A Pocket Guide to

Prevent Bunkering Malpractices In Shipping Industry

The Bunker Detectives®

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A Pocket Guide to Prevent Bunkering Malpractices in Shipping Industry

Publication date: Nov' 2014
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Published by: Marine Insight
(www.marineinsight.com)

Graphic Design: Anish Wankhede

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1. Introduction

In shipping industry, bunker fuel suppliers employ several dubious practices during a typical bunker stem operation. These malpractices are usually more prevalent in Asian ports than in those of North America or Europe.

Having said that no matter which part of the world the vessel is fixed to stem bunkers, the importance of accurately measuring the barge fuel tanks before and after delivery is a crucial phase in any bunker stem operation. It is therefore very important that the vessel's bunker operation team methodically take the barge tank measurements, applying the correct trim/list before and after bunkering, recording the actual temperature of the bunker fuel before/after delivery etc. Proper temperature measurement alone can save thousands of dollars!

Disputes can arise either by innocent mistake or deliberate short supply by the barge; like introducing air to froth up the fuel (cappuccino effect) or giving incorrect temperatures and so on. Also when bunker is being transferred from a refinery to a storage tank and to the barge and then delivered to the vessel, there is a lot of scope for

errors and deliberate manipulations that will result in a difference (sometimes quite significant) between the quantity claimed to have been supplied and the quantity received by the ship.

If this is due to an innocent mistake then probably with fullest co-operation of the barge company/ fuel suppliers and full disclosure of stock movement records might indicate the “missing” bunker.

However, often this is not the case and experience tells us that when disputes do arise over quantity transferred, any ‘post-delivery’ investigation on quantity shortages are often inconclusive especially if the shipboard personnel involved in bunkering operation have neglected the basic principles of safeguarding it’s owners/charterers’ rights in way of collecting and preserving evidence.

Protests, legal fees, etc. all add on to costs with usually neither party actually concluding with certainty what transpired on board. A success of any bunker dispute claim will largely depend on the detailed contemporaneous written evidence by the shipboard personnel at the time the supply is made.

2. Types of Bunker Malpractices

There are many ways to conceal fuel on a vessel – some of the examples are:

- Short bunker delivery
- Hidden compartments
- Use of 'magic pipes'
- Altered sounding pipe lengths
- Non-class approved and / or altered sounding tables
- Sounding tapes not properly calibrated
- Doctored fuel gauges and so on….

The guidance mentioned in this guide should not be construed as exhaustive and is aimed primarily for vessel operators and ship owners to educate their shipboard personnel for better detection and prevention of bunkering malpractices for occurring in the first place.

What the ship owners and operators need to know?

The ship owner and the charterer both have the responsibility for the provision of bunkers – in a time charter the charterers will provide bunkers whereas in a voyage charter the owners will normally supply bunkers. Therefore, it is important for the owners and the charterers, and of course the seafarers to be aware of the tricks of the trade during bunker stem operations.

Image Credit : Min Htet Paing

1. Understanding the Fuel Density & Weight Relationship

Marine fuel is always sold by weight (mass) and delivered by volume. Hence for this reason bunker receipts must always be signed “For Volume Only” and adding the words “weight to be determined after testing of the representative sample”. Never sign for weight if uncertain about the density.

What many bunker surveyors do not realize is that the density given in the supplier’s bunker delivery note (BDN) may not be true and thus the weight determined by calculation should be considered as the ‘preliminary’ weight of the fuel transferred to the vessel. The actual weight is only determined after an independent fuel testing authority verifies the density and then factored into the final recalculation of the actual weight of the fuel delivered onboard. That is why it’s important to obtain bunker samples both onboard the vessel and the barge.

Once the samples are dispatch to the vessel’s chosen independent fuel testing laboratory, a copy of the Fuel Test Reports is given to the surveyor so that the revised bunker survey report can be sent to the client. Below is typical scenario of how density can affect the weight of fuel transferred on board.

A ship owner/charterer has a fleet of 20 vessels bunkering an average of 1000 MT each month.

