

# *Fluid Fuel Technologies*

*The Acknowledged World Leader in Fuel Quality Management*

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## Product and Technical Data

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## **1. Introduction**

Dieselfix is generic diesel fuel, formulated entirely with non-hydrocarbon components, that has the capacity to remedy the most undesirable characteristics of petroleum-based diesel fuel. It achieves these functions in fresh diesel fuel at a dosage ratio of 1-in-4000. Stabilising (fixing) diesel fuel quality eliminates processes that lead ultimately to maintenance procedures that are not only costly in themselves, but involve downtime that is considerably more costly.

Dieselfix provides preventative maintenance for diesel fuel. This is the first time that the concept of preventative maintenance has been extended to include fuel. Maintaining fuel quality and, consequently, fuel systems in pristine condition obviates the need for periodic manual maintenance of pumps and injectors. This is an increase in fuel system maintenance from a periodic, manual procedure to a full time, automatic function.

Dieselfix was not developed as a “fuel saving device”, but as a maintenance product. An inescapable consequence of full-time fuel-injection system maintenance is improved fuel efficiency (lower fuel consumption)

Instead of the gradual loss in fuel efficiency (increase in fuel consumption) as pumps and injectors become fouled with resin, keeping fuel systems permanently clean prevents fuel wastage. In engines that are not new, cleansing of the fuel system produces a decrease in fuel consumption (increase in fuel efficiency).

Since fuel is the single largest cost factor in diesel equipment operation, logic dictates that fuel efficiency is the most effective key to reducing operating costs.

There was no means of maintaining fuel quality prior to this development. Since fuel quality is responsible for most of the maintenance of diesel engines, it is logical that maintaining fuel quality provides significant benefits to users in terms of maintenance cost savings.

## **2. Technical Data**

Compression-ignition (diesel) engines are designed according to the specifications of diesel fuel. It is ***imperative*** that any liquid passing through the fuel-injection system into the combustion chamber must conform to these specifications. (This, hitherto overlooked, necessity is the reason why conventional “additives” have such a poor reputation in the diesel industry).

Dieselfix has been submitted for testing at the South African Bureau of Standards (SABS) and proved to conform to the specifications of SANS 342, the national standard for automotive diesel fuel, as it was designed to do. It has also been tested in Australia, where it conforms to AS 3570, their standard for diesel fuel. In Haifa, Israel, it was tested against the requirements of EN 590, the European diesel standard. Again, as was its design criteria, Dieselfix proved to conform.

In this absolutely crucial requirement, Dieselfix stands alone in a field of thousands of products that all “claim” to offer similar benefits to Dieselfix, but fall horribly short one way or another.

## 2.1. Specification

Dieselfix conforms to S.A.N.S. 342 as follows:

<u>Property</u>	<u>Requirement</u>	<u>Dieselfix Actual</u>
Distillation temp. for 90% (v/v) recovery, °C (max.).....	362.....	173
Flash point, °C (min.).....	55.....	67
Cetane number, (min.).....	45.....	>45
Sulphur content, % (m/m) (max.).....	0,55.....	0
Copper strip corrosion classification (max.).....	1.....	0
Carbon residue of 10% distillation residue, % (max.).....	0,2.....	0
Cold filter plugging point (C.F.P.P.), °C (max.).....	-4.....	-70
Ash content, % (m/m) (max.).....	0,01.....	0
Water content, % (v/v) (max.).....	0,05.....	0
Sediment content, % (m/m) (max.).....	0,01.....	0
Viscosity at 40°C, mm <sup>2</sup> /s.....	2,2 – 5,3.....	2,25
Oxidation stability, mg/100ml (max.).....	2.....	0

## 3. Definitions

3.1. Diesel fuel: a generic term that applies to any fuel that can safely be used in a diesel engine.

3.2. Additive: A chemical that alters the characteristics of fuel.

Dieselfix conforms to the requirements of diesel fuel standards worldwide.

Dieselfix is designed to cause no alteration of fuel characteristics in any way. It works by altering the characteristics of contaminants found in all standard diesel fuel.

Dieselfix, therefore, does not qualify as an “additive” but is generic diesel fuel in the strictest terms of the definitions.

**N.B.** Dieselfix conforms to the fuel requirements of all diesel equipment manufacturers, thus cannot produce any rational objection to its use in equipment manufactured by them.

## 4. Quality of Diesel Fuel

More than any other petroleum-based fuel, diesel decomposes with age. This is characterised by the fuel turning brown in colour and depositing a film of brown resin on all surfaces it comes into contact with. This is familiar to everyone concerned with diesel.

