



Performance Data



X-1R Global Ltd

To: All X-1R distributors

From: Nigel (Mac) McKenzie

Cc:

Date 26th February 2025

Subject: Revision to Diesel Decarboniser Formulation/Diesel Treatment

The needs of modern engines change on a regular basis. In most markets diesel powered vehicles have a slew of anti-pollution measures to ensure that they are not polluting the environment. This includes Exhaust Gas Recirculation (EGR) Diesel Particulate Filters (DPF) and Catalytic Converters. AS these items are involved with reducing pollution it goes without reason that they will become coated with carbonised materials and coked up quickly leading to reduced performance and possibly the sort of pollution that they are designed to stop. This is particularly the case when the fuel is of dubious quality and the machines operate in humid and dusty conditions, like most of South East Asia.

With this in mind and after a number of questions and requests from some of the leading Automotive Manufacturers in the region we began a quest to improve the efficacy of our Decarbonisers in the exhaust area of the vehicle being treated. For the past year we have been testing a specific formulation and I am happy to announce that we are now in the process of a soft-launch of the product throughout the region.

The new product, is an organometallic DPF regenerator/cleaner additive concentrate that also cleans the EGR and Catalytic cleaner suitable for use in all diesel engines and with all levels of fuel quality. It works by lowering the ignition temperature of the soot that collects on the EGR.DPF and Catalytic Converters and thus supports the periodic filter regeneration.

The organometallic compound has a reddish hew and thus the colour of our Diesel Decarboniser/Treatment will in the future be a slightly darker colour and reddish colour, this is something you may want to consider informing your customers of. Following is the performance data sheet released by our laboratory in Daytona for your greater understanding. Should you wish, I can visit to explain the benefits of this addition to our products in greater depth.

Nigel McKenzie

February 2025

Cont.



Performance Data

X-1R DPF Cleaner Concentrate

DPF regeneration tests have been performed with a Euro-5 2.0 L diesel engine following the operating conditions described in Table 1. Standard European fuel compliant with EN590 standard is additized with the X-1R DPF Cleaner to deliver a concentration of 5 ppm active Metal (expressed as ppm metal in fuel or mg metal per kg of fuel). The filter is loaded at low temperature (approx. 240 °C) until the total soot amount is 12 g (approximately 4.5 g soot /L). After checking exact soot amount in the filter by weight, engine conditions are changed to reach the desired DPF/CSF (catalyzed soot filter) inlet temperature (500 °C or 600 °C), the temperature being raised by post-injection at 2200 rpm - 80 Nm for 5 min. Regeneration is monitored over 60 min through back pressure decrease. Total regeneration efficiency is calculated by weight loss of the filter due to soot burn. The regeneration kinetics are expressed as soot burn rate over the time and assumes linear correlation of soot mass burned with back pressure reduction.

Table 1. Engine characteristics and operating conditions for filter soot loading and regeneration at 500 °C

Engine	Euro 5, 2 L, 4 Cylinders, 87 kW		
Diesel Oxidation Catalyst (DOC)	Pt based		
Filter	DPF: SiC CSF: SiC commercial Pt based coating		
Test Procedure			
Step	Speed (rpm)	Torque (Nm)	Duration
External Clean-up (600 °C heating and blow-off)			60 min
Loading procedure (2 g soot/h)			
Filter Soot loading	3000	45	6 h
Regeneration procedure (at 450 °C)			
Engine warm-up at loading point	2200	80	5 min
Filter regeneration	2200	80	60 min

Regeneration Test Results:

Results of regeneration performance, at 500 °C and 600 °C, are compared between DPF+X-1R DPF Cleaner at 5 ppm active Metal, CSF and DPF alone are reported in Figure 1. At 500 °C, X-1R DPF Cleaner dosed at 5 ppm active Metal concentration exhibits more than 90% soot burn after 5 min of DPF regeneration. In comparison, without X-1R DPF Cleaner, regeneration of the CSF is only 22% after 10 min and 20% for the bare DPF. At 600 °C, regeneration with X-1R DPF Cleaner is completed within less than 5 min, and CSF regeneration (50%) differentiates from bare DPF (35% only) after 10 min. This clearly demonstrates the improved capability of the X-1R DPF Cleaner even at low temperature (500°C) and low treat rate (5 ppm active Metal), to deliver DPF regeneration compared to other technologies. The high efficiency of the X-1R DPF Cleaner is attributed to increase in catalytic sites and promote contact with the soot. Such contact between soot and the catalyst is key to securing the efficient low temperature soot combustion. Low DPF regeneration temperature and rapid filter regeneration directly improve fuel economy and CO₂ emissions and assist reliable function of the after-treatment system.



