DurAlt® Fuel Conditioner Benefits In Gasoline and Diesel Powered Vehicles and Equipment

Gasoline and Diesel Fuel Enhancers

E-Mail: Sales@FuelSaverInc.com
Website: FuelSaverInc.com
Toll Free: 866-768-7811
FuelSaver Technologies™
Fuel Enhancer products
use the patented
DurAlt® Technology
DurAlt® Technology performance benefits have been proven in tests by:

- Independent and Government Laboratories.
- Research Laboratories of Major Oil Companies (U.S., Europe and Asia).
- Tests conducted by and in cooperation with Major Engine Manufacturers.
- Some of the DurAlt® test data has been published in two scientific papers by the International Society of Automotive Engineers.
  - “Octane Requirement Increase Control – A New Way of Saving”, 1991
DurAlt® has been Independently Tested and/or Validated by a Host of Fortune 100 Companies
This document was first developed in 1998 on behalf of automobile and engine manufacturers around the world to promote greater understanding of the fuel quality needs of motor vehicle technologies and to harmonize fuel quality standards.

DurAlt® FC technology has been thoroughly tested in research laboratories and in over a billion miles driven in fleet tests and actual use in cars, motorcycles, boats, trucks, locomotive engines, industrial and marine engines, stationary jet and turbine engines, two and four cycle gasoline and diesel engines.

Test data, meeting fuel specifications set by Worldwide Fuel Charter and actual usage all validate no harmful effects with DurAlt® Fuel Conditioner technology.
## Product Benefits

<table>
<thead>
<tr>
<th>DurAlt®: Gasoline Engines</th>
<th>DurAlt®: Diesel Engines</th>
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</thead>
<tbody>
<tr>
<td><strong>8-12% increase in fuel economy</strong></td>
<td><strong>8-12% increase in fuel economy</strong></td>
</tr>
<tr>
<td><strong>15-20% decrease in emissions</strong></td>
<td><strong>Up to 60% decrease in emissions</strong></td>
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<tr>
<td>Reduces combustion chamber deposits (CCDs)</td>
<td><strong>2 number increase in cetane number</strong></td>
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<tr>
<td>Reduces octane number required (ONR), 3-5 numbers</td>
<td><strong>15-20% decrease in engine maintenance</strong></td>
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<td><strong>15-20% decrease in engine maintenance</strong></td>
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**DurAlt®** is comprised of the same elements as fuel and has no harmful side effects.
Combustion Chamber Deposit (CCD) Build-up in Gasoline Engines

- CCDs are carbon deposits from unburned fuel, and deposits from detergent additives used to clean up engine fuel injectors and inlet valves. EPA has required refiners to add detergent additives since 1995.

What is Octane Requirement Increase (ORI)?

- As CCDs build up during first 10,000 to 15,000 miles of an engine's life, engine octane demand is driven up by 5 to 10 octane numbers (ORI).

Fuel Economy and Emission Effects of CCD and ORI

- Anticipated CCD build-up and resultant ORI forces engine manufacturers to detune engines, setting engines at less than optimum efficiency settings to prevent detonation damage, sacrificing fuel economy and performance.

DurAlt® helps eliminate CCDs greatly reducing ORI

- Enables use of 87 Octane versus 93 Octane gasoline with no performance degradation (typically 20¢ / gallon savings at pump)
Consistent Results

Performance of DurAlt® in Controlling Octane Requirement Increase in Gasoline

Laboratory tests of over 50 engines/fuels/test conditions produce consistent results

- Ricardo Consulting Engineers (England)
- Automotive Testing Laboratory (Asia)
- National Institute for Petroleum and Energy Research (U.S. Department of Energy)
- Major European Oil Company (Total Oil, previously TotalFinaElf) using various detergent additives

Product is registered with the US EPA who designated it “substantially similar” to fuel

- Won’t harm engine or engine components
Reduction in Octane # Required

Renault, 400 hr Test (Octane Requirement Increase) KLSA (knock limited spark advance)

Reduced ORI With DurAlt® (Plus Detergent) Total-FINA-ELF
Summary of Octane Requirement Reduction Due to DurAlt® in Laboratory Evaluations

