

## Marine 16 Ltd Diesel Bug Test Kit

The Marine 16 Ltd diesel bug test-kit can be used to check for microbial contamination of diesel fuels in boats, storage tanks, home heating fuels etc.

### Treatment of Fuel

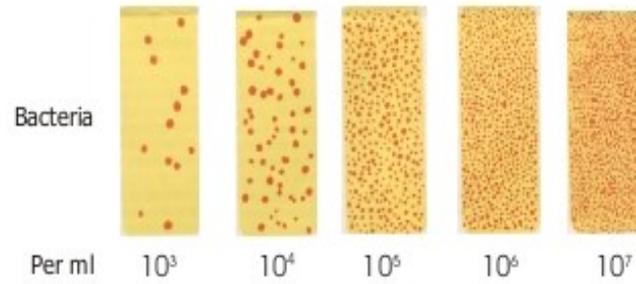
Marine diesel bug may be killed completely by using Marine 16 Ltd Diesel Bug Treatment. In nearly all cases there will be no need to clean out the tank as the dead bug masses are reduce to fine particulates that are either picked up in the fuel filter as with any dirt or passed harmlessly through the engine.

For slight infections a 100 ml bottle will treat 2000 litres of fuel, for mild infections the same bottle will treat 500 litres and for heavy infections 100 ml will be required for every 100 litres of fuel

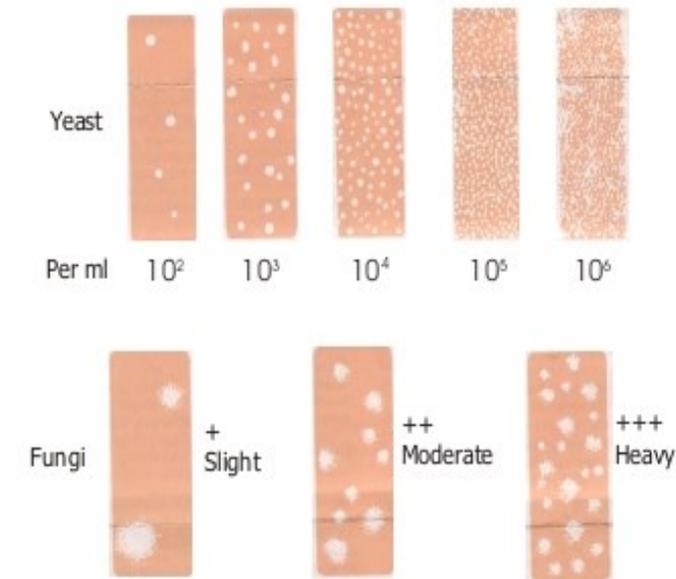
### Instructions:

- 1) Obtain a sample of the fluid, water or fuel/water mix to be tested in a clean container using as little contact as possible.
- 2) Remove the slide from the container carefully avoiding touching the clear or red agars. Immerse the slice into the fuel/water sample for 5 -10 seconds and remove from the sample.
- 3) Allow excess fluid to drain off the slide.
- 4) Blot lower edge of the slide on clean absorbent paper.
- 5) Screw the slide tightly back into the original empty tube.
- 6) Fill in the label and affix it to the tube.
- 7) Place the tube upright in an airing cupboard or on a radiator at 30°C. After 24-48 hours incubation the result can be read on the total bacterial counter agar (TTC). Yeasts and fungi will show on the Rose Bengal agar after about 3-days incubation. If the incubation takes place at room temperature, the results can be read after 2-4 days and 4-7 days respectively.
- 8) After incubation remove the slide from the tube. Compare the density of the colonies growing on the medium with the model density charts without actually counting the colonies. If the normal temperature of the fluid tested substantially differs from the incubation temperature stated above, this may result in slow bacterial growth during incubation. An incubation temperature corresponding to the tested fluid is then recommended.

### Total Bacterial Count Agar



### Rose Bengal Agar



### Interpretation of results

Practically all aerobic bacteria grow on the total bacterial count side (containing TTC) of the slide. Yeasts and fungi appear on the Rose Bengal agar of the slide (pink agar).

