

# Who needs an

# **AirDog**<sup>®</sup>

**FUEL PREPARATOR**<sup>®</sup>

## Industrial Diesel Fuel Air Separation System?

### Anyone who wants to:

- Reduce fuel cost
- Increase horsepower, productivity & torque
- Reduce exhaust emissions
- Extend engine life by restoring injection timing and providing smoother engine run

#### The Problem

Diesel manufacturers provide the most advanced, powerful engines in the world, and under test cell conditions these engines are a marvel of engineering. However, in real world applications, diesel engines generally fall short of the test cell performance in terms of power, fuel efficiency, and exhaust emissions. This is due in large part to shortcomings in the "fuel delivery system." The typical engine transfer pump operates as part of a "vacuum feed system" instead of a "pressure feed system" (like in a test cell). This pump creates a vacuum that pulls fuel from the tank through the fuel filter, and then to the transfer pump.

Due to the volatile nature of petroleum distillates in diesel fuel and restrictions caused by fuel line routing and fuel filters, the fuel can "cavitate" producing vapor. Cavitation increases at higher fuel flows and filters clog. If the engine is operating much above sea level, the situation gets worse due to reduced atmospheric pressure.

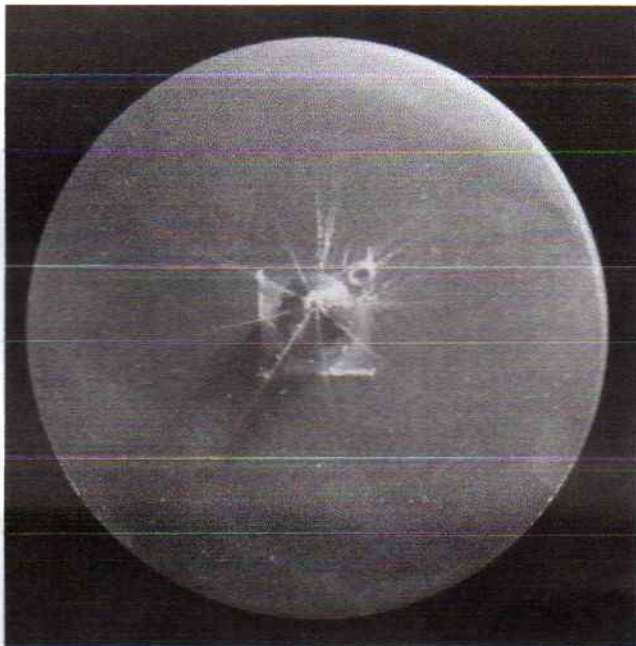
Furthermore, air can become "entrained" in the diesel fuel due to sloshing in the tank and via ultrasonic vibration in both mobile and static fuel tanks. In fact, OEMs report through their service literature that up to 10% air can become entrained in diesel fuel in field service. The result is that air and vapor reach the engine transfer pump due to shortcomings in the fuel delivery system.

These conditions degrade engine performance. Cavitation starves the engine transfer pump. Inadequate flow causes the engine transfer pump to cavitate reducing the flow to the fuel rail and ultimately to the injectors. This reduces engine efficiency. Of more concern, both air and vapor are compressible. The engine fuel system carries these gases along with the liquid diesel fuel through the fuel rail and into the injector. To build sufficient injector pressure, the injector plunger must first compress these gases, using up valuable plunger stroke and crank rotation angle. The plunger must travel further, so the timing is delayed ("retarded") and performance suffers. The retarded injection timing varies randomly with each injection stroke and is the source of the rough idling that is an accepted "fact of life" in almost all diesel engines.

