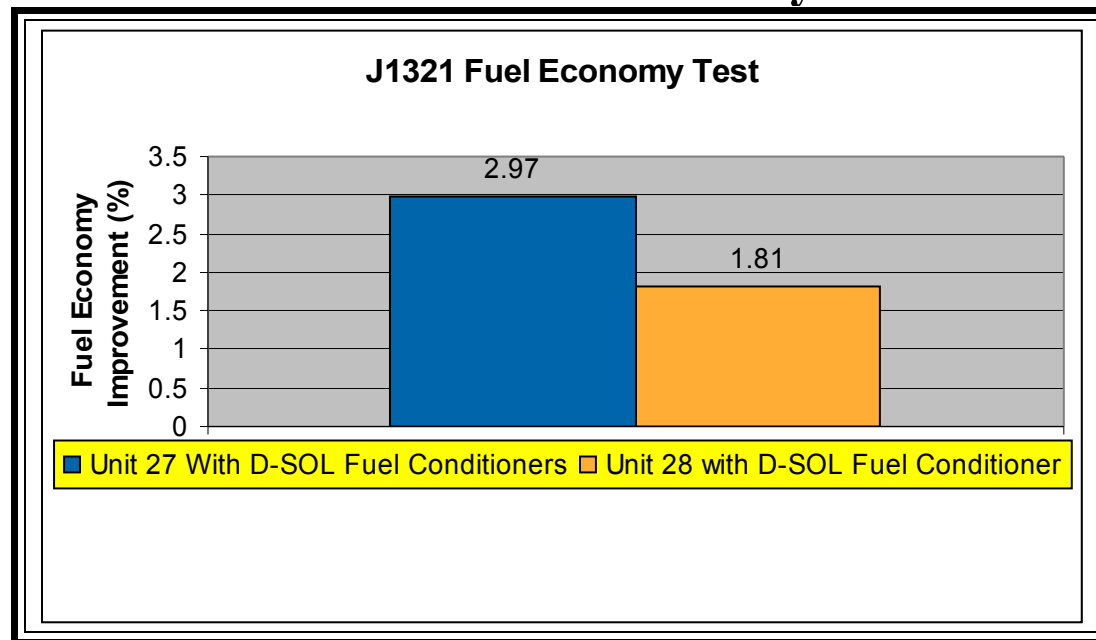
Method: SAE J1321 “Joint TMC / SAE Fuel Consumption Test Procedure Type II”

Procedure:

- **Inspect all trucks, change all fluids, and perform rig alignments**
- **Use trucks to train drivers and to run J1321 practice laps on highway**
- **Run baseline TMC / SAE test procedure on highway using base fuel**
- **Accumulate 15,000 miles on test trucks using D-SOL Fuel Conditioner with base fuel**
- **Repeat TMC / SAE test procedure on highway using base fuel**
- **Compare baseline and post mileage accumulation tests to control truck ratios**

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SFR D-SOL Fuel Economy Test



After 15,000 miles of operation on diesel containing D-SOL Fuel Conditioners, both trucks showed improved fuel economy relative to the control truck.

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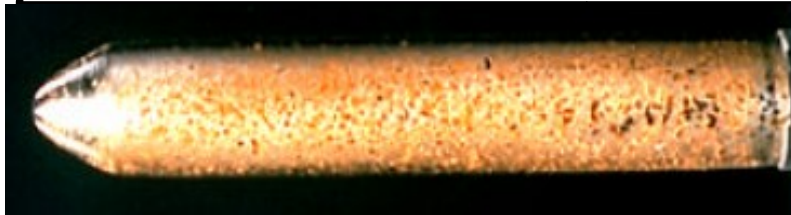
Laboratory Bench Tests

- **NACE Rust Test**
- **SLBOCLE Lubricity Test (ASTM D6078)**
- **HFRR Lubricity Test (ASTM D6079)**
- **Fuel Oil Thermal Stability Test (ASTM D6468)**
- **Oxidation Storage Stability (ASTM D2274)**
- **Water Tolerance (ASTM D1094)**
- **Cummins Fuel Filter Compatibility Test**
 - **Cummins Elastomer Compatibility Test**

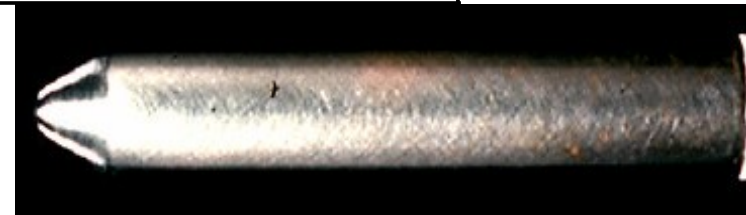
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NACE Rust Test

