

# XS-FUEL WAFER - A Fuel Additive for Gasoline and Diesel In WAFER Form

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## I. INTRODUCTION

In 1995, the development of a new gasoline and diesel fuel additive technology that is based on its proprietary XS-Fuel Wafer® iron catalyst. After three years in international test markets, the XS-Fuel Wafer® was introduced in the U. S. at the 2000 Automotive Aftermarket Products Expo in Las Vegas, Nevada. The development of this product was in response to a need for an economical and effective, yet environmentally friendly, fuel additive. As a manufacturer and distributor of high quality gasoline, diesel and oil treatments and conditioners, it was apparent that the high cost of products added to the cost of shipping, storage and handling of bottles, put many markets out of reach. The need for a quality fuel additive for automotive and industrial applications is universal, but access to these products is often limited, particularly for those markets experiencing economic difficulties and concerns. The XS-Fuel Wafer® has proven to be the ideal answer.

### A. XS-Fuel Wafer® – What is it?

The XS-Fuel Wafer® is a proprietary combination of powdered and granulated fuel additives that have been pressed into tablet form. The resultant product is 100% active, highly soluble when added to gasoline or diesel, and the most efficient and cost-effective way to improve hydrocarbon fuels. The XS-Fuel Wafer® is an EPA registered fuel additive in both the gasoline and diesel categories. The XS-Fuel Wafer® is approved for use in the following applications:

- Cars and light trucks • Heavy duty trucks
- Motorcycles and motorbikes • Light and heavy duty commercial vehicles
- Diesel-powered equipment, stationary generators, pumps (i.e. irrigation pumps)
- Marine applications – personal water craft, small and large boats
- Buses • Taxis (gasoline and diesel)
- 2- and 4-stroke engines, including chainsaws, small garden equipment, snow blowers, snowmobiles and light tractors
- Tractors and farm implements

### B. Safe and Effective

Since its introduction, the XS-Fuel Wafer® chemistry has been used to improve millions of gallons of gasoline and diesel fuel worldwide. Despite a general predisposition against adding a “solid” to the fuel tank, the XS-Fuel Wafer® has been a success because it can provide immediate and noticeable improvement. Even though some product claims, such as improved fuel economy, are based on continuous use, the active components begin to work immediately as the tablet dissolves. The XS-Fuel Wafer® has proven to be extremely safe in today’s increasingly complex engines. The XS-Fuel Wafer® is registered with the Environmental Protection Agency, and the fact that there has never been a damage claim is continuing evidence of the safety of the product. By nature of the components, the XS-Fuel Wafer® is inherently safe. It fully dissolves and treats the fuel rather than the fuel system. There are no components in the XS-Fuel Wafer® that can gel or crystallize to clog fuel filters or injection pumps. On the contrary, it is a combustion catalyst with a completely clean burn sequence, which helps to reduce hard and soft carbon in the combustion chamber, on the spark plugs and on the piston face. The XS-Fuel Wafer® is the safe and effective way to improve all hydrocarbon fuels.

C. The XS-Fuel Wafer® fully dissolves.

When added to fuel, the XS-Fuel Wafer® safely and fully dissolves in gasoline or diesel within 1 to 4 hours. This time frame is contingent on the type of fuel, the ambient temperature and whether the vehicle is moving or not. In a controlled test, the XS-Fuel Wafer® was added to a clear 16-ounce beaker of gasoline. In the subsequent one hour, the fuel tablet completely dissolved. This demonstration was done in 50-degree weather in a moving vehicle. A similar test was performed inside in bottles that were stationary. In this test, despite the absence of any motion, the tablets fully dissolved within 4 hours.

The color of the resultant gasoline was amber, but remained crystal clear without any undissolved debris at the bottom of the bottles.

The XS-Fuel Wafer® chemistry was developed to begin to work immediately upon introduction to the fuel and reaches full potential when it has fully dissolved.

## II. BACKGROUND

This report was written to provide an overview of the XS-Fuel Wafer® from both a technical and marketing point of view. The test documentation used to support the data included in this report is cumulative and is based on both in-house and independent research. AS a manufacturer we continue to monitor and accumulate test data from many sources around the world, as it is recognized that conditions vary in different markets. Test results and benefits experienced by users may vary widely, depending on many factors, but particularly on the quality of fuel and condition of the vehicle. As a manufacturer we suggest and encourage independent evaluation in different markets prior to purchase, in order to determine if the XS-Fuel Wafer® meets the required targets for intended use.

## III. BENEFITS OF XS-FUEL WAFER®

### A. INCREASED OCTANE

The XS-Fuel Wafer® iron catalyst is an octane-boosting gasoline additive that shows the same effectiveness that lead provides, and at low concentrations without the environmental downside of lead. A concentration of 15 ppm is recommended for continuous use as an environmentally beneficial and functionally equivalent substitute for Tetra Ethyl Lead (TEL). Figures illustrate that XS-Fuel Wafer® will provide on average, a 0.5 R + M/2 octane increase at 15 ppm in regular gasoline. Depending on the aromatic characteristics of the fuel, one XS-Fuel Wafer® would typically add:

- 1 to 2 (10 to 20 points) numbers to 87-octane gasoline
- 1 (10 points) number to 89-octane gasoline
- .5 (5 points) number to 92-octane gasoline

Like most other octane boosters, the XS-Fuel Wafer® chemistry is a parabolic compound. This means that at a certain point, the addition of more XS-Fuel Wafers® does not result in increased octane. In many parts of the United States and in some overseas markets, 85-octane and even lower grades of gasoline are offered for sale. The result of using the XS-Fuel Wafer® in the lower grades of gasoline is very dramatic. The XS-Fuel Wafer® can add up to 3 to 4 octane numbers – an astounding 40 octane points. In certain Eastern European and former Soviet Union markets, 78-octane gasoline is routinely sold. The XS-Fuel Wafer® can add up to 7 numbers (70 octane points) to this fuel.

