

A revue of test reports  
and other documents  
relating to the fuel component

TK-7

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Signed Richard D Atkins



Date: 28/12/2005

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A handwritten signature in black ink that reads "DBRay".

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## Executive summary

The purpose of this report is to identify the documents under review, to give opinion on the significance and credibility of these documents, to summarize the key points in each document and finally to draw conclusions as to the attributes of TK-7 as a fuel additive.

In 2003 Mr Zohar Levy contacted Mr Richard D Atkins of Richard Atkins and Associates, and David Ray of Services 4 You Ltd, seeking technical assistance in the promotion of a novel fuel additive TK-7. At that time a number of technical reports were made available which were significant enough for both the above organisations to agree to provide their support. Later Richard Atkins and David Ray designed and supervised further testing of the product in an independent ISO 17025 accredited laboratory.

The “no-harm” aspect of TK-7 is clearly demonstrated. The on-going RAFAEL trial is outstanding; many a major additive company would love to have such an arrangement.

The evidence for fuel consumption reduction is overwhelming. The Octel test was designed to be as difficult as possible for the additive to show a fuel consumption benefit, but it did. Actual fuel consumption benefits averaged over a mixed fleet are likely to be in the region of 10%.

The Valve Seat Recession (VSR) control is remarkable, particularly considering that TK-7 contains no metals or metallic compounds.

There is strong evidence of wear reduction and control of particulate deposition into the crankcase oil.

The writers recommend that this additive should be blended into premium fuel and marketed as a top tier product. Most of the major fuel companies now sell top tier fuels. This product could enhance fuel properties to such a level that the consumer would notice the difference, something that the majors have so far failed to do.

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# 1 Purpose of the Report

The purpose of this report is to identify the documents reviewed, to give opinion on the credibility and significance of these documents, to summarize the key points in each case and finally to draw conclusions as to the attributes of the fuel additive TK-7.

## 2 Introduction

In 2003 Mr Zohar Levy contacted Mr Richard D Atkins of Richard Atkins and Associates, and David Ray of Services 4 You Ltd, seeking technical assistance in the promotion of a novel fuel additive TK-7. At that time a number of technical reports were made available which were significant enough for both the above organisations to agree to provide their support. Later Richard Atkins and David Ray designed and supervised further testing of the product in an independent ISO 17025 accredited laboratory.

## 3 Documents reviewed

1. Caterpillar I-K test at Southwest Research Institute project No. 03-4762-102
2. Israel Ministry of Defence RAFAEL Report No. 94/05/15
3. Power test by David Vizard
4. Apparent Octane test by David Vizard
5. Exhaust Valve Recession Test by David Vizard
6. Carburettor Cleanliness Test by Southwest Research Institute
7. Fleet trial by State of Oklahoma Military Department
8. MAN approval 12/03/1996
9. USA Environmental Protection Agency "Substantially Similar" statement on TK-7
10. Associated Octel Fuels Technology Centre EEC 70/220/EEC fuel consumption tests

## 4 Credibility and significance

A credibility rating for each document is provided based on the authors' knowledge and experience of the originators of each document. 1 = very low credibility, 10 = the highest credibility. A test report from an internationally recognised accredited laboratory using established test methods attracts a rating of 10. A testimonial from an unknown individual attracts a rating of 1.

## 5 Document reviews

### 5.1 Caterpillar 1K test at Southwest Research Institute (SWRI)

*Credibility rating = 10.*

SWRI is the largest and most prestigious independent fuel and lubricant testing establishment in the world. SWRI runs product testing and approval programmes for all the major oil companies.

The Caterpillar IK test is primarily a lubricant test defining Heavy Duty Diesel lubricant performance worldwide. The Caterpillar is also used, particularly for military approval, as a "no-harm" test for diesel fuel additives. Many fuel additives can impair the performance of

the lubricant resulting in increased piston deposits, ring scuffing, cylinder liner scuffing and ring sticking. The results are expressed as a comparison between the known performance of a fuel with and without the additive. In addition to an assessment of the piston and liner, the crankcase oil and the fuel are analysed and inspected and compared with the results without the additive.