	NACE Visual Rating	% Rust
Base Fuel A (Depolarized Isooctane)	E	75-100%
Fuel A + D-SOL Fuel Conditioners	A	None
Base Fuel B Commercial No. 2 Diesel Fuel	D	50-75%



“E” NACE Rating



“A” NACE Rating

SFR D-SOL Fuel conditioners provide superior anti-corrosion protection. This insures superior anti-rust protection in storage facilities, fuel handling systems, and end user diesel engines. SFR D-SOL Series fuel conditioners provide superior anti-corrosion protection in extremely severe diesel fuel. This characteristic ensures superior anti-rust protection in storage facilities, fuel handling systems, and end user diesel engines.

SFR D-SOL Series Diesel Fuel Conditioners Lubricity – SLBOCLE Test (ASTM D6078)

	Load (grams)
Base Fuel A	2750
Fuel A + D-Sol Fuel Conditioners	4550

D-SOL Fuel Conditioners, when added to low lubricity fuels, provide excellent anti-wear performance as measured by the Scuffing Load Ball on Cylinder Lubricity Evaluator Test. The typical industry pass for this test is greater than 3100 grams.

SFR D-SOL Series Diesel Fuel Conditioners

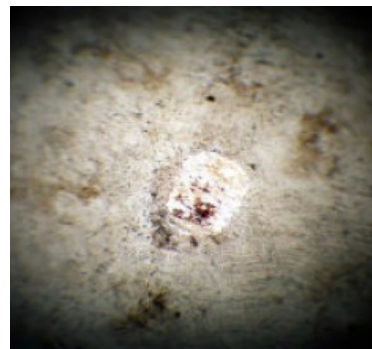
Lubricity – HFRR Test (ASTM D6079)

	Wear Scar Diameter (microns)
Base Fuel A	570
Fuel A + D-SOL Fuel Conditioners	370
Base Fuel B	500
Fuel B + D-SOL Fuel Conditioners	460

FAIL



PASS



Adding D-SOL Fuel Conditioners to a base fuel improves lubricity performance to within the typical passing range of ≤ 460 microns on the High Frequency Reciprocating Rig (HFRR). This performance enhances the wear protection of fuel pumps and other fuel system components.

SFR D-SOL Series Diesel Fuel Conditioners

Thermal Fuel Stability (ASTM D6468)

	Fuel Color (D1500)		% Reflectance
	Initial	Final	
	1		
Base Fuel A	1.5	<3.5	57
Fuel A + D-Sol Fuel Conditioners	<2.5	<3	85
Base Fuel B	<1.5	<2	62
Fuel B + D-Sol Fuel Conditioners	<1.5	<1.5	87
Base Fuel C	1.5	<3.5	48
Fuel C + D-Sol Fuel Conditioners	<2.0	<2.0	88



FAIL



PASS

In this test, SFR D-Sol Series Fuel Conditioners provide excellent stability as illustrated by the high reflection. Thermal degradation of diesel fuel can cause formation of gums, which can increase the formation of deposits and the chance of filter plugging.

SFR D-SOL Series Diesel Fuel Conditioners

Water Tolerance (ASTM D1094)

	Rating After 5 Minutes		Minutes to 20 ml.
	Interface	Separation	
Base Fuel	1	1	1
Fuel +D-Sol Fuel Conditioners	4	3	>10



SFR D-Sol Fuel Conditioners maintain similar fuel/water separation performance to base fuels and offer trouble free handling after any contact with water. D-Sol will insure that emulsions will not readily form, thus prohibiting drivability and rusting concerns.

SFR D-SOL Series Diesel Fuel Conditioners

Elastomer Compatibility

	Change from Base Fuel
Elongation w/ D-Sol Fuel Conditioners	Pass
Tensile Strength w/ D-Sol Fuel Conditioners	Pass
Volume w/ D-Sol Fuel Conditioners	Pass
Hardness w/ D-Sol Fuel Conditioners	Pass

D-Sol Fuel Conditioners are completely compatible with elastomers and seal materials typically found in diesel engines and will not harm their performance. D-Sol Fuel Conditioners were tested with low swell nitrile, medium swell nitrile, and fluoroelastomer components.

SFR D-SOL Series Diesel Fuel Conditioner

Summary

**SFR's New Diesel Fuel Conditioners, Multi-Functional All
Season and Lubricity/Cetane Boost Conditioners
provide:**

- o Enhanced Injector Clean Up Capability**
- o Reduced Emissions**
- o Improved Fuel Economy**
- o Excellent Corrosion Protection**
- o Excellent Thermal/Oxidation Stability**
- o Improved Lubricity**
- o Chlorine Free Chemistry**