In recent tests performed by Core Laboratories in Houston, Texas, one XS-Fuel Wafer® (1 one gram tablet) delivered a 7 point increase in octane. Two separate ASTM D-2699 tests were run using 91 octanes, reference gasoline (RON), and the results were consistent with the performance data accumulated to date.

Sample # 151129 – 008	Sample ID – XS Fuel Wafer
Sample Date: 03/11/05	Description: 4 Wafers Treat 16 Gallons
Research Octane Number: 92.9	ASTM D-2699 03/14/05 LEP

Sample # 151129 – 009	Sample ID – RUL Base Fuel
Sample Date: 03/14/05	Description:
Research Octane Number: 91.0	ASTM D-2699 03/21/05 LEP

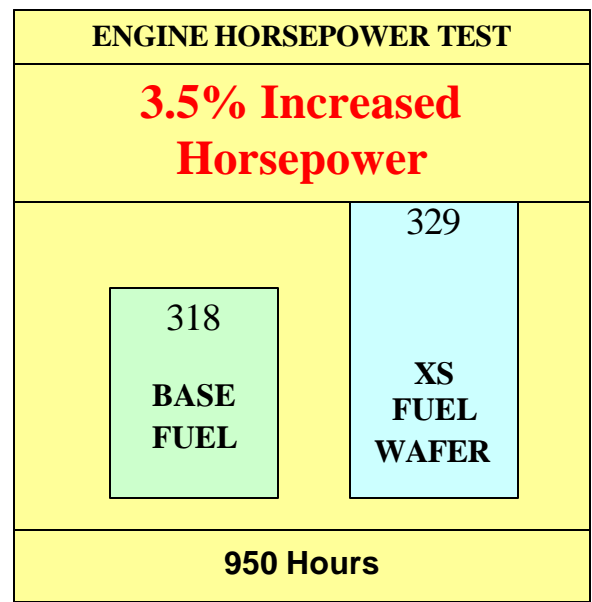
Sample # 151129 – 010	Sample ID – XS Fuel Wafer
Sample Date: 03/21/05	Description: 3 Wafers Treat 16 Gallons
Research Octane Number: 92.7	ASTM D-2699 03/21/05 LEP

Sample # 151129 – 011	Sample ID – XS Fuel Wafer
Sample Date: 03/21/05	Description: 2 Wafers Treat 16 Gallons
Research Octane Number: 92.2	ASTM D-2699 03/21/05 LEP

Sample # 151129 – 012	Sample ID – XS Fuel Wafer
Sample Date: 03/21/05	Description: 1 Wafer Treat 16 Gallons
Research Octane Number: 91.7	ASTM D-2699 03/21/05 LEP

**B. INCREASED POWER AND PERFORMANCE**

When added to fuel, the XS Fuel Wafer® chemistry is designed to promote a cleaner, more complete burn of the hydrocarbon-oxygen mix that is present in the combustion chamber. This results in several benefits, the most readily apparent to the consumer being an improvement in power and performance. In a 950-hour controlled lab test conducted in the United States (Figure IV), the addition of XS Fuel Wafer resulted in a 3.5% increase in horsepower.



This increase in power and performance can be seen in a series of dynamometer tests conducted on a Toyota Camry (Figure V), a BMW 320i (Figure VI) and a Mercedes 380 SEC

(Figure VII). These tests involved a redundant protocol comparing engine power from treated versus untreated fuel. The result demonstrated repeatable improvements in power output across the entire power curve.

Sydney Australia Dynamometer Testing		Before	After	Comments
Figure V	Power Curve for Toyota Camry	64 HP Unleaded Fuel	69 HP	7% increase in power
Figure VI	Power Curve for BMW 320i	Torque Lbs. 1880	2600	At 115 kph, 38% Improvement in power
Figure VII	Power Curve for Mercedes	Torque Lbs. 2250	2400	6.6% increase in power

At the maximum street legal dosage, track testing demonstrated an equivalent 40-point octane increase, resulting in a significant increase in acceleration. Testing was conducted to compare timed 0 to 70 intervals using three gasoline octanes. Gasoline A was pump grade 87 Octane Regular. Gasoline B was pump grade 91 Octane Premium. Gasoline C was the same pump grade 87 Octane as candidate A, but with additive to maximum levels with XS Fuel Wafer® Octane Booster. Timed results show candidates B and C were 9.2% faster than A.

