



# MARITEC

## MARINE FUEL TESTING PROGRAMME



Marine Fuel Testing and Solutions

## **Introduction**

Maritec Laboratories Pte Ltd was incorporated in 1999 as a marine fuel laboratory providing analysis results and technical advice to a portfolio of shipping companies both locally and internationally.

In May 2004, the company was acquired by a group of marine fuel specialists (detailed profile of the management team is available separately as an enclosure). The company was renamed Maritec Pte Ltd. With the enhanced domain knowledge and comprehensive expertise from the management team, Maritec now provides technically superior services at very competitive rates.

## **Bunkers**

Vessels propelled by slow and medium speed engines typically burn heavy marine fuel oil (HFO) in their main engines (usually referred to as bunker). These vessels also consume a lighter grade of fuel in their generators called Marine Diesel Oil (MDO) or in some cases Marine Gas Oil (MGO).

In recent years, there is a trend towards uni-fuel vessels; with generators and main engines using the same fuel. This makes any fuel quality problem even more serious as it could easily result in a “dead ship” that cannot be re-started at sea.



## **Purchasing & Marine Fuel Standards**

There are still some vessel operators who purchase bunkers just based on viscosity grade only.

For example an order may be placed for 1,500 metric tonnes of 380 cSt fuel. This is inadequate as a purchasing specification to protect the buyer, because a 380 cSt fuel with a high content of abrasive catalyst fines that could cripple a ship within hours; will still meet the purchasing criteria based on just the viscosity grade.

## **ISO Standard 8217:2005**

An international specification for purchasing marine fuel has been in existence for some time now. Purchasers of marine fuels should always use the current marine fuel standard ISO8217:2005 in order to achieve some degree of protection.

## Test Parameters

The Maritec fuel testing programme covers more parameters than those listed in ISO 8217:2005. The parameters tested in this program includes:

Density, Viscosity, Water, Micro-Carbon Residue, Sulphur, Ash, Vanadium, Sodium, Aluminium, Silicon, Calcium, Iron, Lead, Magnesium, Nickel, Zinc, Phosphorus, Total Sediment Potential, Pourpoint, Flash Point, Specific Energy, Calculated Carbon Aromaticity Index.



## Common Bunker Problems

Statistically, about 1 in every 5 bunker samples does not meet the ISO 8217:2005 specification in at least one or more test parameter. The off-specifications parameters encountered in marine fuels can be perceived as 2 categories:-

### 1. Viscosity, Density, Water

The parameters of viscosity, density and water have important and immediate implications on bunker costs which affect the profitable operation of the vessel. How these affect the cost of bunkers will be discussed. Viscosity, Density and Water also affect the efficient and safe operation of the vessel and are included in the second category as well.

### 2. Other Test Parameters - Potential Machinery Damages and Operational Problems

The other test parameters in the list of tests have implications on the safe operation of the vessel either from the environmental legislation aspect (eg. sulphur) or from the risk of potential machinery damage eg. Aluminium, Silicon, Vanadium, etc. A fuel with very high vanadium content in combination with sea water contamination could also do a lot of corrosive damage due to the slag formed from the vanadium pentoxide eutectic mixture. In the same manner, a fuel with a high content of Aluminium Silicate from catalyst fines could be disastrous. Some of these test parameters will be discussed in this brochure.

## Viscosity

Bunker is the highest single cost in a vessel's operation, amounting to 40% to 50% of the total operating costs. Under the current high crude oil price scenario, the price differential between a 180cSt and 380cSt on a delivered basis, can vary between USD6 – USD15 depending on the bunker port and the supply and demand situation.

GRADE	QTY (MT)	PRICE (USD)	TOTAL (USD)
180 cSt	1, 000	361/ MT	361,000
380 cSt	1,000	340/MT	340,000
<b>POTENTIAL LOSS (USD)</b>			<b>-21,000</b>

### Example:

An order was placed for 1000 MT of 180 cSt but the supplier delivered a 380 cSt fuel instead. The over-payment made by the buyer would be quite substantial if he was not in the Maritec Testing Programme. In this instance, the difference amounted to **USD21,000.**

### Viscosity Is Important For The Chief Engineer

The viscosity of the fuel delivered is used by the Chief Engineer to determine accurately the pre-heating temperature required to achieve the correct injection viscosity. If he is unaware of the viscosity ordered and uses too low a preheat temperature it will impose a heavy load on the fuel pump drive mechanism and in extreme cases can lead to mechanical failure. Incorrect injection viscosities can also result in erratic fuel nozzle spray and incomplete combustion resulting in high liner wear, burnt piston crowns and high exhaust temperatures.

