



Nanodiamonds (NDs) are among the most promising nanoparticle lubricant and fuel additives since they are superhard and capable of dramatically reducing wear and friction (up to 10 times). Nanodiamonds are carbon based, non-toxic, and the “greenest” possible fuel and lubricant additive.

Standard means of improving fuel-efficiency (FE) using gasoline fuel additives include using detergents to clean internal engine components, combustion improvers for better fuel atomization, and additives to provide friction reduction. In the case of additives for friction reduction, the intake valves, upper cylinder area and ring area may experience reduced friction post combustion. NDs in fuels contribute to these mechanisms and can provide the following global benefits for a wide range of transportation systems:

- (i) reduced fuel consumption,
- (ii) increased service lifetime, and
- (iii) reduced hazardous emissions.

ND-Fuel™ produced by Adámas Nanotechnologies, Inc. is a nanodiamond-based fuel additive that has demonstrated impressive performance in tests involving gasoline engines as well as in laboratory tests.

## **OEM approved bench and field fuel efficiency (FE) tests on gasoline engines**

An independent test laboratory was commissioned to evaluate the ability of ND-Fuel™ to improve the fuel economy in a 2.0L Mazda 4-cycle gasoline engine (with 65000 miles). A full format of nine test sequences was designed as a protocol to establish a "baseline" for the vehicle. The “baseline” parameters included fuel-efficiency, combustion analysis, injector spray pattern, emissions measurement, oil temperatures, cylinder head temperature, power/torque (HP/TQ), and coolant temperature. The testing equipment included an ScanGauge II and Dynamometer.

Once a baseline was established, gasoline mixed with ND-Fuel™ at a 300 to 1 ratio was added to the tank, and the vehicle was tested using stationary and “on the road” testing protocols with two consecutive fillings.



Compared to the baseline, the additive consistently provided a FE benefit of 0.5% to 1.6%, depending upon the engine test. Other engine performance factors showed little or no difference from baseline. Emissions, oil temperature, and injector spray pattern showed no degradation, and HP/TQ showed a minimal increase. An additional test without the additive (after the ND-Fuel™ tests) was performed to determine if vehicle performance would return to baseline levels. Results of continued testing indicated a drop in FE, but still above the baseline; thus, a "residue" effect was observed.

### Summary by the independent test laboratory from the gasoline engine tests:

"Clearly, a FE benefit of measurable, significant, and consistent nature was produced by ND-Fuel™. Other indices show the engine working under less stress, possibly extending longevity. We recommend testing ND-Fuel™ for diesel engines. The design of the typical diesel engine may be such that ND-Fuel™ may afford a significant FE improvement. Optimum treatment levels for the ND-Fuel™ technology are another area that warrants investigation."

### **Personal tests on passenger car**

Adámas conducted tests with ND-Fuel™ in a 2009 Ford Focus. A baseline FE was established with 10 consequent gas fillings. The oil was changed and 120 mL (4 oz.) of Adámas' motor oil additive D-tribo™ was added to 4 quarts of 5W30 Exxon Mobil Superflow oil. A baseline with the oil additive was established with 3 consequent gas fillings. Lastly, 100mL (3.4 oz.) of ND-Fuel™ was added to 11 gallons of fuel for 3 consecutive fill-ups, and fuel consumption measured. Before the oil change, the car had an average FE of  $31.34 \pm 0.31$  mpg. After addition of D-Tribo™, The FE improved by 2.3% ( $32.09 \pm 0.21$  mpg). In each of the three fillings in which ND-Fuel™ was added, the average FE improved to 5.4% ( $33.06 \pm 0.12$  mpg). Small standard deviations in every test demonstrate consistent improvement in the FE as a result of both D-Tribo™ and ND-Fuel™.