Diesel is also well known for collecting water. This is because it is hygroscopic, meaning that it absorbs water from the air. Water is actually at the root of the process by which diesel decomposes. Not only that, but it is responsible for a long chain of processes that are extremely detrimental to both the fuel and engines.

## **5. Detrimental Aspects of Diesel Fuel**

### **5.1. Water**

As mentioned, water collects in diesel fuel through hygroscopic absorption. Molecules of water (humidity) are absorbed by the fuel. This is not condensation. Water exists in diesel fuel in exactly the same three forms as in the atmosphere.

Free water is the familiar version. Everybody has seen how water settles out of fuel to lie at the bottom of the container. Free water is the result of condensation. It can occur inside the tank above the fuel level in cold temperatures, where the condensation runs down the tank walls to the bottom. Mostly, it occurs within the fuel itself.

Suspended water is made up of microscopic “particles” of liquid water that hang suspended in the fuel. This is identical to mist or cloud in air. Suspended water forms as molecules drift together in fuel or when agitation causes free water to break up into minute droplets small enough to “float” in the fuel. Whatever the source, much of the suspended water is microscopically small enough to pass through fuel filters. When suspended, it obviously does not fall into water-traps.

Water-content is molecular. Individual molecules are contained in the fuel identical to humidity contained in air. It is invisible and passes through filters and water-traps. This is arguably the most detrimental form of water in diesel. Because it is invisible, it is little-recognised.

Because fuel absorbs water continuously, water molecules drift together until they form a droplet large enough to settle out. This process is not affected by temperature. Eventually, free water accumulates to lie several centimeters deep at the tank bottom. Underground storage tanks usually have their pick-up pipes at least 30 cm above the tank bottom to avoid transferring water to vehicle running tanks.

All three forms of water produce undesirable effects in fuel and, particularly, in engines.

Dieselfix chemically changes water into a completely different fluid that is fuel-soluble. This ensures that the fluid disperses evenly throughout the body of fuel. The fluid is not water, but is a lubricant and is fully combustible, both of which are the primary properties of diesel fuel.

### **5.2. Fuel Decomposition (a.k.a. “Oxidation”)**

Water-content and suspended water encounter sulphur in diesel. Sulphur-content as low as 0.03% is sufficient to form sulphurous acid with water. This is indicated in fuel analysis by “total acid number” (TAN). The only oxidation that takes place is with sulphur which reacts with waterborne oxygen. Acid breaks down (decomposes) the fuel causing resin to separate from it.

This is why containers that are used for diesel fuel become stained brown. This resin also accumulates throughout the interior of the fuel system in what is commonly known as “gumming”. This is also commonly referred to as “varnish”.

Gumming in pumps and injectors produces negative effects with atomization, spray-pattern and fuel quantity being injected. Usually it causes overfuelling, characterised by emission of black smoke (incompletely burned fuel) from the exhaust. The logical outcome is loss of fuel efficiency (increased fuel consumption)

The standard procedure for correcting this is removal and stripping of pump and injectors, then physically cleaning all components with paintbrush and solvents. When reassembled, the pump requires recalibration purely because it was stripped.

Modern electronic fuel-injection systems are considerably more sensitive to gumming than the older mechanical systems. This is why modern turbodiesel engines produce smoke within a few months. Electronic fuel-injectors are far more complex than mechanical ones and are not overhauled, but have to be replaced at considerable expense.

Dieselfix eliminates this problem in two ways. It chemically converts water into a completely different fluid that is chemically inert with oxides of sulphur so it prevents the acid forming in the first place. Secondly, it contains a mild, highly specific resin solvent that removes gumming from the fuel system. This not only multiplies the life of electronic and mechanical fuel injection systems, but optimises fuel efficiency and exhaust emissions.

### 5.3. Fuel Filter Blockage

This was the original problem that initiated the development of Dieselfix. There is no alternative to good filtration. The problem is that when filters become blocked, the engine stops dead until new filters are installed. The three primary culprits in blocking fuel filters are water, resin and microbial infestation.

Dozens of products will “disperse” water into fuel and even more will “emulsify” fuel and water. These do not achieve the desired result because they do not change the water.

Dieselfix converts water into a fuel-soluble, fully combustible lubricant that bears no similarity to water. The new fluid is absolutely safe in fuel-injection systems and combustion chambers. It is perfectly safe for it to pass through fuel filters, which is achieved by fuel-solubility.

Resin build-up on filter elements is eliminated and Dieselfix’s effectiveness against microbial infestation is already legendary.

In every case, with our own experience (31.8 million km) and customers’ experience (more than 100 million km) Dieselfix has multiplied the effective life of fuel filters several-fold.