9.2% Increased Acceleration With XS-Fuel Wafer		XS Wafer
A – 87 Octane – untreated		17.57 seconds
B – 91 Octane – untreated		15.95 seconds
C – 87 Octane – with XS Fuel Wafer		15.95 seconds

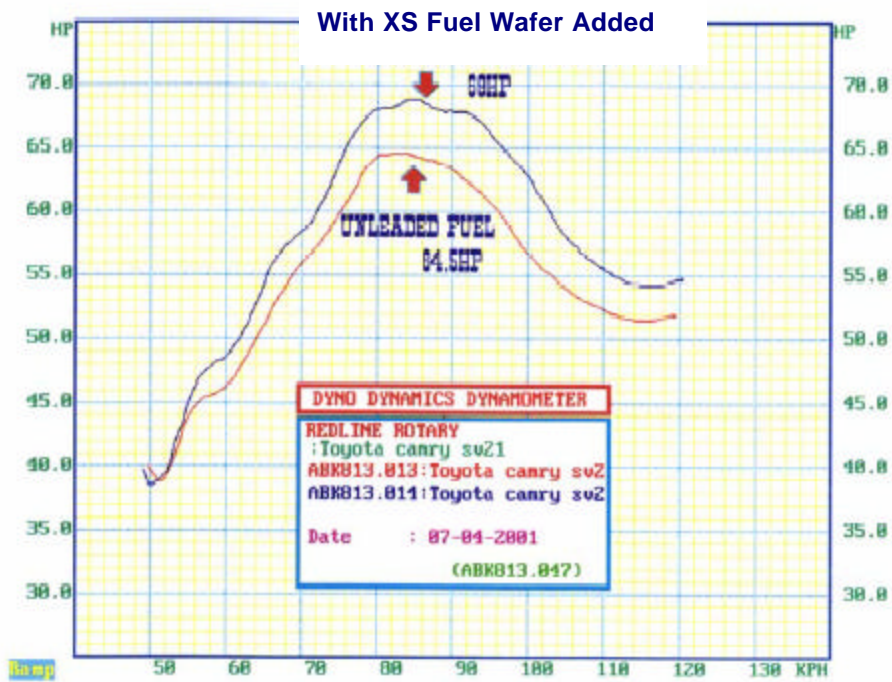


FIGURE V

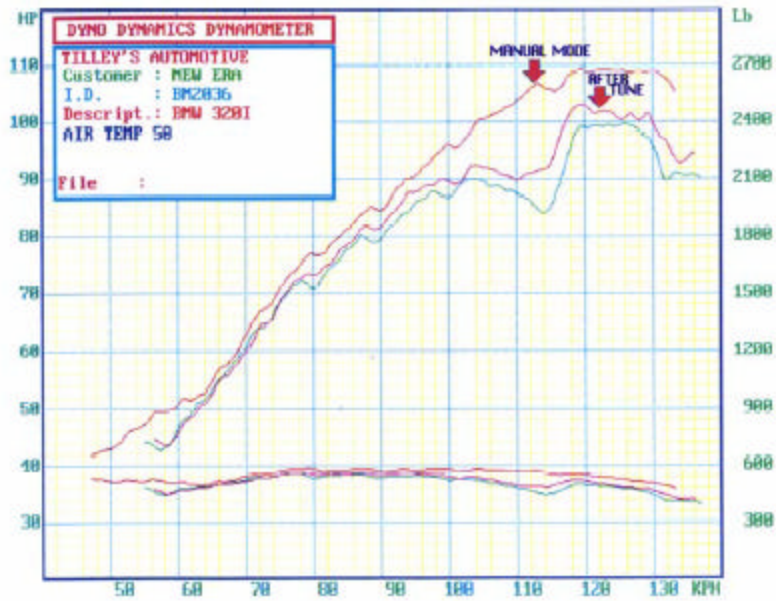


FIGURE VI

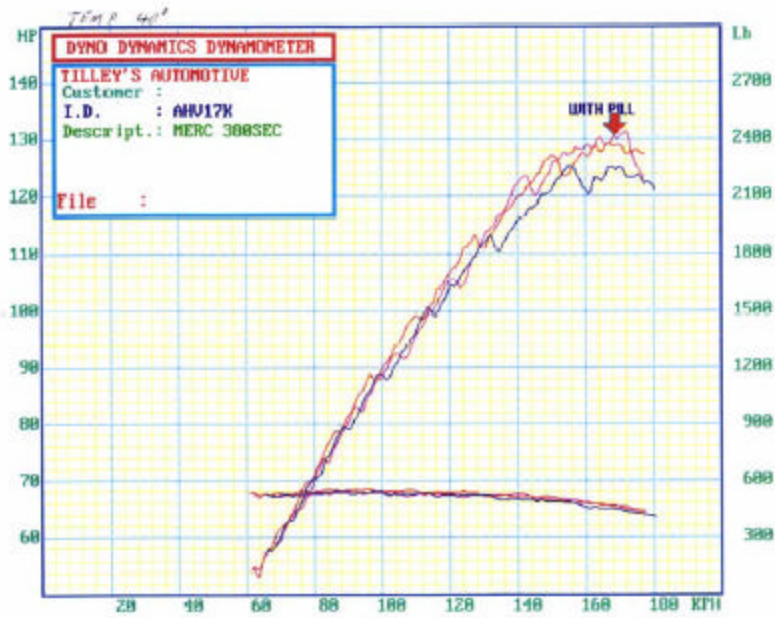


FIGURE VII

A more complete burn of fuel results in increased power and performance.

### C. REDUCED EMISSIONS

The XS-Fuel Wafer® chemistry is a well-tested combustion catalyst that results in improved burn characteristics for all hydrocarbon fuel, particularly gasoline and diesel. Use of XS-Fuel Wafer® results in reduced emissions and cleaner exhaust virtually across the board, however results may vary, depending on a variety of conditions.

#### Manganese (MMT) vs. XS-Fuel Wafer®

MMT is a commonly used aftermarket octane booster. A filing for a waiver under Section 211F of the Clean Air Act for a manganese gasoline additive (MMT) has indicated that use of MMT causes a rapid increase in hydrocarbon emission (in the first 5,000 miles of operation). This is thought to be attributable to manganese deposits building up in the combustion chamber.