Fuel Cost $ USD /MT	650.00	$ USD
Bunker Stemmed per month x 20 vessels	20,000.00	MT
Density of Fuel @ 15 C (BDN Value)	0.9889	
Density of Fuel @ 15 C (TESTED VALUE)	0.9865	
Density Differential	0.0024	
Short Delivery per vessel per month (approx.)	**-2.50**	MT
Commercial Loss per vessel per month	-1,625.00	$ USD
Fleet Commercial Loss per month	-32,500.00	$ USD
Fleet Commercial Loss per year	**-390,000.00**	$ USD

Now imagine a charterer operating a fleet of 50, 70 or 100 vessels – the commercial loss would be value in millions of dollars every year!

Key Notes:
If the density of fuel cannot be verified onboard or independently verified at the time of bunkering, the BDN should be signed only for 'volume' and not for weight.
Remember whenever in doubt or have concerns always issue a letter of protest.

2. Understanding the Fuel Temperature & Volume Relationship

Petroleum products have a high rate of thermal expansion which must be taken into account when several thousand tons are transferred or purchased. The barge will often try to under-declare the temperature during the opening gauge and over-declare during the closing.

This malpractice is quite common in day to day bunkering and therefore it's important for ship officers responsible for bunkering operations to be extra vigilant and check the temperatures of all bunker tanks during the opening gauge and thereafter periodically check and record the temperature of the fuel as it is pumped onboard. The temperatures should be checked both at the barge and the ship's manifold. If temperature gauges are provided it would be prudent to take photographs where permissible.

The barge will often try to under-declare the temperature during the opening gauge and over-declare during the closing. Always verify temperatures of all bunker tanks during the opening gauge and thereafter periodically check and record the temperature of the fuel as it is pumped onboard.

Also note that the existing flow measurement systems will have a separate temperature and pressure gauges where these could easily be tempered with or gauges not being accurate like non-aqueous liquid filled gauges with glycerin and silicone oils often seen

with broken sight glass. The whole purpose of a liquid filled gauge is for the liquid to absorb vibrations, thus providing a dampening effect to enable accurate readings and also to reduce wear and tear by lubricating all moving parts – in other words this affects the integrity and reliability of the gauge readings over time.

There have been cases where the glass in the mercury cup case thermometer is gently heated to create a bubble effect to prevent the correct registering of the temperature of the fuel oil. This malpractice could be illustrated by the following example:

AT OPENING GUAGE (UNDER-DECLARING TEMP)

Actual Temperature	53.0
Declared Temperature	40.0

GOV m^3	Density @ 15 C (g /ml)	Temp C	VCF T (54B)	GSV m^3 @ 15 C	Weight (MT) (in Air)
1000	0.9889	53.0	0.9738	973.8	961.92
1000	0.9889	40.0	0.9828	982.8	970.81
					-8.89

Loss ~~or Gain~~

Approx. Commercial Loss -$5,778.50 $ USD

Within a large fleet the loss could run into millions of dollars a year!

Key Notes:
Always check and record the temperatures of the fuel tanks before, after and periodically during bunkering operation. Carry own infra-red laser temperature gun as a part of your equipment. Remember whenever in doubt or have concern always issue a letter of protest.

3. The Cappuccino Bunkers: (also sometimes known as the Coca Cola Effect)

This essentially may be described as frothing/bubbling effect caused by compressed air blown through the delivery hose. The aerated bunkers when sounded will give the impression that the fuel is delivered as ordered. In fact after sometime when the entrapped air in suspension settles out of the fuel oil the oil level drops and a short fall is discovered. In large bunker deliveries this could be considerable with huge financial implications.

It has often been asked why the flow meter cannot detect the air being introduced in the system and compensate accordingly. Well, most flow meters in use today are of either the wrong type or the wrong size. In other words they are not technologically advanced. All the standard flow meters will only measure the volume of throughput and not the actual mass of fuel being delivered. As a result when air is introduced into the system, which is essentially 'small air bubbles' – the flow meter will register it as volume.

However, there are flow meters out in the market which are capable of measuring the true quantity (mass) of the fuel delivered. We will take a detailed look at Cappuccino bunkers later in the guide.

4. Fuel Delivered with High Water Content

Traces of water in bunker fuel are normally very low about 0.1-0.2% by volume. ISO 8217:2010 Fuel Standards for 'Marine Residual Fuels' gives the maximum allowable water content to be 0.5 % v/v.

Water can originate from number of sources like heating coil damage causing leakages and tank condensation; however deliberate injection cannot be ruled out. In case large quantity is found then a letter of protest should be issued immediately. However, the exact quantity of water can only be determined after the settlement phase where the water would have settled down at the bottom of the bunker tank.