In trials, it is essential to retain fuel filters used before and after Dieselfix for opening and visual inspection and comparison of the filter elements so that the effect of Dieselfix may be seen.

#### 5.4. Corrosion

This is the most-recognised effect, yet diesel is an oil, and oils are non-corrosive. It must be understood that water in diesel fuel becomes acidic, which not only breaks down the fuel, but accelerates corrosion of metals.

Most diesel contains a surprising amount of rust in dust-sized particles in suspension. This originates from the bottoms of bulk storage tanks that become dislodged during filling of the tank. Much of this rust gets caught by fuel filter elements but a percentage is small enough to pass through the filter into the fuel-injection system, where it is highly abrasive. Dieselfix does not affect existent rust, but causes it to drop out of suspension.

Corrosion also affects fuel lines, pumps and injectors, all of which require expensive remedial maintenance. Corroded pump and injector components affect fuel efficiency very negatively, with significant increases in fuel consumption and costs.

Dieselfix converts water into a non-corrosive fluid that eliminates this problem over a period of time. Dieselfix is not a “miracle cure-all” and time is required for existing rust to clear from tanks and fuel system components.

#### 5.5. Abrasion

The least-recognised property of water is that it is highly abrasive. Water-jet profile cutters cut steel as easily as oxy-acetylene cutters, with greater accuracy. Under the pressure of diesel fuel-injection systems, particles of suspended water become as abrasive as granules in grinding paste. Rust particles suspended in fuel accelerate abrasive wear exponentially. Injector nozzles become enlarged so that atomization and spray-pattern are impaired, leading, again, to loss of fuel efficiency and increased costs.

N.B. Due to ever-present corrosion, the abrasive qualities of water are often confused with corrosion and are thus overlooked.

Dieselfix eliminates this problem by converting water into a lubricant.

#### 5.6. Acids Produced During Combustion

The most seriously detrimental effect is the production of acids during the combustion process. During combustion, oxides of sulphur and nitrogen ( $\text{SO}_x$  and  $\text{NO}_x$ ) are formed. Modern diesel fuel has much less sulphur than previously, so  $\text{SO}_x$  has been minimised, but nitrogen is 78% of intake air so it will prove somewhat tricky to reduce that.

$\text{SO}_x$  and  $\text{NO}_x$  plus water form sulphuric and nitric acids. Aside from being environmentally detrimental, some of the acid bypasses piston rings as part of the blow-by into the crankcase.

In the crankcase, acid gets picked up by the engine oil. This breaks down the oil as well as attacking metal surfaces in the engine. Oil manufacturers add alkali to the oil in an attempt to minimize the damage caused by acid, but this is only partially effective.

Sludging of crankcase oil is a well known problem. Sludge is formed by a combination of resin, released by decomposition of oil by acid, and soot, caused by incomplete combustion of fuel. Sludge increases viscosity of oil, impairing free flow through the engine, blocking oil filters and, in severe cases, blocking oil passages and galleries, leading to engine failure. Obviously, acid breakdown of oil leads to decreased lubricity and accelerated engine wear.

The new fluid produced by Dieselfix and water is chemically inert with oxides of sulphur and nitrogen so acids are not formed.

### 5.7. Microbial Infestation

More than 20 species of microbes, mainly bacteria and fungi, can live and multiply in diesel storage tanks. Fungi and aerobic bacteria need free water for habitat. Anaerobic bacteria can survive in diesel alone. They all feed on resin released by decomposing fuel.

The biggest problem is that they can cause repetitive fuel filter blockage until successfully treated. Additionally, bacteria produce strong digestive acids that accelerate the decomposition of diesel and exacerbate corrosion.

The traditional solution is to add “biocides” to affected fuel. Bio- means “life” and cide- means “kill”. Biocides are extremely toxic poisons that kill everything that lives, including microbes. These little bugs haven’t heard that story. Within surprisingly short time, they develop immunity to these toxins and continue to thrive, requiring the use of alternative biocides.

When all the bugs have been killed off, their dead remains pose a secondary problem. Dead organic material has to be physically removed from the fuel to avoid ongoing fuel filter blockage.

Horrendously toxic biocides can produce equally toxic exhaust gases, so, environmentally speaking, this practice is irresponsible in the extreme. Not only is it totally irresponsible but, technologically speaking, it cannot be described as anything more than infantile.

Dieselfix is only mildly toxic (classified as non-toxic according to the requirements of the United Nations Committee for Transportation of Hazardous Goods) It kills Bacteria and fungi by eliminating their habitat and nutrient source. No life form can develop immunity to absence of habitat and nutrients. In what can justifiably be claimed as a technological breakthrough, Dieselfix then dissolves the dead organic remains, thus providing a solution to a problem that has persisted since Rudolf Diesel developed his engine.