Conversely, a study of long-term use of XS-Fuel Wafer® as a gasoline additive documents that XS-Fuel Wafer® reduces harmful emissions. Unlike MMT, use of XS-Fuel Wafer® is proven to reduce combustion chamber deposits. At 15 ppm, in a controlled field test conducted in Europe, data shows that XS-Fuel Wafer® reduced hydrocarbons by 25%, carbon monoxide by 78% and smoke/particulates by 73%. Test data regarding NOX is inconclusive. Some tests show a reduction of NOX while some tests resulted in no reduction.

Additional independent tests (Table II below) show significant reductions in harmful emissions with the use of XS-Fuel Wafer®.

	Before adding XS-Fuel Wafer®	After Adding XS-Fuel Wafer®	Comments
<b>California Smog Test 2001</b> (1984 Nissan)			
Unburned Hydrocarbons – 15 mph 40 PPM 20 PPM 50% Reduction	40 PPM	20 PPM	50% Reduction
Unburned Hydrocarbons – 25 mph 28 PPM 20 PPM 28.57% Reduction	28PPM	20 PPM	28.57% Reduction
<b>Singapore Productivity and Standards Board 1998 (Figure VIII)</b>			
Unburned Hydrocarbons – 400 km high speed (Rover 280Si 4 Dr)	6	4	33% Reduction
Unburned Hydrocarbons – 400 km high speed (Rover 280Si 4 Dr)	8	4	50% Reduction
Unburned Hydrocarbons – 1440 km – (Hyundai Excel 1.3 GL)	886	155	83% Reduction
<b>Sydney Australia Dynamometer Testing 2001</b>			
Carbon Monoxide Emissions	2.83	2.07	26.86 Reduction