#### Results

Parameter	Description	No additive	With TK-7
WDK	Overall level of piston deposits	271.4	216.4
TGF	Percentage of top ring groove filled with carbon	42%	11%
Ring Stick	0=free 10=fully stuck	0	0
Piston scuffing	0=none	0	0
Ring scuffing	0=none	0	0
Liner scuffing	0=none	0	0
Fuel Cetane No.	Higher is better	43.6	45.3
Oil particulate contamination	Quantity of particulate in oil	0.93 mg/l	0.58 mg/l

## 5.2 Israel Ministry of Defence RAFAEL Report No. 94/05/15

*Credibility rating = 9.*

RAFAEL is the State of Israel Ministry of Defence Armament Development Agency. RAFAEL has a worldwide reputation, operates within a high security environment and employs Engineers, Chemists and Technicians of the highest quality. This report was commissioned by the Israeli Minister of the Environment. RAFAEL had initially tested TK-7 in 5 vehicles.

#### Results of 5 vehicle trial

	Chevrolet van	Mercedes diesel	Ford Erica	Subaru	Fiat Uno
Engine cc	4100	-	1300	1600	1100
Average km/litre before	5.38	4.13	8.50	8.7	14.51
Average km/litre with TK-7	6.23	4.62	9.24	9.42	15.77
Percentage improvement	<b>15.8%</b>	<b>11.8%</b>	<b>8.7%</b>	<b>8.4%</b>	<b>8.6%</b>

Following this test TK-7 was gradually introduced to the whole fleet. In addition to a reduction in fuel consumption RAFAEL also reports a significant reduction in breakdowns and required maintenance with oil change intervals extended by 50%. RAFAEL continues to monitor the performance of its fleet of more than 1700 vehicles which have covered over 14,000,000 km to date. This fleet includes vehicles designed to run with leaded gasoline. These vehicles run with unleaded fuel with TK-7 and show no signs of exhaust valve seat recession (VSR). There have been no detrimental effects observed and RAFAEL continues to enjoy reduced maintenance and fuel costs for all their vehicles.

### 5.3 Power output tests by David Vizard

*Credibility rating = 7.*

David Vizard is a well respected automotive engineer and technical writer. Vizard tested all available fuel additives in the USA which claimed to increase power output. Only TK-7 gave a power increase which was 4.7% in a Chevrolet 5.3 litre engine installed on an automated test stand at his laboratories.

### 5.4 Apparent Octane tests by David Vizard

*Credibility rating = 7*

Vizard found that, in a high performance Chevrolet engine, 91 octane gasoline with TK-7 had the same anti-knock properties as 100.9 octane racing gasoline.

### 5.5 Exhaust Valve Recession Test by David Vizard

*Credibility rating = 7*

Vizard ran an engine designed to operate with leaded fuel (i.e. an engine with “soft” valve seats). The engine was run at severe conditions with unleaded fuel resulting in a high level of VSR. The valve recession was reduced by more than 70% when TK-7 was added to the unleaded fuel.

### 5.6 Carburettor Cleanliness Test by SWRI

*Credibility rating = 10.*

Southwest Research ran two carburettor cleanliness tests on fuel with and without TK-7.

Results

	Base fuel		With TK-7	
	Test 1	Test 2	Test 1	Test 2
Sleeve deposits mg.	2.9	2.2	2.0	1.5
Bar deposits	14.0	10.1	1.1	1.8

### 5.7 Fleet trial by State of Oklahoma Military Department

*Credibility rating = 6.*

The State of Oklahoma Military Department ran a comparative fleet trial on 33 vehicles, 22 with standard pump fuel and 11 on fuel treated with TK-7. After 8 months of testing the TK-7 treated vehicles returned a 10% fuel saving with no perceptible change fuel consumption of the 22 control vehicles.

### 5.8 MAN approval 12/03/1996

*Credibility rating = 10*

The truck manufacturer MAN issued a document giving approval for the use of TK-7 diesel additive in all MAN diesel trucks.

### 5.9 USA EPA “Substantially Similar” statement on TK-7

*Credibility rating = 10*

This document confirms that the TK-7 gasoline and diesel products do not contain any substances about which the Environmental Protection Agency (EPA) is concerned. Many additives contain substances excluded under “substantially similar” and such additives may only be sold if the EPA can be persuaded to apply an expensive “waiver” each year. TK-7 is the only additive with Valve Seat Recession control that meets “Substantially Similar”; all the others contain metals which exclude them from this category.

## 5.10 Associated Octel EEC 70/220/fuel consumption tests

*Credibility rating = 10*

This test programme was designed by Richard Atkins and David Ray in conjunction with other specialists at the Associated Octel Fuels Technology Centre in the UK.

The programme was designed to establish whether TK-7 could demonstrate fuel economy benefits when tested in accordance with internationally recognised procedures under controlled conditions in an ISO 17025 approved laboratory.