<table>
<thead>
<tr>
<th>ORI Reductions</th>
<th>VW, 1.6</th>
<th>Toyota, 1.5</th>
<th>Ford, 2.3</th>
<th>GM, 3.8</th>
<th>Europe, No-lead</th>
<th>Europe, No-lead</th>
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<tr>
<td>0%</td>
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<td>10%</td>
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<tr>
<td>20%</td>
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<tr>
<td>30%</td>
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<td>40%</td>
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<td>50%</td>
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<td>60%</td>
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<td>70%</td>
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<tr>
<td>80%</td>
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Auto-Road Mileage Accumulation Before ORI Test

Automotives Chassis Dyno Test Cell
The above chart provided by Total Oil demonstrates that detergent and DurAlt® FC reduce CCDs below the level of CCDs from fuel only.
Benefits of DurAlt® FC in Gasoline

DurAlt® reduces combustion chamber deposits resulting in lower octane requirement by engine and reduced maintenance expenses.

DurAlt® improves fuel economy 8 – 12%, while decreasing emissions 15 – 20%.

DurAlt® reduces/eliminates engine knock.

DurAlt® reduces engine noise.
DurAlt® Accelerates Combustion in Diesel Engines

• In the initial stages it reduces the “Ignition Delay” and the amount of fuel burned in “Premixed Burning Phase.” This results in the reduction of noise and slightly lower NOx emissions.

• Early release of fuel energy in the “Diffusion Burning Phase” results in higher temperature and a longer time for subsequent combustion. This helps in soot oxidation, thus reducing insoluble diesel PM.

• The higher temperature and longer time also help in HC combustion and reduction of SOF portion of diesel PM.

• The higher temperature may somewhat increase NOx in this phase which is compensated by NOx reduction in the earlier phase. Thus, no significant change in NOx emissions.

• The combustion acceleration by DurAlt® Fuel Conditioner is also supported by an average increase of the cetane number by 2.0 to 2.5 numbers.
Emission & Fuel Economy Effect of EGR Systems on Diesel Engines

- Exhaust Gas Recirculation (EGR) in diesel engines reduces NOx emissions approximately 25% (at 5-10% EGR level) by lowering both the flame temperature and the speed of burn in the combustion zone.

- Recirculated exhaust gases displace oxygen in the combustion chamber which limits the level of EGR. With EGR there is a consequential rise in CO, particulate (smoke), and unburned HC emissions. A further negative effect of EGR equipped diesel engines is a reduction in fuel economy by 10% to 13%.

- When EGR is used with diesel engines, the exhaust gas is generally cooled before reintroduction. Cooling and recirculating the exhaust gas has its disadvantages, most notably there is an increase in ignition delay and combustion noise.
DurAlt® Fuel Conditioner Effect on Emission & Fuel Economy on Diesel Engines Equipped with EGR Systems

- **DurAlt® Fuel Conditioner** reduces ignition delay, improves fuel economy (offsetting EGR fuel economy penalty), lowers particulates (smoke), lowers CO and HC emissions, reduces engine noise and generally compensates for the negative effects of the EGR system.

- Positive NOx benefits of the EGR system are not impacted by **DurAlt® Fuel Conditioner**.

- **DurAlt® Fuel Conditioner** is registered with US EPA and has received the EPA’s designation as “Substantially similar” to fuel. In addition, **DurAlt® Fuel Conditioner** meets all the requirements for diesel and gasoline fuel additives specified under the “Worldwide Fuel Charter”.
Summary of Improvements with DurAlt® Fuel Conditioner in Diesel Engines Operating Irrigation Pumps in Nebraska

<table>
<thead>
<tr>
<th>Test Results</th>
<th>Test Results</th>
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<tbody>
<tr>
<td>4.0% Isuzu</td>
<td>11.5% John Deere</td>
</tr>
<tr>
<td>5.0% John Deere</td>
<td>12.0% Detroit</td>
</tr>
<tr>
<td>5.8% Caterpillar</td>
<td>14.0% John Deere</td>
</tr>
<tr>
<td>7.0% John Deere</td>
<td>12.8% John Deere</td>
</tr>
<tr>
<td>9.8% Detroit 6-71</td>
<td>20.0% Cummins</td>
</tr>
<tr>
<td>11.0% John Deere</td>
<td>22.0% Caterpillar</td>
</tr>
</tbody>
</table>

The improvement in every engine will vary based on many factors.
DurAlt® Fuel Conditioner Improves Lubricity in Low Sulfur Diesel Fuels

Source: Exxon Chemicals
DurAlt® Fuel Conditioner Accelerates Combustion (Diesel)