Also if the ship received a fuel with a viscosity way beyond the pre-heating capacity of the vessel's equipment; then the vessel would be legally considered to be un-seaworthy. If the vessel is proceeding to a country with a colder climate, there will be difficulty in pumping the fuel from the double bottom tank thereby putting the vessel, crew and cargo at risk.

### Potential Cost Savings From Using A Higher Viscosity Fuel

Traditional thinking is that a 180cSt is better than a 380cSt fuel. This is not necessarily correct because a 380 cSt, is in fact a safer fuel grade. The reason for this is that when blending a 380 cSt the likelihood is that less slurry oil (which is a component of the cutter stock) is used. The slurry oil typically contains a very high content of catalyst fines. A 180 cSt fuel requires more cutter stock.

The specific energy difference between the two grades is not significant but a large price differential in the range of USD6/MT up to USD15/MT (delivered basis) now exists between the two grades in some ports. Thousands of dollars can be saved by using a 380 cSt fuel if the vessel has sufficient pre-heating capacity to achieve the viscosity needed at injection. The additional heating required is about 15 deg C more.

### Density

Bunker is sold by weight, but delivered by volume. The density is used to calculate the weight of bunkers delivered. The potential financial loss to a ship-owner from an over-declared bunker receipt can be very substantial, as illustrated: -.

### Example:

A ship-owner purchases 3,000 MT of 180 cSt fuel at a price of USD361/MT. The bunker receipt showed a density of 0.9888 gm/ml. Maritec tested density was 0.9576 gm/ml. This would have resulted in an overpayment of **USD 34,295**, if the density had not been tested.

	VOLUME (M3)	DENSITY @ 15 DEG C	WT (MT)
BUNKER RECEIPT DATA	3,034	0.9888	3,000
MARITEC LAB RESULTS	N.A.	0.9576	2,905
SHORT DELIVERED WEIGHT (MT)			-95
LOSS IN (USD) WITH BUNKER PRICE @USD 158/MT			-34,295





### **Density Is Required By The Chief Engineer**

Besides the commercial implications of density in the bunker transaction, the Chief Engineer also requires the correct density value in order to set the centrifuges efficiently. He cannot assume that the Bunker Receipt has provided the correct density. Vessels fitted with conventional centrifuges are unable to handle fuels with density greater than 0.991 gm/ml. Hence, the Chief Engineer has to be aware of the density of the fuel received on board.

Density, water, ash and sulphur content are used for calculating the nett specific energy of the fuel. Buying bunkers is buying energy. The specific energy of the fuel should always be factored into the bunker price evaluation. The higher the density, the lower will be the specific energy of the fuel.

### **Water Content**

The current ISO8217:96 Standard specifies that the maximum amount of water allowed in the fuel is 1 %. This is an expensive price to pay for water which may cause operational problems. The value of 1% in fuel cost may also be substantial if the amount bunkered is large. The water content also lowers the energy content of the fuel. Some ship-owners specify no more than 0.5% in their purchasing specifications. The ISO8217:2005 Standards specifies a maximum water content of 0.5%.



Excessive water content can cause problems in the fuel pre-treatment and high pressure fuel injection systems. A rule of thumb is that sodium content of about 80-100ppm per one percent of water in the analysis results indicates the presence of sea water. Salt water can lead to severe corrosion, sticking of pumps and injectors, excessive deposits in cylinders and turbochargers. Salt water, when present in a high vanadium fuel can cause slag deposition with subsequent corrosion in the superheater and reheater tubes as well as exhaust valve burning in a diesel engines

### **Aluminium Silicate Compounds (Catalyst Fines)**

Bunker is typically made up from the very thick residue left after refining the barrel of crude. This residue is then blended to lower viscosity grades such as 180 cSt, 380 cSt or 500cSt fuel, using a cutter stock.