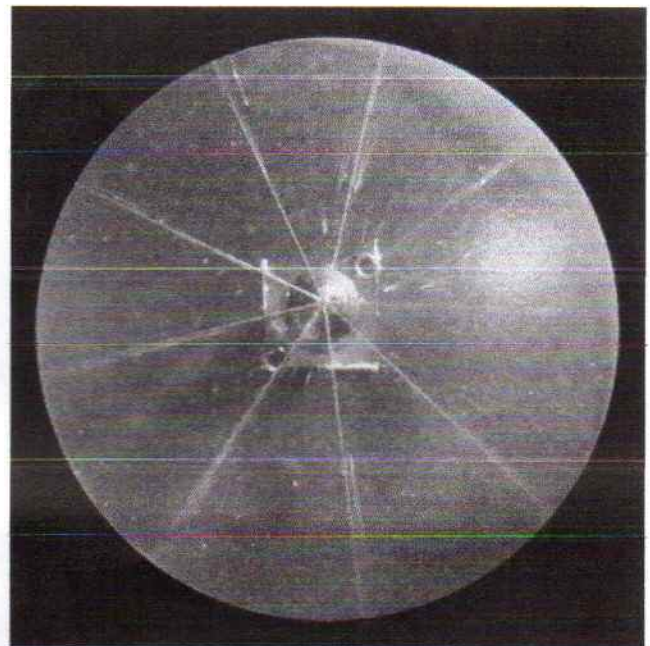
### The Solution

Field and independent laboratory testing both prove that **RETROFITTING ENGINES WITH THE AIRDOG DIESEL SYSTEM SOLVES SHORTCOMINGS OF THE STANDARD FUEL DELIVERY SYSTEM AND IMPROVES ENGINE PERFORMANCE!** The PureFlow<sup>®</sup> patented vapor removal/fuel pump retrofit system (1) Removes entrained air and vapor, (2) pumps pure diesel fuel to provide positive head pressure to the engine transfer pump; and (3) Thereby eliminates fuel cavitation from the engine transfer pump.

This restores fuel delivery to "test cell" conditions, eliminates the adverse consequences of the transfer engine pump cavitation and improves engine performance. Injector spray patterns show the improved performance with PureFlow<sup>®</sup>.



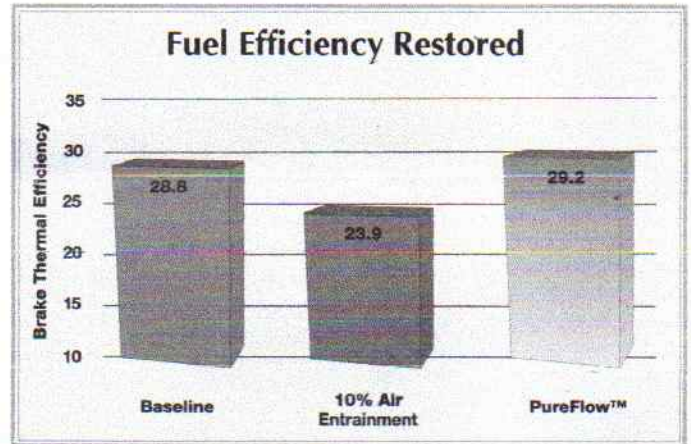
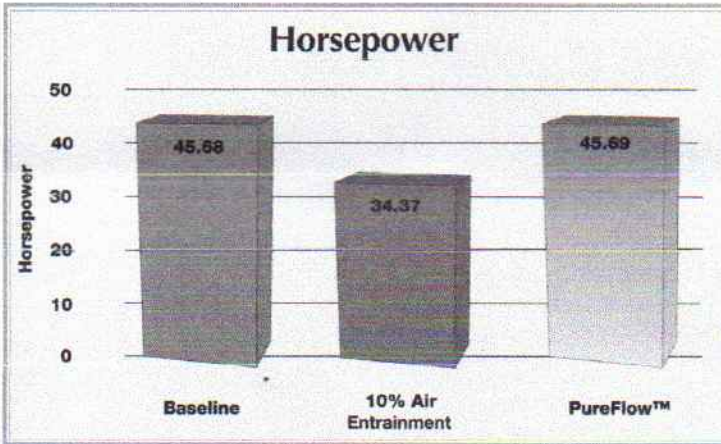
*Injector spray pattern without PureFlow<sup>®</sup>*