X-1R DPF Cleaner Concentrate

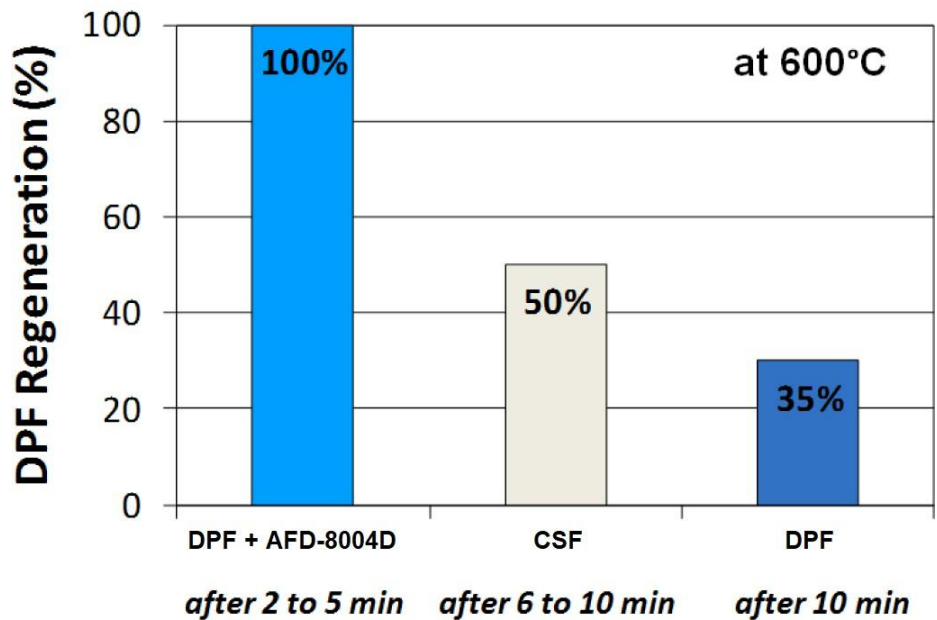
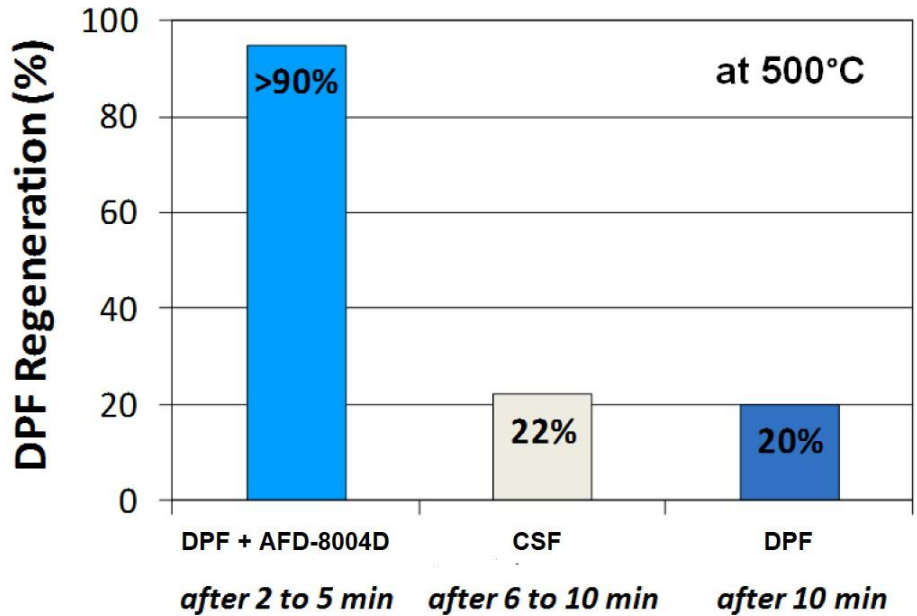


Figure 1. Compared regeneration efficiency at 500 °C and 600 °C between DPF+AFD-8004D at 5 ppm active Metal, CSF and DPF alone:

Delivering this improved functionality at a low treat rate (5 ppm active metal) improves X-1R DPF Cleaner tank autonomy on the vehicle, but also lowers DPF ash accumulation, thus increasing the DPF ash cleaning maintenance interval.