## **6. Fuel Quality Management**

Many diesel fuel consumers are unaware that once fuel has been delivered into their storage tanks, it is their own responsibility to maintain the quality of the fuel as delivered. Failure to do so produces costly breakdowns of their equipment.

To date, oil companies provide such tips as “good housekeeping” and suggest cycling fuel as rapidly as possible. This is largely meaningless in terms of diesel fuel quality.

Fuel must be sampled at every delivery from the bottom of the tanker. If any free water is present, the fuel should be rejected. This is because the Standard Specification stipulates, “the fuel shall be clear and free of visible water.”

The practicalities of diesel equipment operation usually prevent rejection of a fuel delivery, so it must be accepted that there will be a little water in the fuel, **ALWAYS!!** Nevertheless, it is important to report the presence of visible water to suppliers to keep them “on their toes”.

At least twice a week, samples must be drawn from the bottom of storage tanks. Visual inspection is all that is necessary.

When visible water is present it can either be removed physically with a thief-pump or double dosing with Dieselfix. Double dosage must continue until all traces of visible water are eliminated.

## **7. The “Proof of the Pudding”**

Given the history of “additives” in the diesel industry, everybody with any experience is naturally sceptical about “claims” made by additive manufacturers and salesmen. Invariably, petroleum-based additives have either failed to deliver results or produced side effects that are worse than the original problem. Thus, users are encouraged to monitor their equipment as closely as possible so as to identify and quantify the effects that Dieselfix produces.

7.1. Fuel Consumption. As mentioned, Dieselfix was developed as a maintenance product and not specifically as a fuel saving device. However, permanent maintenance of the fuel-injection system unavoidably produces improved fuel efficiency. Where fuel systems are already gummed, Dieselfix can, within days, produce decreases in fuel consumption that defy the logic of existing science, providing that fuel system calibration is correct and wear is within acceptable limits.

An advantage of Dieselfix is that when it is introduced and increased fuel consumption is recorded, it is most often an unmissable indication that fuel-injection system components are worn or incorrectly calibrated and require replacement or recalibration.

7.2. Oil Analysis. The importance of oil analysis as a diagnostic and monitoring tool cannot be overstressed. Operators who do **not** have their oil analysed by professional laboratories are “groping around in the dark” regarding engine function and condition. It is the “blood test” of engine condition and performance.

It is essential that oil analysis is performed before and after introducing Dieselfix. The report after Dieselfix is applied will show singularly positive improvements and no trace of any detrimental effects.

7.2.1. Soot contamination will drop by up to 90%.

7.2.2. Lubricity will show reduced depletion.

7.2.3. Viscosity will show reduced increase.

7.2.4. Total Base Number (TBN) will show reduced depletion. (Reduced acid contamination)

7.2.5. Wear-metal content will show reduction of between 20% and 40%.

7.2.6. Sludging will be reduced by up to 90%.



There are no undesirable changes indicated in oil analysis. Given the unenviable reputation of the “additives industry” no harmful additives would ever have been offered on the market if oil analysis had been performed during the research and development of those products.

Further confirmation of the beneficial effects of Dieselfix can be observed by cutting open used oil filters used before and after introducing Dieselfix and visually inspecting the elements.

### 7.3. Exhaust Gas Analysis.

During development and pre-market trials, one characteristic that Dieselfix demonstrated very early was the reduction of exhaust smoke. That was sufficient for our requirements at that time. Since the introduction of Dieselfix to the underground mining industry where Diesel exhaust emissions have to be analysed regularly as a requirement of Mining Law, the results exceeded the most optimistic predictions. Importantly, mines measure unwanted gases far more accurately than automotive exhaust gas analysers.

Two major mining groups, on multiple mines, multiple shafts and more than 300 diesel engines, all proved the same trend.

Carbon monoxide was reduced to “trace”, NOx reduced by 97% and, most significant of all, carbon dioxide reduced by 70%.

Hydrocarbons were all but eliminated and exhaust gas temperature reduced by several degrees Centigrade.

The results of the survey were signed off by qualified professional engineers.

Every change is singularly positive with no trace of undesirable effects.

## **8. Costs and Economics**

The economic factors involved in managing diesel equipment are complex in the extreme. In order to reduce the multifold advantages of using Dieselfix to a simple calculation, fuel consumption can be singled out at the most convenient.