*Injector spray pattern with PureFlow<sup>®</sup>*

## Laboratory Test Results

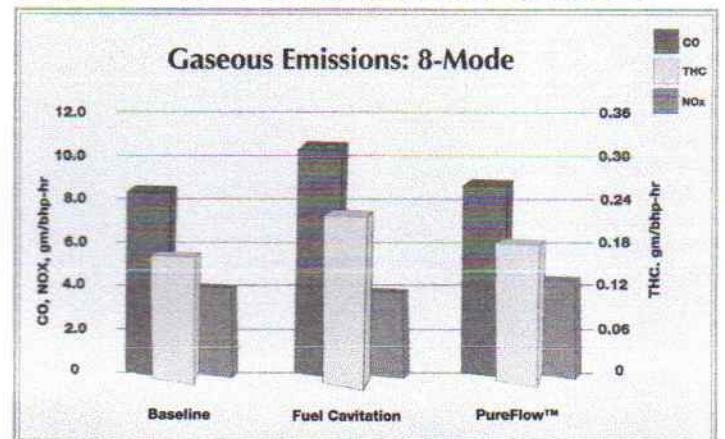
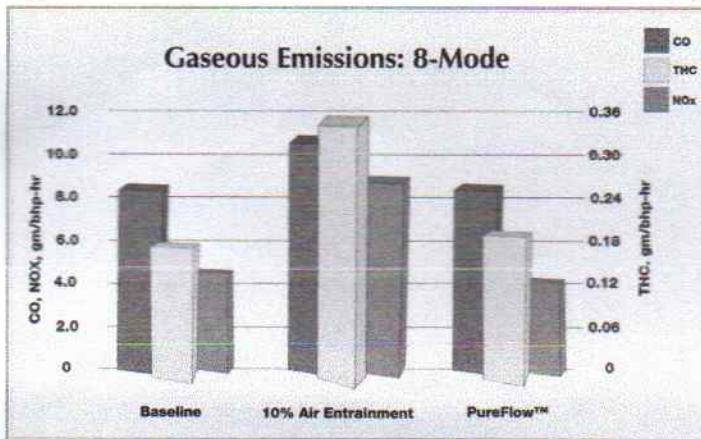
Independent laboratory test\*, showed that in 8-mode off-road applications with 10% entrained air horsepower dropped from 45.6 hp to 34.37 hp and brake thermal efficiency dropped from 28.8% to 23.9% (a 17% reduction in fuel efficiency). PureFlow® Diesel System restored both horsepower and fuel efficiency.



With cavitation, horsepower dropped from 46.68 hp to 35.18 hp and brake thermal efficiency dropped from 28.8% to 27% (a 6% reduction in fuel efficiency). After installing the PureFlow® Diesel System, both power and fuel efficiency were restored.

## Restores Emissions Performance

Exhaust emissions are an increasing environmental concern. With fuel efficiency improvements of up to 6% or more, total fuel consumed is reduced, so total exhaust emissions are reduced as well! Field test results of DEUTZ BF4M 1013C showed that after only 100 hours of "run in" the NOx emissions decreased 44% (1043.98 to 582 ppm). Lab test results also indicate the PureFlow® Diesel Systems restore exhaust emissions that normally increase due to air entrainment and cavitation.



**So, who needs an AirDog Diesel System?**

**You Do!**

# Never heard of "entrained air"?

*These people have:*

**Caterpillar®**, Special Instruction 651-1250 points out:

"Normally No. 2 Diesel Fuel contains about 10% air in solution although the air is not visible."

**Cummins Service Topic 5-135:**

"The source of the vapor is the fuel itself."

**The Fluid Power Institute at the Milwaukee School of Engineering**

confirms that entrained air and vapor are present in all liquids, especially petroleum based liquids.

**Milwaukee School of Engineering, Handbook of Hydraulics states:**

"There are two types of contaminants, Fluids and Solids. Probably the **most destructive fluid contaminate is Air.**"

**Caterpillar® Bulletin PEHP7046:**

**Air & Vapor Can Cause Permanent Injector Damage:**

"Damage can be caused by anything in your fuel system that should not be there, including.....air bubbles".