The low viscosity cutter stock used for blending would typically include a slurry oil from another part of the refining process. Slurry oils tend to have a very high concentration of used catalyst, (commonly known as catalyst fines). These catalyst fines are inadvertently carried over from the refining process into the slurry oil.



Catalytic fines are typically aluminum silicate compounds which are highly abrasive. If present in the bunkers in excessive amounts they can cause severe and rapid wear to fuel pump plungers, engine liners, piston rings and other machinery components. The maximum limit under the ISO8217:2005 Standard is a combined Aluminium plus Silicon i.e. (Al+Si) content not exceeding 80 ppm, in order to achieve an acceptable level at the inlet to the fuel pump.

There are initiatives from shipowners and testing companies to have this limit revised to a lower level because the current Al+Si limits of 80 ppm assumes that all fuel cleaning equipment are working at rated efficiencies, which may not always be the case. For marine diesel of DMC grade, the Al+Si limit is 25 ppm under the current ISO standard.

### **Other Sources of Contaminants**

As bunkers are stored in tanks and transported either by pipeline, bunker tanker or barges; there will always be other potential contaminants like rust, sea-water, industrial waste etc that may find its way into the bunkers.

### **Industrial Waste & Chemicals**

Contamination from chemicals, industrial effluent etc has become a serious area of concern in recent years. As governmental pressures on disposal of such waste become more stringent we can expect more incidences of problem bunkers. Bunker is such a viscous and black product that it is an ideal medium to hide such waste.

The detection of chemicals and industrial waste contamination requires specialized tests and equipment and cannot be detected through the routine test parameters covered by the ISO8217:2005 parameters.

Maritec is able to provide such specialized tests for example: using FT-IR or GC-MS techniques, at added cost if the customer requires these tests.

### **“Dead Ships”**

Several instances have been recorded of vessels being totally immobilized by chemical waste in the bunkers delivered, resulting in both main and auxiliary engines being put out of commission. The vessels were put at risk and had to be towed back to port at very high costs. Several of these vessels were uni-fuel vessels.

We regret that there is insufficient space in this brochure for a full treatment of all the test parameters but please do contact us for a personal presentation. Our contact details are on the back page of this brochure.

## Maritec Fuel Testing Programme

To join the Maritec Fuel Testing programme, the shipowner or ship-operator can enter into an agreement with Maritec to test an agreed number of samples per year without restriction on the number of vessels joining the programme. The vessels' information is registered into the Maritec database and each vessel will be provided with a Sampling Kit containing 40 sample bottles. Detailed instructions and documentation are provided in the manuals on how to collect representative samples and the urgent dispatch of the samples to the Maritec laboratory.



Each vessel should be equipped with a Maritec Line Sampler in order to be able to take a proper representative sample. The Sampler is custom-made in stainless steel to fit the vessel's bunker manifold flange and comes complete with the necessary gaskets, bolts and nuts. A "cubitainer" is used to collect the fuel sample. A new "cubitainer" is used at every bunkering, in order to avoid cross contamination from a previous bunkering. These "cubitainers" are available on order from Maritec.



During the bunkering operations, the Chief Engineer uses the Maritec Line Sampler fitted at the flange of the bunker manifold and collects a continuous drip sample into a 5-litre "cubitainer" throughout the whole duration of the bunkering operation. This is the primary sample.

(It is important that samples are not taken using a spot method by opening the sampling valve intermittently, as this will result in a non representative sample.)



The primary sample collected by continuous in the 5-liter "cubitainer" is sub-divided into 4 bottles per bunkering. Bottles should be properly sealed, signed off, recorded and distributed by the Chief Engineer as follows:

1. Retain on Vessel
2. Retain on Vessel
3. Send to Maritec Laboratory
4. Offer to Supplier
5. Surveyor

If a surveyor is involved; an additional sample may be taken. Our experience shows that in most cases, there is a shortage of samples in dispute cases. Hence an additional sample retained on board the ship will be invaluable in case of litigation.