X-1R DPF Cleaner Concentrate

Flexibility Regarding the Sulfur Content in Fuel:

Sulfur content in fuel is one of the challenges to robustness and durability of the strategies developed for modern emissions standards. DPF regeneration tests with X-1R DPF Cleaner have been carried out with fuels containing between 10 and 350 ppm sulfur, and results are presented in Figure-2 (AFD-8004D treat rate is 5 ppm active metal). It shows oxidation rate of the soot remains the same irrespective of the sulfur content of the fuel. Compared to regeneration without X-1R DPF Cleaner, a 150 °C improvement in temperature, to reach the same combustion rate, is evident. Clearly the X-1R DPF Cleaner technology shows little sensitivity, in DPF regeneration function, towards sulfur content.

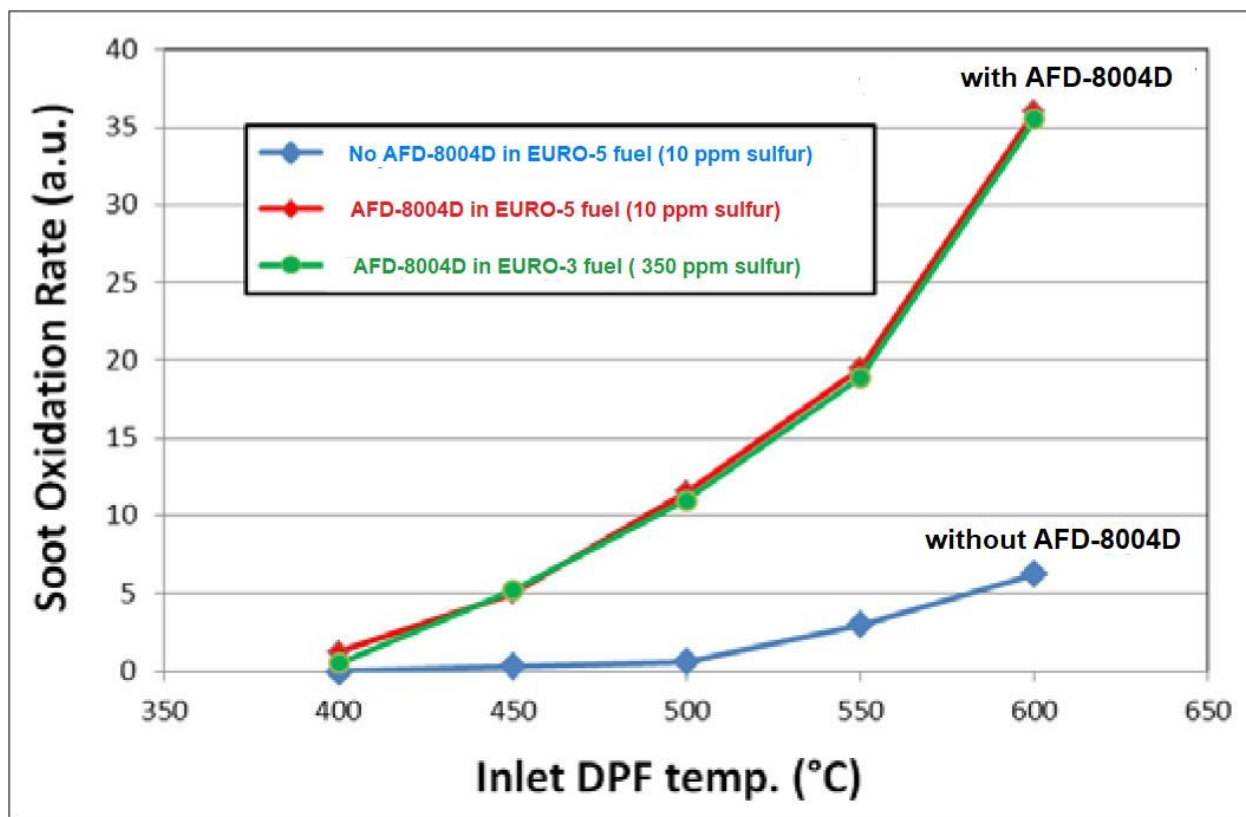


Figure 2. Soot oxidation rate with or without X-1R DPF Cleaner in fuels with different sulfur contents.