**University of Illinois College of Engineering**

**PureFlow® Fuel Air Separation System Tested and Confirmed**

**University of West Virginia Mechanical and Aerospace Engineering**

Increased Power Output Confirmed through ISO 8178 8 Mode testing

Torque Rise Off Idle Increased by 106%, Peak Torque by 6%



**CHOOSE EXCELLENCE.  
CHOOSE QUALITY.  
CHOOSE THE AIRDOG INDUSTRIAL  
FUEL AIR SEPARATION SYSTEM!**

Removes all types  
of fuel contaminants  
(Dirt, Air, Vapor, & Water)

Adjustable Pressure  
Regulator

4 Year Limited Warranty

Dual port gerotor  
pump for quiet,  
balanced operation



Models available for most all  
commercial trucking and industrial  
diesel engines

The AirDog FPII 4G Industrial's Patented System EFFICIENTLY  
REMOVES ENTRAINED AIR AND VAPOR from your diesel fuel for:

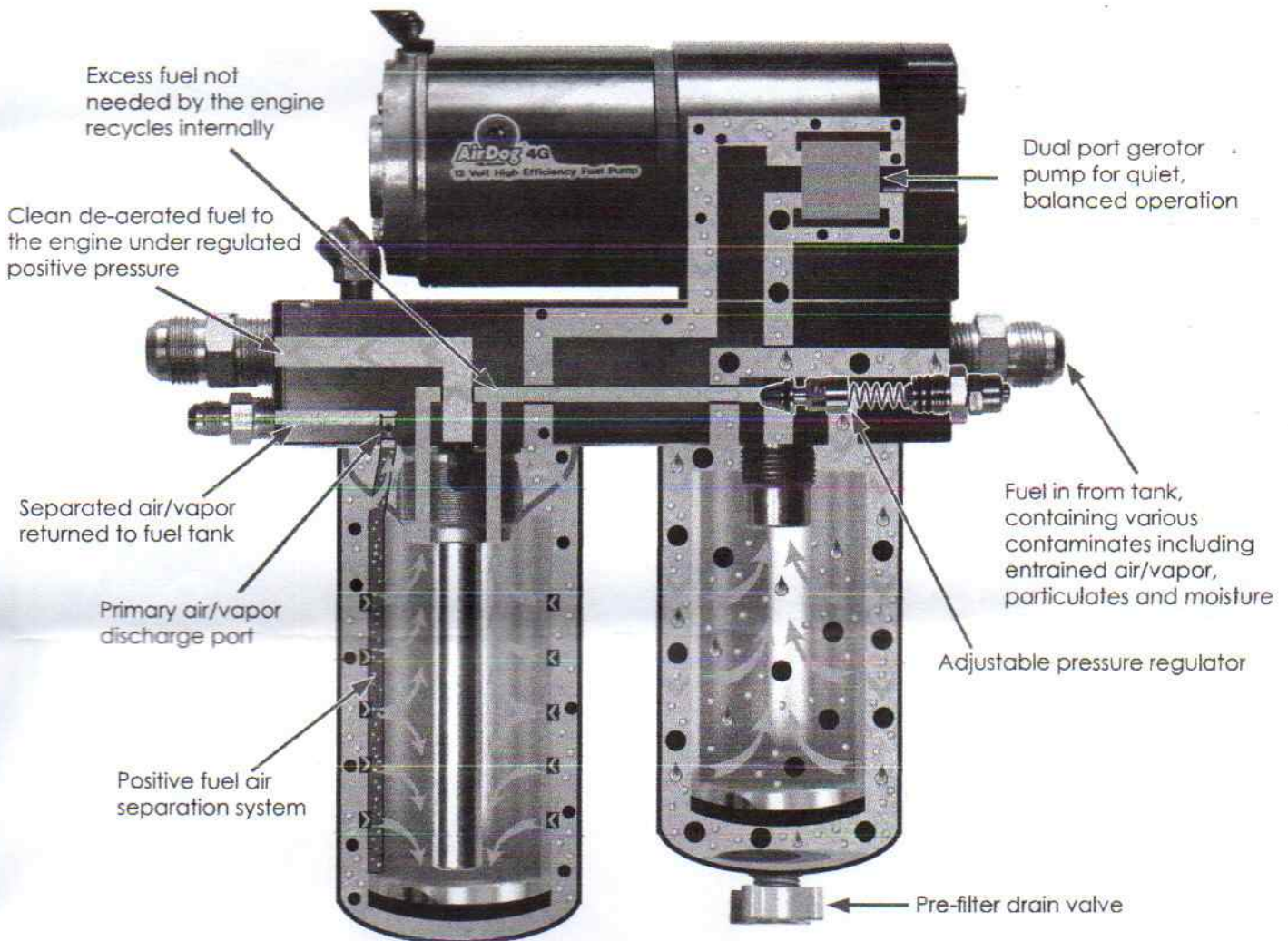
- Increased Fuel Economy
- Longer Injector Life
- Improved Throttle Response
- Peak Performance
- Maximized Torque
- Smoother Engine Idle