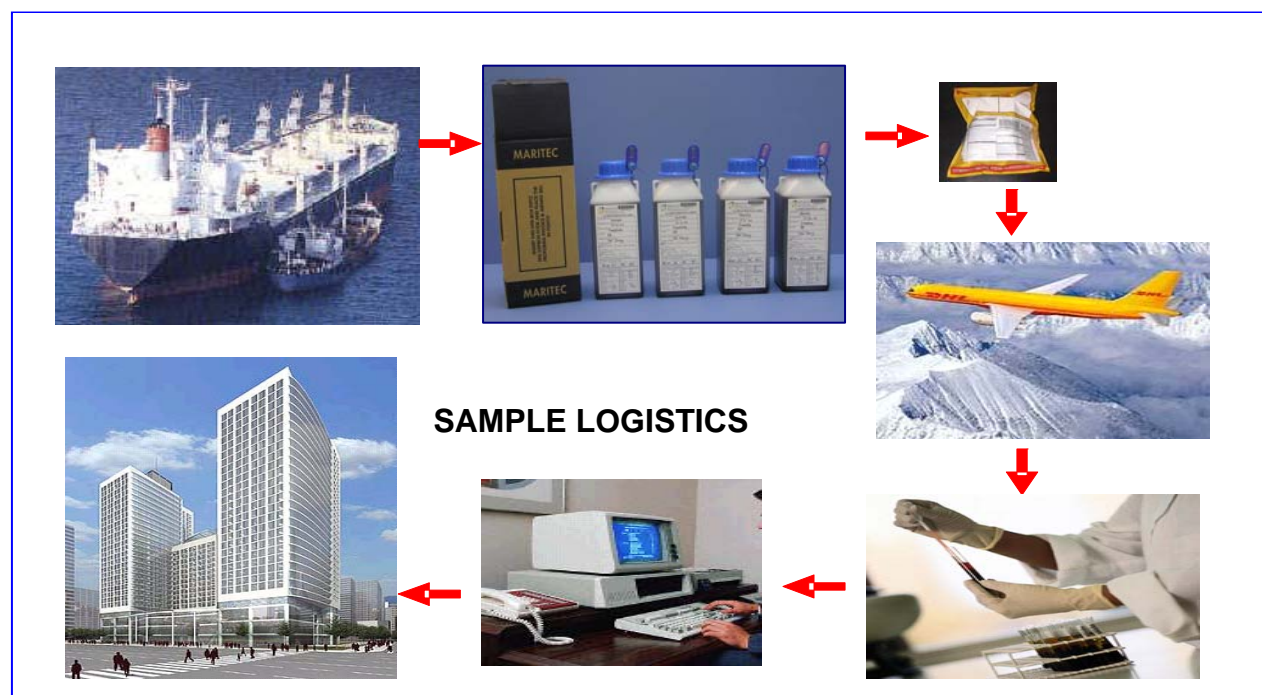


The sample intended to be sent to Maritec laboratory is packed into the (International Air Transport Association) IATA approved carton. The IATA carton and documents should be put into the DHL Express flyer and given to the vessel's agent with instructions to contact the nearest DHL office urgently to pick up the sample.



The sample is then urgently couriered by DHL to Maritec laboratory. Maritec has an exclusive worldwide account with DHL and the account number is preprinted on the Air WayBill. The agent does not have to pay DHL as the parcel will be accepted for payment at destination by Maritec. Upon sample arrival in our laboratory, the client is notified by email of sample receipt. The test results with advisory is reported within 24 hours of sample arrival. Maritec laboratory is open every day regardless of public holidays and weekend. There is no sample waiting to be tested of a local holiday.

A schematic of the logistics process is shown:



### Major International Airhub

Singapore is a major international air-hub where major logistics companies like DHL, UPS, Fedex, TNT, Danzas, have their operational offices and sorting centres. This makes moving samples to Singapore very fast and simple.

In fact, 60 airlines provide links to 152 cities in 51 countries worldwide. 69 international airlines operate over 3,200 flights per week to and from Singapore.

This is a competitive advantage over other testing services where the laboratories are not located at a major air-hub. Connecting flights from air-hubs to remote locations can be few and far between; while inland transportation often experience delays waiting for cargo consolidation.





### **Some Advantages Of A Single Laboratory**

Maritec laboratory is accredited under the Singapore Accreditation Council Singapore Laboratory Accreditation Scheme (SAC-SINGLAS) and meets the requirements of ISO accreditation standards ISO/IEC 17025.

Having a single strategically located laboratory at a major air-hub has its advantages. All samples are stored and available at one location. Any need for re-test or compatibility check would not involve having to locate samples landed in various associated laboratories around the world.