Dieselfix treatment adds 17 cents (South African) or 2 cents (U.S.) to the price of a litre of diesel, which is about 2% of the present fuel price. Improvements in fuel consumption vary from engine to engine, depending on the condition of the fuel-injection system at the time of introduction of Dieselfix. Therefore, reduction in fuel consumption of 2% pays for the Dieselfix.

The average reduction in fuel consumption stands at a little more than 8%. Outstanding examples exceed 25% and rare cases exceed 30%. **N.B.!!!** These improvements reflect *increases* (lost fuel efficiency) that occurred as fuel systems became gummed. Dieselfix has simply returned fuel consumption to slightly better than “normal”.

### 8.1. Example

Cost of 4000 litres diesel @ ZAR13-00 /litre.....	R52 000-00
Value of 3% reduction in consumption.....	R1 560-00
Cost of 1 litre Dieselfix (Excluding V.A.T.).....	R750-00
Actual saving.....	R810-00
Percentage return on investment.....	108%

**N.B.** The above figures do not reflect the far greater gains through reduced downtime, nor savings on reduced unscheduled maintenance or gains due to longer life of engines, fuel systems.

### **9. Undesirable Side-Effects**

The history of the additives business is highlighted by failure. This is amply reflected in operators' attitudes, which vary from profound scepticism to open hostility.

The reason is simple. Petroleum-based additives can never conform to diesel fuel specifications. The refining process separates crude oil into different products. There is only one petroleum product that conforms to diesel fuel specifications and that is diesel fuel.

The addition of any petroleum distillate to diesel is going to change the fuel beyond what is acceptable to a diesel engine and long-term damage will result.

When Dieselfix was developed, the developer used the same outright scepticism in proving the product. No other product in the history of the fuel industry has been subjected to so much close and minute scrutiny as Dieselfix. The only reason Dieselfix does not produce any trace of any undesirable side-effects is through strict adherence to diesel fuel specifications.

The logic is inarguable and Dieselfix has never produced any harmful side-effect since its inception in 1992. There have been many queries when failures have occurred but, in every case, the root cause of the failure has been traced to other sources and Dieselfix has come out with an absolutely clean bill of health.

A so-called "side-effect" is nothing more than a normal effect that manufacturers failed to detect during their research and development. The existence of any side-effect is tantamount to criminal negligence and shows total disregard for the safety of other peoples' capital equipment.

### **10. Summary**

Water is the root cause of all the problems experienced with diesel fuel and engines. Dieselfix has a unique reaction with water, converting it into a fuel soluble, fully combustible, non-corrosive lubricant that does not react with oxides of sulphur and nitrogen.

The most serious single symptom is the gumming of the fuel-injection system with resin. Dieselfix contains a mild solvent that gently dissolves resin back into the fuel, where it belongs, leaving the fuel-injection system absolutely clean and able to function as it was designed.

Where microbes exist in fuel tanks, Dieselfix eradicates their habitat and food-source, thus killing the organisms. Dissolving the dead remains solves the problem entirely.

Those are the three functions that Dieselfix performs. It is simple rather than complex. As much as it may seem that Dieselfix does “everything”, it is, in fact, water that causes all of the problems. Dieselfix simply changes water into a fluid that is compatible with diesel. This is a classic case of “remove the cause and the symptoms disappear.”

## **11. Conclusion**

All owners and operators of diesel-powered equipment, from private cars to cargo ships, have a vested interest in controlling their operating costs, thus preventative maintenance came into being. Until the advent of Dieselfix, preventative maintenance was confined to manual workshop procedures carried out on the equipment. For the first time, operators have a pro-active means of maintaining fuel quality and extending preventative maintenance to include fuel. This eliminates the need for several manual maintenance procedures, particularly unscheduled maintenance concerning fuel-related breakdowns.

The biggest single economic advantage comes from minimising downtime. This is the most underestimated cost factor in diesel equipment operation. Downtime represents 100% loss of income from affected equipment, while fixed costs continue unabated. Revenue lost through downtime can never be recovered, yet, inexplicably, those losses are not reflected in accounting systems. Out of sight is out of mind.

Today, the problem of “Global Warming” is very current and very topical. Where most “authorities” are aiming at reducing carbon dioxide (CO<sub>2</sub>) by 10% and 15% “over the next 10 years”, Dieselfix will reduce CO<sub>2</sub> emission from diesel engines by that ***within days***. This makes Dieselfix the most important environmental consideration ***ever***, and indispensable to any environmentally-conscious operation.

When the multiple benefits of using Dieselfix are quantified, added up and coupled to the absolute proven safety of using it, the conclusion is that this is the most indispensable aid to efficient and effective diesel equipment operation in the history of the industry.