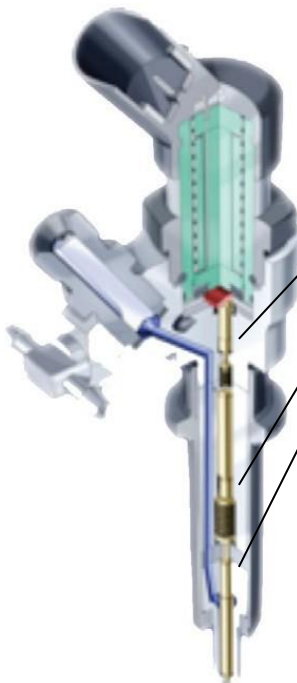
Performance Data

X-1R DPF Cleaner Concentrate



- 2.0 liter / 4 cylinder
- Direct injection turbocharged / intercooled

- Continental common rail equipment
- Euro V injector design (six 110 μm holes, 1,600 bar pressure)



Internal diesel injector deposits (IDID)

- Deposits inside injector: at valve, piston and needle
- Recent field problems (rough engine operation, no engine start)
- Engine tests to evaluate fuel propensity to form internal deposits



External spray hole deposits

- Inside / around spray holes
- Field problems (powerloss)
- CEC F-98-08 test to evaluate fuel propensity to form spray hole deposits

AFD-8004D helps ensure consistently high engine performance by keeping injector spray holes clean and preventing power loss (Keep Clean effect). It also effectively removes already formed injector deposits and restores lost engine power (Clean Up effect). As shown on the right, the use of X-1R Diesel Treatment effectively removes Internal Diesel Injector Deposits (IDID) in vehicles.

Images of injector interior (solenoid coil face)