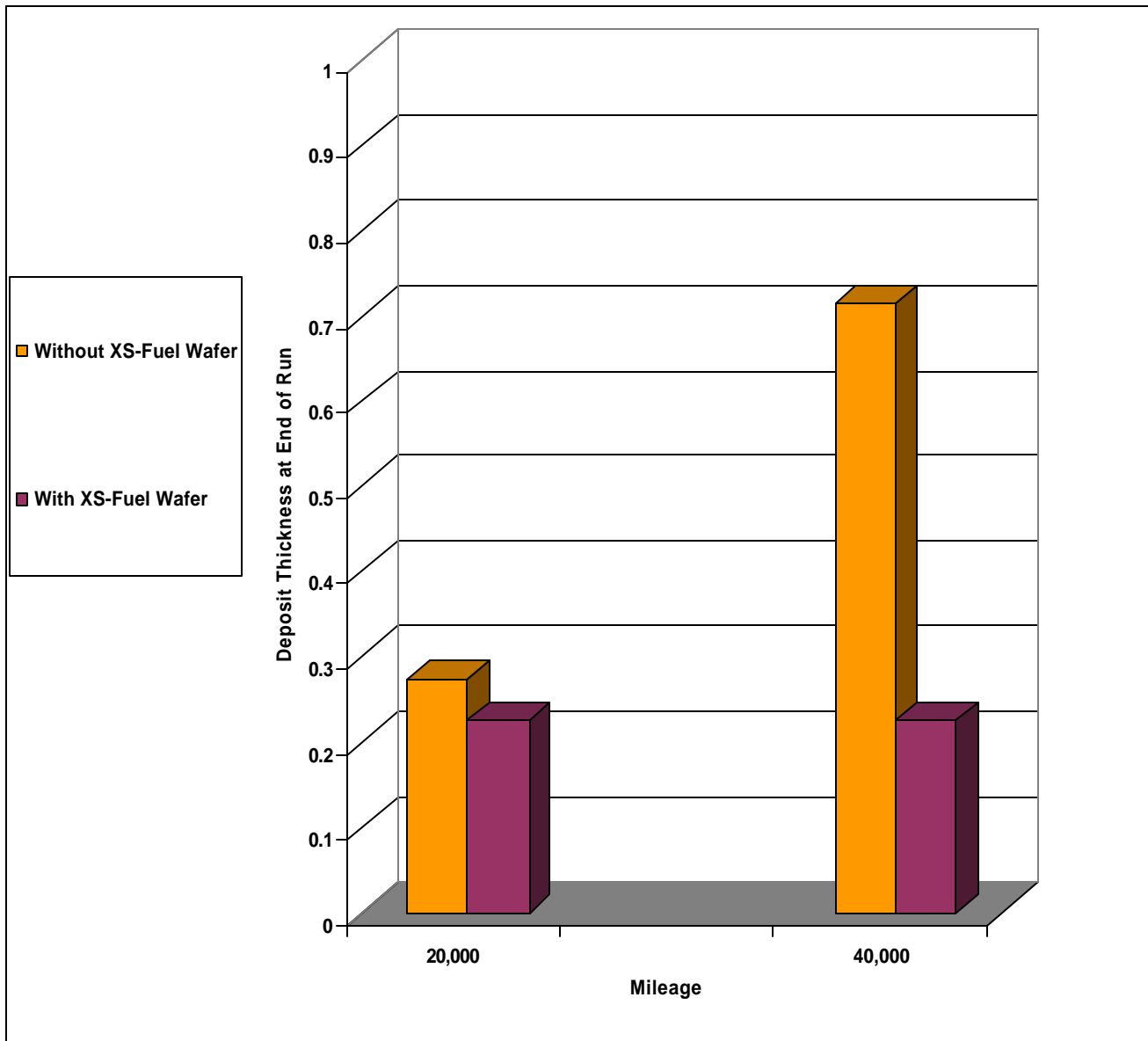
#### D. REDUCED COMBUSTION CHAMBER AND SPARK PLUG DEPOSITS

The addition of lead to gasoline provided many benefits beyond octane improvement. A little known benefit was deposit control. Lead formed a nonconductive coating that retarded the formation of deposits in the combustion chamber, in the exhaust valve areas and on the spark plugs. When lead was eliminated from gasoline, the use of unleaded gasoline resulted in increased deposits and related performance problems within these critical areas. Use of the XS-Fuel Wafer® technology will restore this deposit-retarding feature to any grade of gasoline. Similar to the coating from the use of leaded gasoline, this barrier is non-conductive to electric charges and one nanometer thick. Two important studies verified this phenomenon:

Dynamometer tests were performed using two identical engine blocks with unleaded fuel for the equivalent of 50,000 miles (800 hours total). The test protocol involved running one engine with no additive and one with XS-Fuel Wafer® at 15 ppm for 25,000 miles. Deposits were measured and cleaned.

The engines were switched and the test repeated, running one engine with XS-Fuel Wafer® and one without for 25,000 miles. The results showed a 29% reduction in piston deposit thickness with XS-Fuel Wafer® treatment and a reduction in octane requirement increase (ORI) (Figure IX).

Similarly, two 1.8-liter engines were operated on the highway for 50,000 miles each. After 50,000 miles, the unleaded fuel engine without XS-Fuel Wafer<sup>®</sup> showed 2.4 times thicker deposit than the XS-Fuel Wafer<sup>®</sup> treated fuel engine and, again, the XS-Fuel Wafer<sup>®</sup> fueled engine showed significantly lower octane requirement increase. Additional tests performed in Europe confirm the ORI control benefits of XS-Fuel Wafer<sup>®</sup>.



The deposit-retarding barrier that XS-Fuel Wafer<sup>®</sup> lays down on the combustion chamber and spark plug surface has a distinctive reddish brown color. This looks somewhat like a stain, or to someone unfamiliar with the product, it may appear to be rust. This coloration is noticeable when pulling spark plugs.



Photo E

## E. IMPROVED FUEL ECONOMY

Another benefit of using all the hydrocarbons in the combustion chamber is increased fuel economy. It stands to reason that the lower the hydrocarbon exhaust from the tailpipe, the greater the economy. A Ford Fleet Economy Test showed a typical improvement of 8 to 12 percent in fuel economy. A test on General Motors vehicles (Table III) resulted in similar improvements in fuel economy.

DYNAMOMETER COMPARISON OF DETERGENT VS. XS WAFER IN DIESEL FUEL IN GENERAL MOTROS PROTOCOL TESTS		
530-Hour Diesel Dynamometer Test	Improvement	
	Typical Detergent	XS Wafer
Fuel Economy (300- 500 hrs. avg.)	2%	12%
Smoke Reduction	None	53%
Engine Cleanliness:		
Valve Deposits	38%	85%
Combustion Chamber Deposits	22%	51%

In 1994/1995 we conducted a major automotive fleet update of the performance documentation for our (XXX) gasoline treatment (Field Test Report 45400-1994-02). The largest fleet documentation data previously conducted was a fleet test of 163 cars. Because this test is now dated, and the engine technology has progressed from carburetor/lead fuel to closed loop port injected engines, we decided to run another large scale double blind automotive fleet test. The continued excellent response of electronically controlled port fuel injected engines with (XXX) gasoline treatment, which was proven in the treated universe, was confirmed in this new test.

The most recent fleet demonstration was conducted in the U. S. in 1994/1995 with two universes of a utility fleet company. The first universe, with (XXX) gasoline treatment, had 300 vehicles (233 with gasoline and 67 with diesel). Its performance was compared during twenty months prior to the test, five months during the test and three months after the test.

The second universe, similar to the first group was used as the placebo group and consisted of 350 vehicles. They received bulk fuel treatment with the detergent component of (XXX) gasoline treatment, but without the other active components. The results are presented in the attached percentage deviation plot to show:

1. The twenty months of history is completely within the +/- 4.2% - 95% confidence band.
2. Only one of the five test data points for the placebo group is beyond the 95% limit, so there is no significant placebo effect.
3. After 170 gallons of (XXX) treated fuel was consumed in the first two test months, the (XXX) treated fleet averaged a 10.8% MPG improvement in the last three test months.
4. When additive treatment was terminated in early January, there was a brief carryover of the benefit (December, January, and February average still within 95% limit of 10.8% improvement). This brief carryover is due to the surface catalytic effect of using (XXX) and is usually noticeable.
5. The last two three-month averages show the treated universe returned (and placebo remained) completely within the 95% range for their twenty-month history, so the effect was solely attributable to the use of (XXX)

Because fuels differ considerably from country to country, extensive testing has been conducted in a variety of markets internationally using locally available indigenous fuels. In markets where fuel quality is less regulated, the results from using XS-Fuel Wafer® tend to show additional improvements. Table IV below shows the results of a field test conducted by the Singapore Productivity and Standards Board.

Singapore Productivity and Standards Board (PSB)		October 1998. One dimensional test for fuel economy only. Vehicle: Rover. Driving distance 486 km
Before	After Adding XS-Fuel Wafer®	Comments
34.996 liters fuel consumed	33.034 liters fuel consumed	Fuel Efficiency Improvement: 5.9% Note: Second test results were 3.4%, but noted traffic jam at second Causeway. Results: 4.65% average.