Maritec bar-codes all sample kits and bottle labels sent to customers and tracks usage of samples returned to the single laboratory location. This allows Maritec to predict the vessels requirement for new sampling kits and take proactive action for timely delivery of a new sampling kit to the vessel. Maritec stresses attentive customer servicing and the client is assigned a dedicated account executive who will serve as a familiar and dedicated single point of contact.

### **Test Parameters against ISO 8217**

The sample is urgently tested and results compared against the current ISO8217 Specifications for Marine Fuels.

The parameters tested or calculated are:

- Density @ 15 deg C
- Viscosity @ 50 deg C
- Water By Distillation
- Sulphur
- Flash Point
- Pour Point
- Micro Carbon Residue
- Total Sediment Potential
- Ash
- Vanadium
- Aluminum
- Silicon
- Sodium
- Magnesium
- Calcium
- Iron
- Lead
- Nickel
- Zinc
- API Gravity (calculated)
- Net Specific Energy MJ/Kg (Calculated)
- CCAI - Ignition Quality Index (Calculated)



## Internet Web Access

The test results and appropriate technical advice are promptly transmitted by email to the manager in charge of the vessel within 24 working hours of sample arrival at Maritec. Results are stored in the Maritec database and clients can access their own results at anytime through the Maritec web site. Clients are provided with a User ID and Login password to access their own results as well as other useful information via the internet.



## Benefits of Testing with Maritec

Many satisfied customers regard fuel testing as a necessary cost. Their perspective is more like “The company cannot afford NOT to be on a good fuel quality testing programme” rather than that the company cannot afford to pay for fuel testing.

Indeed, the cost perspective should take into account the risk to the vessel, crew and the cargo. Even the value of cargo alone could amount to many millions of dollars for a container mother-ship. There will also be tremendous consequential loss due to disruption of schedules to feeder vessels, loss of cargo and loss of reputation and goodwill.

There are at least two very good reasons among many for joining the Maritec Fuel Testing programme.

## Prevention Is Better Than Cure

In many instances the supplier in a port may be the only supplier there; leaving the ship-operator no alternative source of bunker OR that supplier may be a state-owned oil company, where recourse for poor quality fuel or litigation is impracticable.

In such a situation, knowing the quality of the fuel supplied and preventing the damage from happening on the vessel, has to be the priority rather than any concern about litigation after the fact when the vessel’s engines have already been damaged.

Owners of vessels which are chartered out will need to protect their investments, otherwise the vessel may be returned with severely worn engines over and above fair wear and tear. On the other hand, charterers would also benefit from joining the Maritec programme to protect themselves against undue or unfair claims by owners.

## **Ultimately, prevention is still cheaper than cure.**

With the extremely high bunker fuel prices, excellent charter rates and the long lead time needed to obtain spare parts; it is a small price to pay to join the Maritec programme.

### **Due Diligence**

Shipowners and ship-operators are required under the ISM Code to demonstrate due diligence.

Fuel Testing is nowadays mandatory for tankers.

Joining the Maritec programme adds to this compliance and provides a systematic procedure and documented contemporaneous evidence essential in a dispute, litigation or arbitration case. Ship managers will be able to operate professionally and avoid having to be constantly in a crisis mode trying to find spares and repair yards or to face irate shipowners.

With the high fuel prices and elevated charter rates, the consequential losses from engine damages could be tremendous. Joining the Maritec Fuel Testing Programme would be a minor cost to ensure safe and profitable operation of the vessel. Please contact us at:



**Maritec Pte Ltd  
192 Pandan Loop #05-27  
Pantech Business Hub  
Singapore 128381**

**Tel: +65 6271 8622  
Fax: +65 6271 9236  
Email: [sales@maritec.com.sg](mailto:sales@maritec.com.sg)  
Website: [www.maritec.com.sg](http://www.maritec.com.sg)  
(Company Registration Number: 19906554N)**

**MARITEC PTE LTD**

192 Pandan Loop, #05-27 Pantech Business Hub, Singapore 128381

Tel: (65) 6271 8622 Fax: (65) 6271 9236 Email: [sales@maritec.com.sg](mailto:sales@maritec.com.sg) Website: [www.maritec.com.sg](http://www.maritec.com.sg)

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