A Toyota Camry vehicle was run for a total of 18000km on a robot controlled all weather chassis dynamometer. For the first 7000km the vehicle was fuelled with street grade EN228 European 95 Octane unleaded gasoline. For the remaining 11,000km the vehicle was run with the same gasoline but treated with the recommended level of TK-7. Fuel consumption was determined according to European Directive EEC 70/220 with more than 30 such determinations being made during the programme.

### Results

Combined fuel consumption in litres/100km according to Directive EEC 70/220		
Fuel	EN228 unleaded	EN228 unleaded + TK-7
Combined fuel consumption	<b>11.57</b>	<b>10.98</b>
<b>Impact of TK-7 on fuel consumption</b>		<b>-5.1%</b>

The fuel consumption was still improving when the end of the test was reached. Further running would very likely have resulted in a reduction of more than 5.1%.

The reduction in fuel consumption was matched by a similar reduction in CO<sub>2</sub> emissions. On stripping of the engine at the end of the test the cylinder head and piston crowns were found to have minimal carbon deposits, those remaining being soft enough to be wiped away with a cloth. There was an evident coating of lubricant on the cylinder walls, later analysis showing that this did not come from the crankcase oil.

## 6 Discussion of results

The Caterpillar test in addition to “No-harm” shows a significant reduction in piston deposits, an increase in Cetane number of the fuel and reduced particulate contamination of the crankcase oil.

The RAFAEL report provides exceptional “No-harm” data coupled with a fuel consumption saving of over 11%. RAFAEL was able to increase oil change intervals by 50%, probably as a result of lower particulate contamination of the crankcase oil as seen in the Caterpillar test. Valve seat recession (VSR) control in engines with “soft” seats was also demonstrated.

The David Vizard testing shows an immediate power increase of 4.7% coupled with enhanced knock control in a high compression high performance gasoline engine.

The recession tests further support the RAFAEL experience of VSR control with TK-7.

The SWRI carburettor Cleanliness Test shows detergent capability in preventing harmful deposit formation in carburettors.

The State of Oklahoma Military department trial further confirms the no-harm data coupled with a fuel saving of more than 10%.

Vehicle manufacturers are extremely cautious about approving the use of any fuel additive. The approval from MAN is highly significant because it shows that MAN has no concerns whatsoever about the use of TK-7 in their vehicles.

Inclusion in the EPA “Substantially Similar” category is remarkable because no other product with VSR control has this (All other VSR control additives contain metals which exclude them from “Substantially Similar”)

The testing at Associated Octel confirms much of the data from elsewhere. The testing was conducted under the strictest regimes with triplicate measurements taken at each point with instruments calibrated against international standards. The laboratory was approved to ISO 17025 and the test methods used to determine fuel consumption were those laid down by the European Commission. The test fuel was EN228 street grade gasoline. The tests showed a reduction in fuel consumption of 5.1% which was still improving when the test was stopped. The lack of heavy carbon deposits on the pistons and in the combustion chamber supports the results from the Caterpillar test. The deposition of wear metals into the crankcase oil was reduced on the addition of TK-7, again in line with the Caterpillar result.

## **7 Conclusions**

- There are no harmful side effects from the use of TK-7.
- Actual fuel consumption benefits from this product, averaged over a mixed fleet, are likely to be in the region of 10%.
- TK-7 in unleaded gasoline controls valve seat recession in older engines designed to run with leaded fuel.
- The product controls the build-up of potentially damaging hard carbon deposits in engines.
- There is strong evidence of wear reduction and control of particulate deposition into the crankcase oil.

## **8 Recommendations**

The writers recommend that that this additive should be blended into premium fuel and marketed as a top tier product. Most of the major fuel companies now sell top tier fuels . This product could enhance fuel properties to such a level that the consumer would notice the difference, something that the majors have so far failed to do.



## **9 Resume**

### **9.1 Richard D Atkins**

Chief Executive Richard D Atkins and Associates Engineering Consultants, Chartered engineer, Fellow of IMechE, Chairman of the IMechE Automobile Division, Southern Centre, and 40 years experience in the automotive industry, Consultant and University Research Fellow, Lecturer & Tutor. Long standing member of SAE and PTNSS (Polish internal combustion engine scientific group)

### **9.2 David B Ray**

Managing Director of Services 4 You Limited, Consultants to the Motor and Petroleum Industries. 26 years managerial experience in the oil industry with Esso, Ricardo and the British Internal Combustion Engine Research institute. Mr Ray has chaired many CEC and BTC industry committees and has presented papers worldwide.