## F. LEAD SUBSTITUTE AND VALVE SEAT RECESSION

### Background – The Removal of Lead

Tetra Ethyl Lead (TEL) is a Class B poison and environmentally unacceptable for health reasons. Beginning in 1973, The U.S. Environmental Protection Agency required the reduction of lead in gasoline. All new cars manufactured in the U.S. from 1978 on were required to run on unleaded gasoline. When fully implemented in the 1980's, this program effectively removed an environmental contaminant, but resulted in justified concern about equipment durability and performance for consumers who owned pre-1978 vehicles. This durability concern was verified as fact in a joint U.S. Department of Agriculture/EPA report to the President and Congress (October, 1988) which stated "...medium and high speed engines with soft valve seats and some high speed truck engines with induction hardened cast-iron or soft steel valve seats will experience excessive valve-seat wear if operated on unleaded gasoline."

After the removal of lead, vehicles manufactured before 1978 required that a qualified lead substitute be added to unleaded gasoline to avoid valve seat recession (VSR). Leaded gasoline provided lubrication for valves, and without lead to buffer the valve seat, older engines were vulnerable to damage. The newer post 1978 engines were designed with hardened valve seats. Other than pre-1978 cars and trucks, vehicles that require the addition of a lead substitute include:

- Off-road equipment
- Boats
- Farm tractors
- Vintage and antique automobiles, trucks and motorcycles

### The XS-Fuel Wafer® Alternative

Because of the susceptibility to valve seat recession, this report provides technical documentation for XS-Fuel Wafer® as a lead replacement in engines. XS-Fuel Wafer® is a safe and logical option for petroleum distributors and aftermarket suppliers to offer to those needing an alternative, while avoiding the environmental and toxicological problems associated with lead. XS-Fuel Wafer® is an iron catalyst and this report documents its efficacy as a total replacement to provide the functional and durability benefits of TEL.

Specifically, XS-Fuel Wafer® provides:

- Environmental and toxicological acceptability
- Anti-knock efficacy
- Valve recession elimination

**SPECIAL NOTE:** XS-Fuel Wafer® offers the protection of lead, and poses no risk to engines that do not require the protection of lead. XS-Fuel Wafer® is not lead and does not threaten newer engine technologies like the catalytic converter or oxygen sensor. It is 100% safe for use in today's engines that are designed for lead-free gasoline.

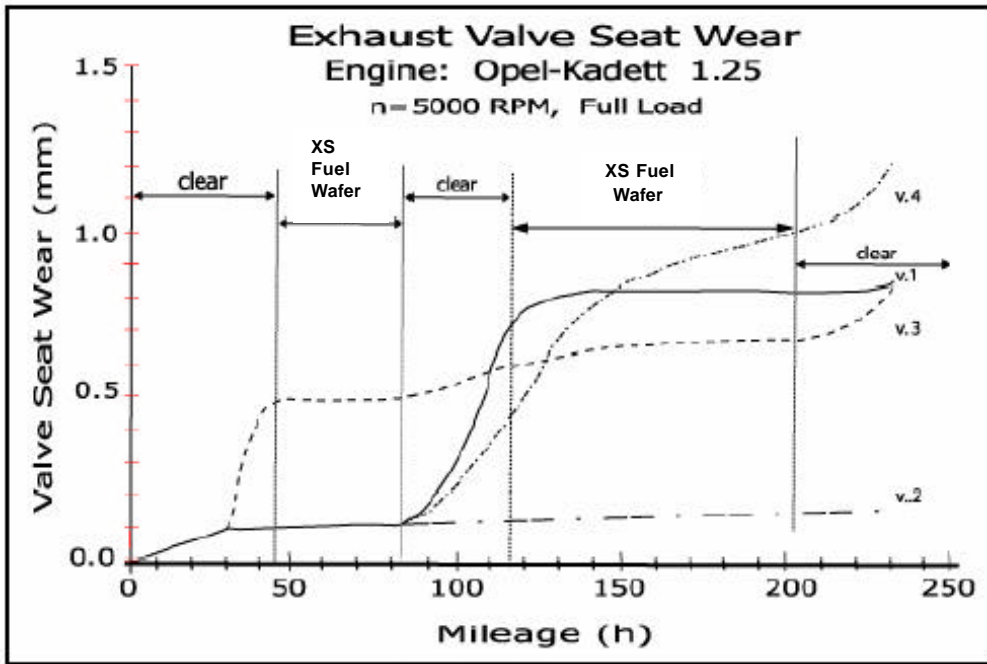


FIGURE XI

### XS-Fuel Wafer® Provides Valve Recession Protection

XS-Fuel Wafer® stops valve recession which has already begun and prevents valve recession from starting. One of the primary functional requirements for a lead replacement product is the ability to protect against valve recession. XS-Fuel Wafer® was evaluated on a dynamometer test stand at a 15 ppm dose for this property. Figure XI presents the results of this evaluation. The engine was repeatedly switched between unleaded fuel and the identical unleaded fuel treated with XS-Fuel Wafer®. The data plot clearly shows that XS-Fuel Wafer® at 15 ppm dose rate both protects against valve recession and stops or retards existing valve recession due to operation on unleaded fuel – a unique performance attribute of this technology. Figure XII shows two field tests on cars switched from leaded to unleaded fuel, confirming the ability of XS-Fuel Wafer® to dramatically reduce or stop valve recession.