# INDUSTRIAL Fuel Air Separation System

How the AirDog® Fuel Preparator® Fuel Air Separation System Operates!



The AirDog®II, designed to operate at flows and pressures beyond the maximum requirements of the engine, receives fuel under vacuum from the fuel tank containing entrained air/vapor, particulate contaminants and unknown quantities of water. The fuel passes through the water separator which removes the large particulate contaminants that could damage or jam the gerotor fuel pump. The fuel, with only entrained air/vapor and tiny particulate contaminants remaining, enters the fuel pump.

The fuel, under positive pressure flow, enters the fuel filter. As the fuel passes through the filter media and remaining particulate contaminants are caught and contained, the entrained air/vapor is also separated. Through the POSITIVE FUEL AIR SEPARATION FEATURES of the PATENTED FUEL PREPARATOR® the separated air/vapor is discharged from the filter and back to the fuel tank through the Primary Air/Vapor Discharge Port.

The fuel passing through the filter media, free of contaminants & power robbing air/vapor and at pressures and flows always able to meet the needs of the engine, exits the fuel filter through two passageways. First, the fuel for the engine passes into the fuel pickup tube and on to the engine. Then, the excess fuel not needed by the engine recycles internally through the pressure regulator back to the water separator.

HEAVY DUTY & INDUSTRIAL  
DIESEL FUEL SYSTEMS  
By **PureFlow**  
Technologies, Inc.



HEAVY DUTY & INDUSTRIAL  
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Technologies, Inc.

## The AirDog Champ High Pressure Fuel Air Separator

### THE SOLUTION FOR MAXIMUM DIESEL ENGINE EFFICIENCY

Regardless of the type of injection system that your engine has, it will never perform at the designed efficiency level with air and vapor entrained in the fuel. Air and vapor present in fuel contributes to increased fuel consumption and exhaust emissions, a loss of power, rough idle, and shortened injector life. The Champ removes the air and vapor from fuel and helps the engine perform as intended.

No Electrical Connections  
No Moving Parts

Receives fuel flow from  
engine transfer pump

Quick & Easy frame mount  
installation with included  
chassis sandwich bracket

6 micron particulate filters, long lasting  
microglass media



Positive air separation with  
primary air  
discharge port

Clean, Pure, Air Free Fuel  
delivered to engine

Can be adapted to most Heavy  
Duty Diesel Engines

4 Year Limited Warranty

With the AirDog<sup>®</sup> Champ system installed,  
your diesel engine can perform as designed,  
even under the most extreme conditions.

- ◆ Improves Fuel Economy
- ◆ Lengthens Injector Life
- ◆ Smoother Idle
- ◆ Improves Throttle Response
- ◆ Maximizes Torque
- ◆ Eliminates Air & Vapor

Proudly manufactured and assembled in the USA



HEAVY DUTY & INDUSTRIAL  
DIESEL FUEL SYSTEMS

By **PureFlow**<sup>™</sup>  
Technologies, Inc.

“Spin-On” the AirDog Champ II High Pressure Fuel Air Separator installed between the secondary fuel filter head and filter to remove entrained air and vapor from the fuel flow to the engine, and regain optimal fuel system performance.