### Determination of total bacterial count (colourless agar)

Most bacteria give rise to red colonies. The bacterial count/ml of the sample is determined by comparing the density of the colonies appearing on the slide with densities shown on the model chart. If there are colourless colonies present, these should also be taken into account when estimating the density of growth. In cases where large colonies occur it should be remembered that it is the density of the colonies which is important and not their size.

If the bacterial content is very high (over 107/ml) there is a confluent growth of bacteria. This may appear as a uniformly red surface layer. This kind of growth may be misinterpreted as a poor or negative result and it is advisable in doubtful cases to compare the incubated slide with an unused one. It is not possible to give any universally valid limits to illustrate the critical microbial count. This has to be determined by experience.

**bacterial count 104**

**bacterial count 105 to 106**

**bacterial count 106 or more**

**slight infection**

**moderate infection**

**heavy infection**

### Determination of yeasts and fungi (pink agar)

Growth appearing on the slide may consist either purely of fungi or yeasts or may be caused by both fungi and yeasts forming mixed growth. Fungi give rise to soft and fluffy colonies while yeast colonies are usually ball shaped and slightly puffed up. Sometimes they are flat and dry. Comparison of yeast growth with the model chart is carried out as with bacteria.

### Disposal of used slides

As the incubated slides are bacterial cultures they should be handled carefully. Disposal of used slides can best be achieved by incinerating, by immersing both slide and container in a household bleach overnight or by autoclaving them after loosening the cap (a pressure cooker can be used for this).

### Storage

Unopened tubes should be stored at room temperature (about +20°C/68°F) and protected from light and draught. The expiry date is marked on the package. Slides must not be frozen. Unused slides showing bacterial growth should be discarded.

**Temperature fluctuations may result in condensation settling in the bottom of the dip-slide tupe. This sterile liquid can simply be disposed of down the sink. The usability and the results are not affected by this, provided that the media are not visually dehydrated.**

**As this test can be affected by handling and sampling techniques no guarantee can be given on the accuracy of these results.**

## Diesel Bug

### Exciting questions and answers on these annoying little organisms.

Diesel bug is the boating name given to the organisms that form slimes in diesel fuels.

Diesel bugs are in fact microbial organisms and come in three main varieties where fuel spoilage is concerned.

#### What are they?

##### Bacteria

The most common species are Pseudomonas, Klebsiella, Micrococcus, Arthrobacter, Flavobacteria and Acinetobacter.

##### Yeasts

These include the Candida, Saccharomyces and Hansenula families.

##### Moulds

The most common moulds are Cladosporium resinae (The name used until it was changed to Hormoconis resinae) and Aspergillus fumigatus.

This list is only a tiny part of what can occur and indeed the bacteria also exist as aerobic and anaerobic. The aerobic ones require oxygen and the anaerobic do not. The latter produces by-products that can eat holes in half inch steel plate and give off bad-egg smelling, toxic gas.

#### Where do these organisms come from?

Generally the microbes get to your boat through the fuel distribution network but they may enter through airborne particulates. These organisms like still fuel and temperatures between 5°C and 70° C. Around 30°C is ideal for growing organisms and they multiply extremely quickly.

If fuel is changed in the holding tanks on your boat, at the fuel berth or at the distribution it has been believed that this will prevent diesel bug proliferation. This is quite so in the tanks themselves as the bugs do not get the conditions to reproduce. Once they reach the boat tank however and it is not moved for a week or so they happily set about multiplying.

#### What do they feed on?

The micro-organisms feed on water, hydrocarbons and nutrients in the fuel. The water only needs to be available at 100 ppm in the fuel for bacterial growth to occur. The water is present in the tank from within the delivered fuel and from condensation. You will be familiar with draining this off from your water separator on a regular basis. The hydrocarbons come from the fuel itself and the other nutrients from the fuel additives required for the fuel to perform to the required standards.

#### What problems do diesel bugs cause?

The most obvious visual sign of microbial activity is the formation of sticky, slimy, polysaccharide polymers that form strings and films. These block fuel filters and even fuel lines. They also capture particulate matter and create mats. Even if they get through the filter unit they can block the injection ports in the engine on an uneven basis giving rise to potential failure of the crankshaft due to uneven loads from the pistons.