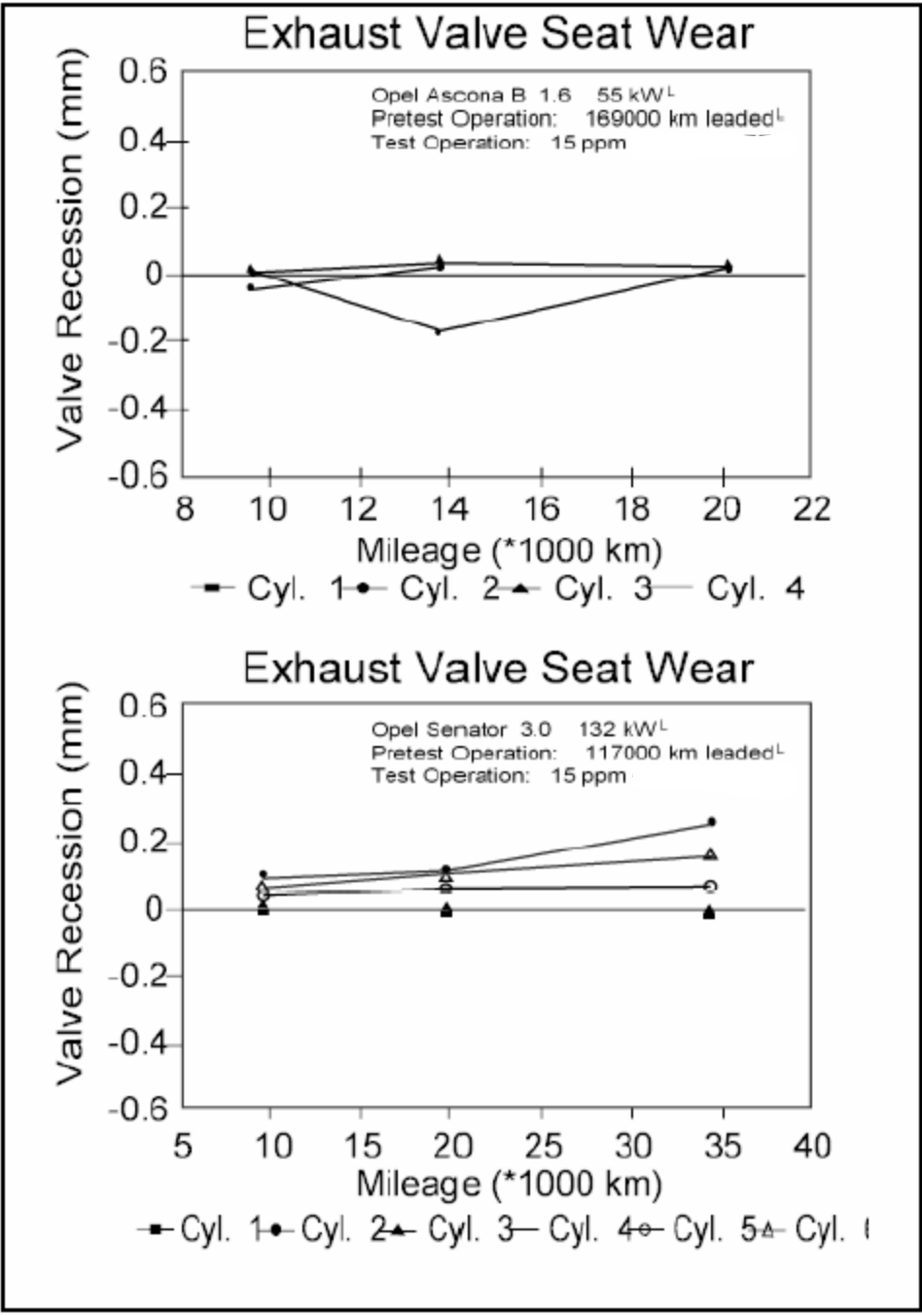


Figure XII

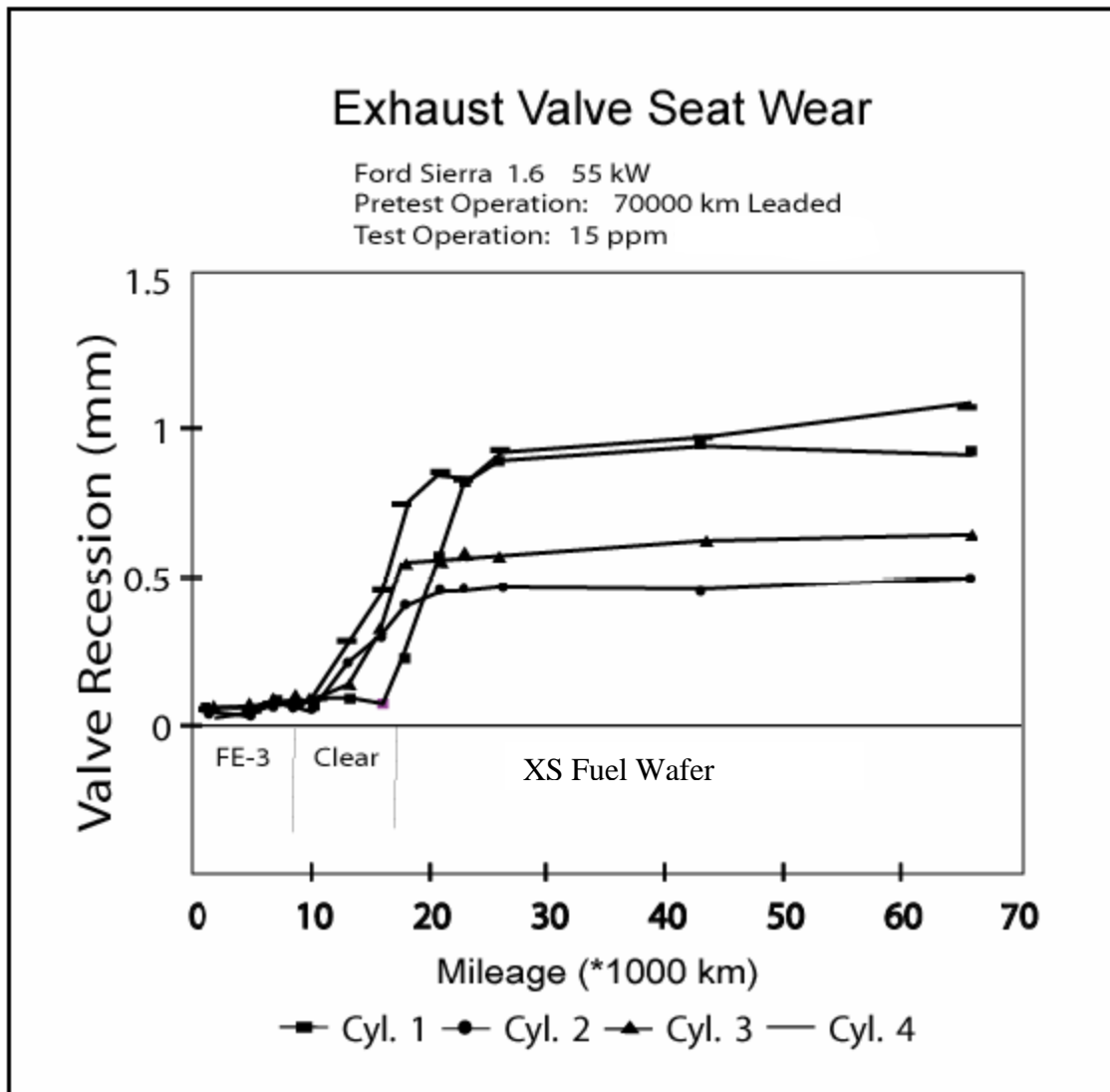


Figure XIII

#### IV. ENVIRONMENTAL AND TOXICOLOGICAL ISSUES

The Ninth edition of the Merck Index lists the lethal dose (orally for rats) for Tetra Ethyl Lead (TEL) as  $LD_{50} = 12.3 \text{ mg/kg}$  which compares to a  $LD_{50}$  of  $1,890 \text{ mg/kg}$  for XS-Fuel Wafer<sup>®</sup>. This comparison suggests XS-Fuel Wafer<sup>®</sup> has 150 times higher tolerance. More importantly, the above reference regarding TEL states "Caution: acute or chronic poisoning may occur if inhaled or absorbed through the skin" (page 1186). Animal studies included in the Material Safety Data Sheet showed XS-Fuel Wafer<sup>®</sup> to be non-irritating to either abraded or intact skin, and dust inhalation studies with mice failed to produce any fatalities at the maximum achievable concentration of  $150 \text{ mg/m}^3$  (about 20 ppm in air).

The use of XS-Fuel Wafer® in fuel results in inorganic iron (iron oxides) with no statistically significant increase in iron concentration in the particulate emission from motor vehicles. Furthermore, iron is already the largest metallic in automotive exhaust. This is due to metal-to-metal wear and exhaust pipe slough contributions to emissions. Consequently, incorporation of XS-Fuel Wafer® in automotive gasoline contributes no new or increased exposure to metallic emissions. The Environmental Protection Agency of the U.S. requires registration of additives for gasoline dispensed through large diameter nozzles or in aftermarket containers, and XS-Fuel Wafer® is fully registered for both gasoline and diesel applications.