For  
Detroit Diesel Series 60  
Engines  
(1987-2009)  
with Engine Mounted  
Secondary Filter Head



For CATERPILLAR®  
3406E,  
C13, C15 & C16  
Engines

Uses CAT®  
1R-0751 Filters



Uses CAT®  
1R-0749 or  
1R-0750  
Filters

Simple Spin-On  
Installation

Positive air separation  
with primary air  
discharge port

No Electrical Connections  
No Moving Parts

Receives fuel flow from  
engine transfer pump

4 Year Limited Warranty

- ◆ Improves Fuel Economy
- ◆ Lengthens Injector Life
- ◆ Smoother Idle
- ◆ Improves Throttle Response
- ◆ Maximizes Torque
- ◆ Eliminates Air & Vapor

**THE RIGHT CHOICE FOR  
YOUR DIESEL ENGINE!**



**You could be  
losing over  
\$3,600  
per truck  
every  
year**



### **Losing all your profits at the fuel Island?**

Diesel Engines have long been known to lose power, increase fuel consumption and have increased exhaust emissions, *ESPECIALLY* when air/vapor is present in the engine's fuel system. AirDog, Champ, & Champ II remove the *ENTRAINED AIR/VAPOR* from the fuel system so your engine can operate at *PEAK EFFICIENCY* for *INCREASED FUEL ECONOMY, MAXIMIZED POWER OUTPUT* and *REDUCED EXHAUST EMISSIONS*.

**SAVE FUEL.  
INCREASE POWER OUTPUT.  
REDUCE EXHAUST EMISSIONS.**



**PureFlow** Technologies, Inc.

The following are actual customer testimonials collected from customer who have purchased our products. These are not paid testimonials. None of the following testimonials of the AirDog® product are given by employees or contractors of PureFlow® Technologies Inc.

**CAT**



#### **Cat C15 W/Regen**

My truck performs like never before since installing the AirDog® system. Now I have plenty of power and I am able to pull my oversized loads during regen cycle with ease. The AirDog® system does exactly what they told me it would! The picture above is my truck and typical load, 50 Meter blade grossing just under 95,000 lbs.

Alex D Chapin, S.C.

#### **Cat C15**

“The AirDog® lets my Cat C15 deliver the consistent power I need to haul quarter million pound loads. **I depend on it.**”

Herald K. Inman, KS

#### **Cat C15**

“I installed the AirDog® and right away the engine was smoother. My fuel mileage went from 5 to 5.8mpg. I run the same route everyday so there aren't any other factors that would have affected the fuel mileage. I am very pleased with the quality of the AirDog® system. Best of all it's made in the USA.”

Jason H. Wooster OH.

## Cat C13

The City of Huntington Beach Fire Department has installed six Air Dog units onto our Pierce Arrow XT engines with Cat C-13 power plants. We were having problems with fuel injectors failing due the amount of heat and significant fuel aeration in the fuel delivery system. Much of the problem was determined to be caused due to the distance between the fuel tank and the transfer pump. We reached out to PureFlow Technologies to see if they had a transfer pump that could be incorporated into the existing system near the fuel tank. They advised me about their AirDog® system designed for our exact problem. Since we have installed the AirDog® systems we have had no signs of injector seal issues and no injector failures. In addition to having a quality product the staff at Pureflow Technologies have been very supportive and are very knowledgeable about today's fuel delivery systems and their inherent problems with aeration. Thanks to Purflow Technologies Inc. and the AirDog® we feel that we have taken a step in the right direction to solve what has been an industry wide problem costing fleets a lot of money and making OEMs null about the issues.

Eddie Corella  
Fleet Operations - Fire Department Shop  
Huntington Beach CA. 92647



### Cummins ISX 15 Common Rail

I installed an AirDog® to my ISX15 about 3 months ago. After installing the AirDog® system I realized an increase in fuel economy from 4.5 MPG to 5.4 MPG. Additionally, I experienced a reduction in "Urea" usage of about 10%.

Buck A. Redfield, SD



### **Detroit Series 60 14 Liter**

On the morning of 8/01/13 the 4G HD AirDog® was installed on our customers 500 Series 60. We previously installed a K&N filter, Bully Dog Heavy Duty Gauge Tuner, and a Bully Dog exhaust manifold to bring the customers fuel mileage from 5.4 up to 6.2 and overall HP of 550 and 1811 Torque. Once making a run on our Dyno we quickly realized how much he gained by installing the AirDog® system. Horse power went to 569 and torque jumped to a staggering 1888. The customer then left on his first run of 3000 miles just to return and report more gains regarding the fuel mileage, it now sits at 6.7mpg. So overall improvements were, after the installation of the AirDog® system he gained 19hp, 77 ft/lbs torque and a 0.5 mpg increase!