The by-products of bacterial action are often acidic and when this settles into the water phase at the bottom of the tank, especially during lay-up it can cause corrosion of steel tanks and brass or copper fittings.

#### How can I get rid of them?

Prevention is of course the best cure. As you are generally unsure of the nature of the fuel you are using continual prophylactic treatment direct to your tanks is recommended. This will prevent organism growth even though the organisms may still be present. There are two routes that can be used, biocides or enzymes. Enzymes are perhaps the more eco-friendly. These are NOT biocidal but do remove the detritus from bacterial activity allowing it to be burnt away. If there is any biocide present in the fuel enzymes will be deactivated. Care must be taken when using enzymes, as there may be some residual biocide that has been used in the fuel distribution chain. This may be insufficient to stop organism growth but may be enough to prevent enzyme activity. Enzymes are inactive at low temperatures.

Biocides are available in different types. All are harmful to aquatic organisms if spilt so care must be taken when using them. Once in the fuel they are generally burnt completely in the combustion process. With almost all biocides used for fuels there is no evidence to show organism resistance developing from continual use. Biocide use can be bacteriostatic which means it prevents growth or bactericidal which means it kills bacteria.

If there is a bad case of diesel bug in your fuel it will be necessary to treat it with a shock (bactericidal) dose of biocide followed by regular treatments of bacteriostatic quantities.

The supplier will give you details.

#### How do I choose a biocide?

The biocide of choice should have the following properties:

It should:

Neutralise acidic by-products (especially at lay up)

Kill or prevent the growth of the wide range of organisms that may be present.

Operate over a wide range of temperatures.

Disperse into both the water and fuel phases in the tank.

Remain active for a long period.

Be as safe as possible for the environment and the user.

Burn completely in the combustion process.

Have no detrimental effects on the engine components or the combustion performance.

The dead bugs should be in a form that is easily removed by the filter or pass harmlessly through the engine.

Be on the Biocidal Products Directive approved list.

## Diesel Fuel

### The Diesel Engine

Diesel engines, known as compression-ignition engines run on middle distillate fuels which are mid-way between a lubricating oil and gasoline (Petrol). Diesel engines use compression to ignite the fuel and no spark is required. To enable the diesel engine to start easily it is normally fitted with a glow plug to allow the fuel to ignite before the engine properly warms up. Marine diesel engines do not have very sophisticated engine management systems seen on modern cars and are relatively simple and tolerant of a variety of fuel types. Under extreme conditions or at the end of maintenance schedules these tolerances diminish and fuel quality is vital for engine performance.

Diesel engines also perform at their best under load, i.e. at higher engine temperatures. Many boat engines run at idling or slow speeds while coming in and out of ports and often do not reach full operating temperatures. Under these conditions the diesel fuel does not burn well and bores and rings can become contaminated with gums and varnishes. Injectors too build up with residues and spray patterns deteriorate resulting in poor atomisation and subsequent loss in power, starting and increased fuel consumption.

(TIP: When running engines to charge batteries do so with the system in gear to load to the engine. Make sure the boat is secure before doing so!)

### Diesel Types

The best quality and most stable diesel fuels are made from “straight run” stocks derived directly from crude oil. Most commercial fuels however also contain a proportion of catalytically cracked material. In the distribution chain for diesel fuels there are also holding tanks at distribution centres, tankers and storage tanks at the fuel berth. In today’s commercially competitive world brand loyalty is often sacrificed for economy and the fuel you eventually use in your craft may be a combination of fuels from a variety of sources.

The fuel may also be fresh or quite old.

In the EU the control of diesel quality is defined by EN590, details of which are at the end of this paper.

The two critical factors for diesel performance are “Heating Value” and “Cetane Number”

The **heating value** is a measure of the energy content of the fuel so shipping companies and railway operators go for maximum heating value provided that other basics are met.

**Cetane number** is a measure of how easily the fuel burns. The higher the number the easier the burn. Low revving large marine engines on ships can tolerate fuels with CN’s as low as 20 while some high-speed automotive diesels require 55CN fuels to perform correctly.