At 20 degrees, 66% of energy is released with DurAlt® FC versus only 46% of energy released without DurAlt® FC.
Effects of DurAlt® Fuel Conditioner on Noise Reduction
(Idle, 1.6L Engine, 50 Hours Durability)
Effects of DurAlt® Fuel Conditioner on Cetane

![Bar chart showing the effects of DurAlt® Fuel Conditioner on various commercial fuels.](chart)

- **LC**: Average Cetane increase of 2.5
- **D2-1**: Average Cetane increase of 5
- **D2-2**: Average Cetane increase of 4
- **PRE**: Average Cetane increase of 5
- **LS**: Average Cetane increase of 6

**Average 2.5 Cetane Increase with DurAlt® FC**
## Summary of Cetane Improvement Test Data

<table>
<thead>
<tr>
<th>Base Fuel Cetane Number</th>
<th>Cetane Number With DurAlt®</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) 45.4</td>
<td>47.1</td>
</tr>
<tr>
<td>2) 45.4</td>
<td>47.1</td>
</tr>
<tr>
<td>3) 45.4</td>
<td>47.1</td>
</tr>
<tr>
<td>1) 50.5</td>
<td>52.5</td>
</tr>
<tr>
<td>2) 50.5</td>
<td>52.5</td>
</tr>
<tr>
<td>3) 50.5</td>
<td>52.5</td>
</tr>
</tbody>
</table>

### Test Results

**DurAlt® Fuel Conditioner Improves Diesel Fuel Cetane Value**
Reduced Diesel Emissions

National Institute for Petroleum and Energy Research (U.S.)

Detroit Diesel, EPA 13 Mode Cycle, 20 Hr Durability

<table>
<thead>
<tr>
<th>Test Results</th>
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</thead>
<tbody>
<tr>
<td>22% Reduction in HC Emissions</td>
</tr>
<tr>
<td>(HC reduced in all modes)</td>
</tr>
<tr>
<td>17% Reduction in CO Emissions</td>
</tr>
<tr>
<td>61% Reduction in Smoke at 1600 RPM Full Load</td>
</tr>
<tr>
<td>25% Reduction in Smoke at 2100 RPM Full Load</td>
</tr>
<tr>
<td>1% Reduction in Fuel Consumption</td>
</tr>
<tr>
<td>No Change in NOx Emissions</td>
</tr>
</tbody>
</table>
Reduced Diesel Emissions

Ricardo Consulting Engineers (England)

DurAlt® Fuel Conditioner in Diesel Car, ECE 15 Cycle, 50 Hr. Durability

<table>
<thead>
<tr>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%  Reduction in CO Emissions</td>
</tr>
<tr>
<td>39%  Reduction in Particulate</td>
</tr>
<tr>
<td>43%  Reduction in HC Emissions</td>
</tr>
<tr>
<td>No change in NOx Emissions</td>
</tr>
<tr>
<td>3%   Reduction in Fuel Consumption</td>
</tr>
<tr>
<td>Cleaned Injector Nozzles</td>
</tr>
<tr>
<td>Reduced Engine Noise</td>
</tr>
<tr>
<td>2.5   Number Improvement Cetane</td>
</tr>
</tbody>
</table>

Diesel Car Emission Test Cell With Chassis Dyno
Benefits of DurAlt® FC in Diesel Fuel

**DurAlt®** improves combustion in diesel engines resulting in better fuel economy (8 – 12%), lower PM (up to 60% less smoke), HC, and CO emissions

**DurAlt®** improves Cetane Number an average of 2 - 2.5 numbers

**DurAlt®** improves lubricity in low sulfur diesel; contains anti-microbial to kill bacteria in ULSD

**DurAlt®** reduces engine noise
Mercy Ships (operates the “Africa Mercy”, the world’s largest non-governmental state-of-the-art hospital ship)

Fuel Savings and Reduced Deposits: “We now save approximately $26,000 each time we refuel. We have removed a few cylinder heads recently from one of the 800kva generators and the mechanic was noticing that the carbon buildup was less than before. There is less soot build up.” M.Z., Engineering Superintendent

Crowley Petroleum Services (Anchorage, AK)

Biocide and lubricity properties: Uses conditioner in tugboats to improve lubricity in Ultra Low Sulfur Diesel and to prevent algae and bacteria growth in fuel

Great Lakes Marinas (Michigan)

Reduction in Deposits – Eliminated engine varnish deposits, increased valve guide/seat life; marinas require fuel distributor provide product in delivered fuel