Chris Coleman  
L & N Truck Service  
Ellenwood, GA

## **PACCAR ENGINES**

### **Paccar MX-13**

I have seen great fuel mileage improvements as my prior average fuel consumption was in the mid 6's. My last two tanks were 7.2 and 7.9 which is the most I have ever gotten!

George, Malone Transportation

Dow City, IA

Installed New 4G with Micro Processor on 01/10/13



### **Volvo VED12**

Now after I installed my AirDog®, my last 800 mile fill, I got 7.4 MPG.

Current fuel mileage is up .4 MPG. I had the truck in a Volvo shop, the shop service manager commented about how smooth the engine sounded. He was quite impressed.

I am shifting gears much less now with the AirDog® installed.

Lonnie B.  
Bartlett, IL

The preceding testimonials are actual statements given by customers of AirDog® products and are representative of their experience and opinions regarding AirDog® products. There are not guarantees of performance by Pureflow® Technologies Inc or any employees or representatives of Pureflow® Technologies Inc. and should not be considered as such.

# *StageCoach Transportation, Ltd*

7965 East 190<sup>th</sup> Street Hastings, MN 55033

651-437-3334

Fax 651-437-8138

The following is a testimonial written by Gary Ries, owner of StageCoach Transportation, Ltd., located in Hastings, MN:

I previously observed measurable fuel savings with multiple Air Dog installations on my Detroit Series 60 engines. When the new Champs were introduced to me, I was impressed with the simple bolt-on installation, and the promise of more fuel savings and power-improving results. After installing these on multiple trucks in my fleet, I can report that some of my trucks are averaging over 9 ½ mpg. I feel the Champ is a big part in achieving these amazing results. We have never had any injector problems or fuel gelling-up in over 8 years. I will install Champs on any new trucks that I add to my fleet.

## Selected Test Results of the AirDog® System

*Mine Safety & Health Administration:* Utilizing derated diesel fuel with agitation at 7,000 ft. of elevation, researchers realized emissions improvements at idle for DPM, CO, NOx and CO<sub>2</sub>.

*West Virginia University:* The University utilized a Caterpillar 3306 engine on a stationary test stand. Results included:

- Doubling of torque at idle and substantial increase at low engine speeds.
- "Very effective in removing air from the fuel supply system."
- Increased fuel flow to the engine.

*NREC Power Systems/SETCO:* Stack Emissions and Fuel Consumption Testing was conducted to test for NOx emissions and for fuel consumption with and without the AirDog® system, performed on Engine Model 16-645E3C.

- Once the AirDog® was installed, NOx decreased by 264.7 ppm, from 1188.5 ppm to 923.8 ppm. Once test administrations removed the AirDog®, NOx emissions began to rise.
- Fuel consumption with an AirDog® remained at a steady 172 ghr. Once removed, fuel consumption increased to 190 ghr.

*Pride Transportation:* Pride installed the AirDog® system on a Freightliner Century, with a Cummins N14-525 engine.

- Fuel consumption improved .8 miles per gallon, from 6.5 mpg to 7.3 mpg.
- Increased torque range of engine resulted in improved Trip "% Distance at Max Speed" of 5.39%, from 16.44% to 21.83%. This increased driver efficiency (reduced trip drive time) by increasing the average drive speed from 48.56 mph to 52.23 mph. Net driving time saved on trip of 9,522.5 miles was 13.79 hours, equating to 720 additional revenue miles driven without increasing hours on driver's log.
- The test truck had 208,794 miles on its odometer. If the AirDog® system had been installed on the tractor from its original service date, a reduction of 302.1 Log Hours of driving time could have been realized, or an additional 15,778 revenue miles could have been achieved, assuming an average speed of 52.23 mph.
- Fuel filters were replaced every 80,000 miles.

*Bentex Services Inc:* "I am a believer in AirDog®. We have equipped our entire fleet. We are one of the top fuel mileage fleets around." After installing the AirDog® systems on its fleet and averaging 6.8 mpg over the course of three years, Bentex was commended by Detroit Diesel for the outstanding fuel performance of its fleet.