## V. CONCLUSIONS

The XS-Fuel Wafer® is in distribution in over 20 countries after being introduced to the marketplace in 1998. The global differences in fuels, vehicles and operating conditions have put XS-Fuel Wafer® to the test worldwide, and the results are consistently positive. XS-Fuel Wafer® has been demonstrated to provide substantial improvements in critical performance areas:

### 1. Octane increase

- Adds 1 to 2 numbers to 87-octane gasoline
- Adds 1 number to 89-octane gasoline
- Adds .5 number to 92-octane gasoline

### 2. Engine performance

- Reduces combustion chamber deposits that can cause octane requirement increase, dieseling, and performance problems
- Adds power
- Improves drivability and performance

### 3. Harmful emissions and smoke

- Reduces smoke up to 53%
- Reduces up to 75% of unburned hydrocarbons

### 4. Fuel Economy

- Improves fuel economy by up to 8-12%

### 5. Valve Recession

- Maintains valve seat integrity as well as lead.
- Reverses existing recession within 5,000 miles.
- Provides complete duplication of leaded gasoline performance advantages while satisfying the environmental concerns requiring lead elimination from gasoline.
- Meets all EPA requirements for use in leaded (large nozzle dispensed) gasoline or off-road/marina fuel supplies.

LABORATORY AND FIELD-TESTED, EPA REGISTERED - XS-FUEL WAFER® IS THE SAFEST, MOST ECONOMICAL AND EFFECTIVE FUEL ADDITIVE AVAILABLE.