High Performance Boat Racing

Lightning Performance Products, Inc – “Since we started using DurAlt® Fuel Conditioner, we have seen a noticeable increase in performance. But more important is what it has done to increase valve guide and valve seat life. We recommend this product for use in all of our engines, whether it is an offshore race engine or an everyday pleasure boat engine.”
The Alaska Railroad (Anchorage, AK)

**Fuel Economy** – Test results on diesel generators indicated a 13.4% reduction in fuel consumption (Feb 2007); now in testing on locomotives

**Reduction in Particulate Matter** – Eliminated all smoke

Pikes Peak Cog Railway (Colorado Springs, CO)

**Reduction in Particulate Matter** – “Smoke and diesel emissions have been greatly reduced” - S.S., Shop Foreman, Manitou and Pikes Peak Railway Company

Pittsburgh Area Railroad

**Fuel Economy and Reduction in CCDs** – Test results showed a 5% reduction in fuel consumption. Varnish and solids deposits drastically reduced around piston-ring and ring groove area, as evidenced by air box inspections, resulting in a much cleaner power assembly

Midwest Electric Utility Coal Trains

**Fuel Economy** – Test results showed a 14% reduction in fuel consumption for a GM EMD 16-cylinder locomotive diesel engine. Test results indicate a 9% reduction in fuel consumption for a General Electric 16-cylinder locomotive diesel engine
Results – On Road/Off Road Vehicles

El Paso County, Colorado Fleet Management (Colorado Springs, CO)

Fuel Economy and Reduced Maintenance – “Our fuel economy has improved by around 8%, and we have not lost a single engine since starting with the conditioner. We also have not needed maintenance on fuel injectors or fuel pumps.” - P.M., County Fleet Manager, previously lost 2-3 engines/year (in use August 2006 to present; converted entire fleet in Jan 2007)

Summit County, Colorado County Bus Transit System (Frisco, CO)

Fuel Economy – “Our fleet (of heavy duty buses) average miles per gallon rose over 13%. We have noticed a reduction in start up smoke and a reduction in smoke output under load. Further, after adding DurAlt to our fuel systems, there was a slight decrease in fuel system maintenance that we can only attribute to the cleansing properties in the DurAlt product.” – J.J., Transit Director, Summit Stage

Off Road Mining Fleet (Michigan)

Fuel Economy – Test results on Volvo mining trucks (2005 Model VNL64T300) w/EGR Engine VE D12-465 HP and average 135,000 miles on trucks; distance driven during test was 52,490 miles: 6.53% average improvement in fuel economy
Individual Consumers

Reduction in Octane Requirement – “Not only has it improved the miles per gallon in my 2006 Infinity FX by 10-20%, I have been able to use regular gas instead of premium with no degradation in performance, saving me 20 cents/gallon at the pump!” T.G., Chiropractor, Colorado

Fuel Economy - “I averaged 16% to 25% reduction in fuel consumption in my mini-vans, and a 40% reduction in fuel use in my 98 Dodge Ram Pickup; the truck also was quieter and ran noticeably smoother!” R.L., Engineer, Colorado

Smøther Operation and Fuel Economy – “I have a 1998 Pontiac Grand Prix and started noticing a vibration when my car would sit and idle. After running just one tank of fuel treated with DurAlt, I noticed the vibration was gone. After a few more tanks I saw my gas mileage had improved 2-3 miles per gallon.” R.C., Business Owner, Pennsylvania

Fuel Economy and More Power – “I started using DurAlt in a 1995 Ford F-150 at 132,000 miles. Prior to using DurAlt this truck delivered an average of 18 miles per gallon on the trip to and from work. Going over Fremont Pass (11,318 ft) each day required me to shift down into third gear. Using DurAlt, mileage rose to 23 miles per gallon and it also climbs both sides of Fremont Pass now in fourth gear rather than third.” J.J., Fleet Manager, Colorado
Summary – Gas and Diesel Engines

• **Improves air quality**
  – 15% - 60% decrease in emissions

• **Improves fuel economy**
  – Average 8% – 12%

• **Reduces engine maintenance**
  – Average 15% – 20%

• **Reduces noise pollution**
  – Engines run smoother and quieter

• **Increases engine lubricity/anti-microbial**
  – Critical for new low sulfur diesel fuels
Bottom Line: Savings for You!

- Small improvements in fuel economy make a **BIG** difference in operating costs

- Product more than **pays for itself** in reduced operating expenses putting money back in your budget

- Better fuel economy and reduced emissions benefit your fleet, our country and our planet