At Start: Deposits in Injectors



After 2 tank fills with fuel additized with X-1R Diesel Treatment

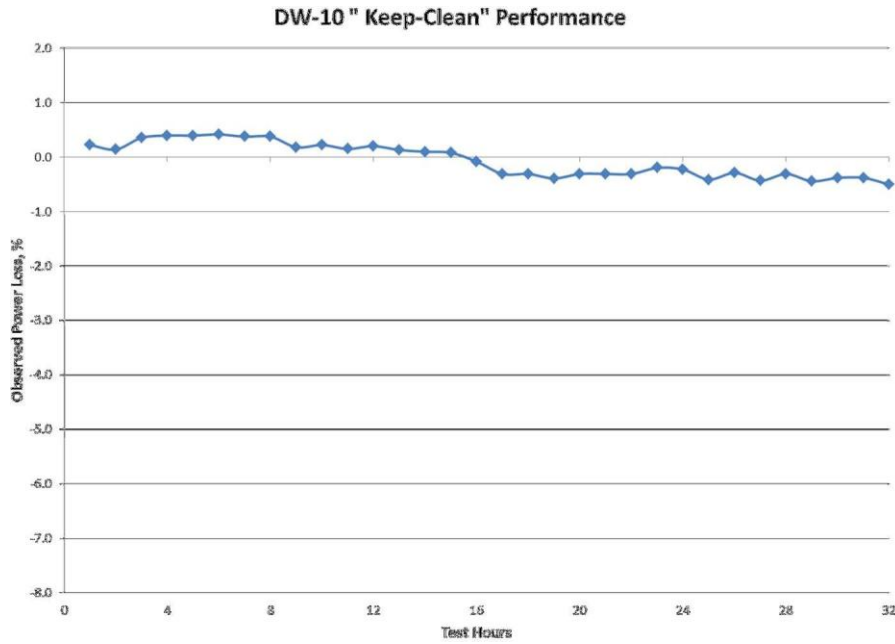


After 5 tank fills with fuel additized with X-1R Diesel Treatment

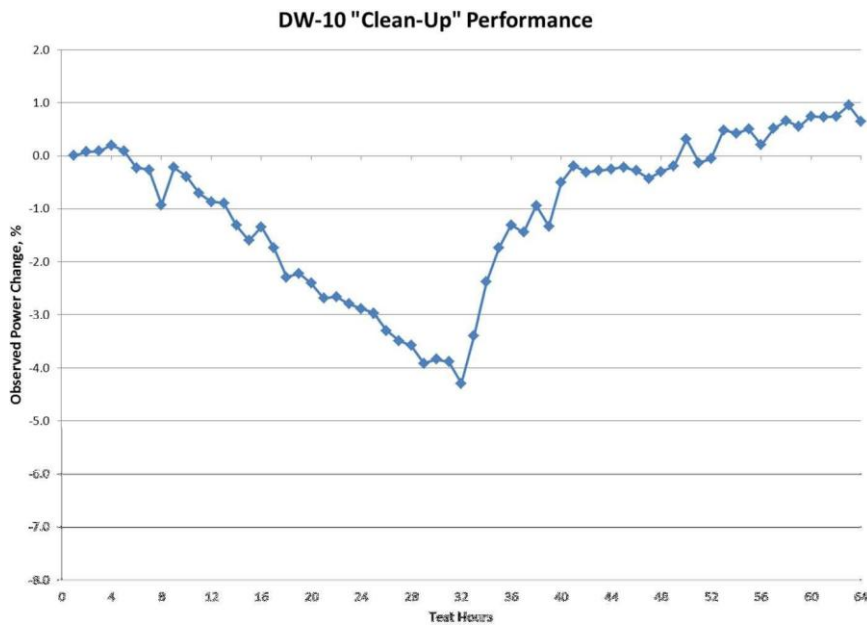


X-1R DPF Cleaner Concentrate

DW-10 "Keep-Clean" Performance:



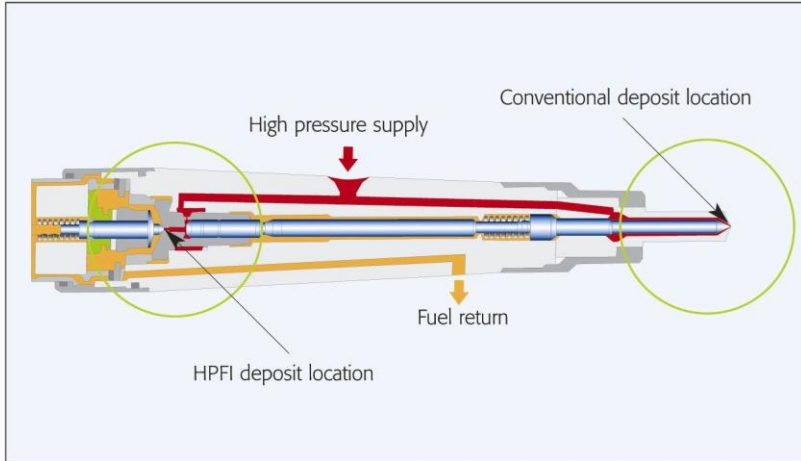
DW-10 "Clean-Up" Performance:



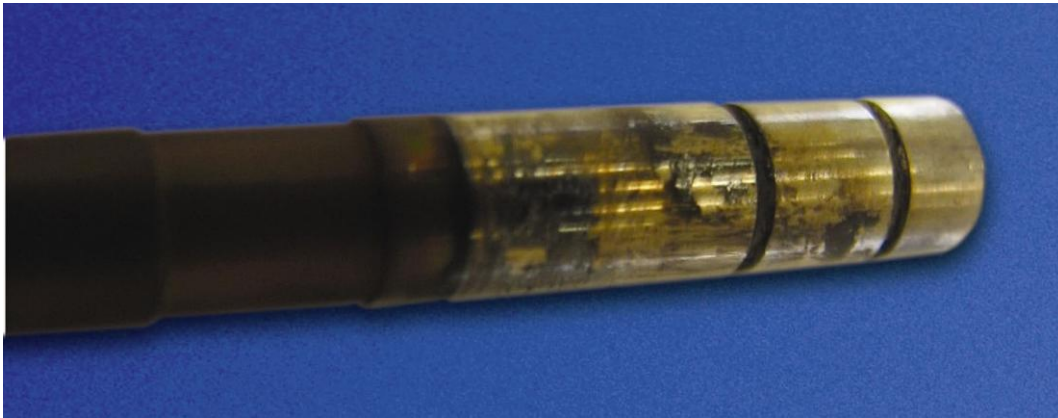


Performance Data

X-1R DPF Cleaner Concentrate



Injector before AFD-8004D treatment:



Injector after AFD-8004D treatment:



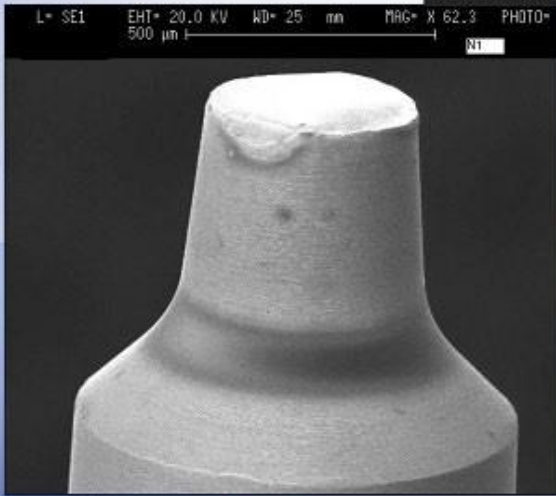


Performance Data

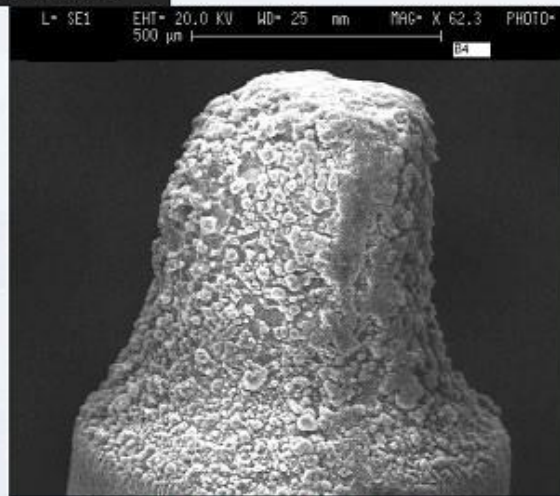
AFD-8004D

XUD-9 Performance

XUD-9 Injector Needles



New

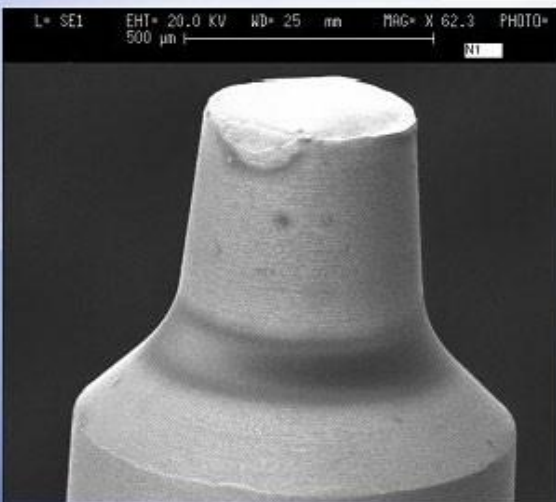


After Base Fuel Run

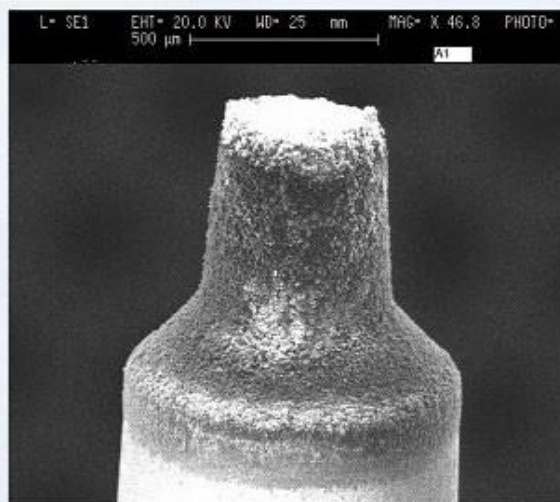
AFD-8004D

XUD-9 Performance

XUD-9 Injector Needles



New



Base Fuel with AFD-8004D



Performance Data

X-1R DPF Cleaner Concentrate



Internal Diesel Injector Deposits

Metal Carboxylates

- Deposit build-up leads to Diesel Metering Valve or Nozzle Needle sticking
- Keeps injector from opening/closing properly
- Results in over-fueling and/or no start
- Over-fuelling can lead to catastrophic results (severe engine damage)



Fuel Filter Blocking - Illustration



15,000 miles on Diesel# 2



30,000 miles on Diesel w/ AFD-8004D

- Problems highlighted in medium duty urban fleets and mine vehicles

Highly Stressing Environments