# PureFlow<sup>TM</sup>

## Technologies, Inc.

*Canyon Fuel Company, LLC:* Canyon Fuel installed the AirDog<sup>®</sup> system on its mining equipment engine, a Deutz BF4M 1013C.

- Realized a 77% reduction in CO, from 825 ppm to 187 ppm.
- NOx dropped from 857 ppm to 582 ppm.
- Canyon also noticed a significant reduction in noise from the diesel engine.

*The Doe Run Company:* The mining division of Doe Run installed the AirDog<sup>®</sup> system on a Front End Loader, Caterpillar 3406 to conduct tests for smoke opacity reduction. The Company found that the AirDog<sup>®</sup> reduced average opacity from 57.7% to 13.4%, a decrease of 76.8%.

*Metropolitan Government of Nashville, TN:* The Metropolitan Government of Nashville, TN conducted a test of smoke opacity with a diesel-powered Volvo Truck. Testing found a reduction in smoke opacity of 21.7%, from 12.0% to 9.4%.

The summary of tests:

Doe Run Lead Mine (South of St. Louis); Engine tested was a 3406 C "Mechanical" CAT engine. The snap idle opacity (smoke) without the AirDog<sup>®</sup> was 57%. The snap idle opacity after installing the AirDog<sup>®</sup> was reduced to 13% for an overall reduction of 76%.

Nashville Metropolitan health Dept.: Engine tested was a Series 60 Detroit. The test was performed at Covington Detroit in Nashville. The snap idle opacity without the AirDog<sup>®</sup> was at 12.9%. After installing the AirDog<sup>®</sup>, the snap idle opacity was reduced to 9.1% or 29%.

Canyon Fuel, LLC @ Dug Out Mine (Price Utah), Nox-testing: After installing the AirDog<sup>®</sup>, the engine was monitored for Nox emissions. On initial startup, Nox increased by 5%. After 100+ hours of running, Nox levels has dropped by 46%.

Ministry of Transportation, Vehicle Inspection Association, Tokyo, Japan Testing:

15 Mode Transient Tests of the "In-Use" diesel performed;

	Target (g/km)	Actual (w/ AirDog <sup>®</sup> ) (g/km)	Surpassed Target %
CO	3.46	0.599	82.7%
HC	0.63	0.076	87.9%
Nox	1.75	1.206	31.1%
DPM	1.07	0.064	8.57%
( Diesel Particulate Matter)			

**HEAVY DUTY AND INDUSTRIAL DIESEL FUEL SYSTEMS**

## SUMMARY

High level of unburned HC (Hydro Carbons) present in the exhaust, created by delayed or retarded injection timing, is a result of the vacuum feed fuel supply systems commonly in use on all diesel engines today. This high level of unburned HCs creates carbon deposits in the combustion chamber of the "in-use" diesel engine. This results in a decrease of volume in the combustion chamber which increases the compression ratio of the engine. This, in turn, increases the temperature at combustion. The Nitrogen in the 'intake' air reacts to the 'higher than anticipated' combustion temperatures and results in high levels of Nitric Oxide and Nitrogen Dioxide, the Nox gasses that are common in the diesel engines exhaust.

Installing the AirDog® on the diesel engine eliminates the source of 'retarded injection timing' and restores the performance of the engine to the designers desired operating specs. This eliminates the excessive unburned hydrocarbons, as illustrated above. After correct injection timing has been restored, the carbon deposits have been 'burned out' by the natural burn of the engine. The Nox levels have now been reduced virtually to the desired levels as originally certified by the engine manufacturer. A reduction of 46%, as illustrated above by the Canyon Fuel LLC tests.

Additional benefits of restored injection timing and a full power stroke of the diesel engine are lesser amounts of fuel consumed while increasing power output of the engine.



The logo for AirDog Fuel Preparator features the word "AirDog" in a large, stylized, outlined font. Below it, the words "FUEL PREPARATOR" are written in a smaller, bold, sans-serif font. A registered trademark symbol (®) is located to the right of "PREPARATOR". The logo is centered on the page and has a light, semi-transparent appearance.