### FUEL PERFORMANCE CRITERIA

We have covered the two most important aspects of your fuel quality, Heating Value and Cetane Number. (TIP: You will not be able to tell what you are getting when you fill up of course!)

#### The following also apply to diesel quality and performance:

**Viscosity** is a measure of how the fuel flows. A viscous or thick fuel will not atomise well at the injectors and give poor fuel consumption and high emissions. If it is too thin excessive wear can occur in the injection pump. Low speed engines can use thicker fuel than high speed ones. A minimum viscosity is set to ensure minimum protection of pumps.

**Low temperature flow** is affected by the amount of paraffins in the fuel. At low temperatures these can form waxes that prevent the fuel from flowing as frequently reported from lorry parks by the media during cold winters. (TIP: It is worth noting that the refiners alter their formulations seasonally so that they do not pay for anti-freezes when they do not need to. You however may not know in what season your fuel has been made. Also at lay-up you will probably have fuel in the tank that was summer grade)

**Storage stability:** In storage fuels may be attacked by atmospheric oxygen which can cause varnish deposition. In the presence of water, bacterial action can cause a build-up of slime near the fuel/water interface resulting in blocked filters or fuel lines. Even small amounts can cause diesel-powered heaters to fail. Even without water some bacteria can exist and they have been known to eat through ½ inch steel plate! (TIP: These anaerobic types can be recognised by a bad egg smell being given off from the fuel.)

**Component compatibility:** Diesel fuels are injected into the engine through precision pumps acting at high pressure. Dirt and water contamination must be avoided to protect these critical components. The specifications give tight limits for these and some fuel retailers fit extra filters at the pumps to help prevent against dirt picked up in the distribution system. (TIP: Check your fuel filter regularly and remember to drain the water from the separator. Fuel atomising pumps are extremely expensive.)

**Sulphur content:** Sulphur occurs naturally in all crude oils and is present in refined products. The combustion of sulphur gives sulphur oxides that are measured for the purposes of emissions control. They are believed to form acid rain. With the introduction of more stringent controls on emissions low sulphur fuels have been introduced especially as sulphur can poison emission control devices. The treatment of diesel fuel to remove sulphur compounds also removes other chemicals from the stock. This can lead to the fuel having poor lubrication properties and reduced stability. Suppliers now add extra additives to overcome this problem, as there is potential for rapid pump wear.

**Lubricity:** In many diesel fuels the fuel itself can provide lubrication for the injection pumping system.

**Water content:** ALL DIESEL FUELS CONTAIN SMALL AMOUNTS OF WATER. The amount of water that a fuel can hold is controlled by temperature, hydrocarbon type and distribution. As temperature decreases the water drops out and collects with any water that has built up as a result of condensation or in-leakage. If EU specifications are adhered to (see below), the allowable water content before any condensation is added could be 20ml in a 100 litre tank – almost half a wineglass. That is sufficient to grow a huge number of bacteria. This water provides the conditions for proliferation of diesel bacteria (**Diesel Bug**) in the fuel tank. (TIP: This can be overcome with the regular use of biocides.)

**Biodiesel:** Many of you will have heard of biodiesel. This is a diesel fuel made from agricultural products such as soybean, rapeseed, palm and coconut oils. Normally this is converted to a methylester for fuel use. This can be blended with normal diesel stock or used neat. Biodiesel can have good lubricity but is often quite viscous and can give high injector deposition and poor cold flow.

#### Diesel Specification for the EU

Grade	EN590 (2004)
Cetane Number, min	51
Cetane Index, min	46
Density (Kg/M3 @ 15C)	820-845
Viscosity (cSt @ 40C, max	2.0-4.5
Distillation,max	
T85 C	350
T95 C	360
Sulphur ppm, max	350 until 31.12.04 and then 50 ulsd 10 max
Polyaromatics (%vol) max	11
Flash point C Min	55
CCR 10% (%wt) max	0.3
Total contaminants (%wt) (%vol) max	0.0024
Water (%wt) max	0.02

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