Key Notes:

High water content causes other issues like removal costs to ashore if the OWS (Oily Water Separator) onboard is not able to filter it out and also reduces the fuel's specific

energy.

Fuel samples provided by the barge may not have any traces of water as the samples may have been taken prior to bunkering and mixing of water. Always ensure that the fuel samples are collected during bunkering and not before or after. For these reasons never sign labels in advance or sign for samples of unknown origin. Samples should only be signed for those actually witnessed.

Use of water-finding paste on the sounding tape is good for distillate fuels only and does not work with residual fuels. Even incorrect type of ‘water-detecting’ paste could be used. On-site testing should be done for water-in-oil test.

It may be not viable for the ship operators to invest in high end equipment for such purposes but as a minimum the vessel should be able to test a bunker representative fuel sample for water, test for density and compatibility. Remember whenever in doubt or have concerns always issue a letter of protest.

05. Inter-tank Transfers (gravitating of fuel)

During opening gauge the fuel could be transferred from high level to a low level (or empty / slack tank) by gravity. For example a barge may have four tanks 1P/1S, 2P/2S, 3P/3S and 4P/4S. The opening gauge starts from say aft tanks 4P/4S. While the gauging is underway, the tank level of 4P/4S could be easily dropped under gravity to a slack or empty tank forward say 1P/1S. Thus essentially the same fuel quantity is measured twice.

This method is still in use and if not detected the barge can claim that full quantity was delivered to the vessel but the vessel will have a substantial shortfall. Once the bunkering has commenced it is too late to do anything and it will be virtually impossible to trace the 'missing' fuel.

A thorough investigation will be needed to determine the exact stock control quantity and full disclosure from the supplier can take many months/years of legal action and still the matter may not be resolved.

It is imperative that the attending surveyor or vessel's representative re-gauges the

tanks in the following sequence:

- If the initial gauging was forward to aft, then after gauging the last aft tank; the surveyor or vessel's representative should re-gauge all tanks from aft to forward. The readings should be exactly the same.

As an additional precaution, at the commencement of bunker transfer, the surveyor or vessel's representative should re-gauge the first tank(s) used to transfer oil to the vessel. The reading should match that taken during the initial gauging.

Key Notes:
The only effective way of dealing with this dubious practice is re-sounding the tanks as above before bunkering commences.

Remember whenever in doubt or have concerns always issue a letter of protest.

6. Flow meter/Pipe work Tampering

Bunker barges fitted with a flow meter should be checked for proper functioning by sighting a valid calibration certificate and ensuring the seal is intact.

There may also be unauthorized piping (by-pass lines) fitted to the flow meter running into the pump suction side and thus this unauthorized contraption will register the throughput of fuel twice through the flow meter.

Key Notes:

- Verify flow meter seal is intact
- Verify validity of the calibration certificate and that it is for the same type flow meter
- Look out for any suspicious by-pass lines running after the flow meter
- Consult the barge piping diagram if in doubt
- Remember whenever in doubt or have concerns always issue a letter of protest

7. Quantity Measurements By Flow Meter Only

The barge may claim that the soundings and ullage ports have been sealed by customs or seized or some other reasons and therefore force the vessel to go by the volumetric flow meter only. Remember that this may be just the first sign of an unscrupulous barge Master as such we wary of other tricks of trade.

Key Notes:

- Never agree and go by the flow meter only fuel delivery
- Remember whenever in doubt or have concerns always issue a letter of protest

8. Pumping / Mixing Slops into Bunkers

Though we seldom come across this now because of tighter sampling procedures in place, but introducing slops and thus contaminants into the fuel delivery will reduce the actual fuel amount and can also create engine problems down the line. Unfortunately this cannot be detected until the representative fuel samples have been tested by an independent fuel testing facility.

A typical scenario where this malpractice would be carried out is after an argument over short supply; the barge would pump in sludge / water to make up for the short supply. As the sample collection would have been completed; it is therefore imperative that if allowed a second pumping re-sampling is done both on the barge and the vessel.

Key Notes:

- Always witness and collect samples by continuous drip method i.e. the sample to be drawn continuously throughout the bunkering delivery period
- It should be a practice onboard to isolate the fuel delivered to separate tanks and not to be consumed until such time the fuel testing report gives a clean bill of health
- In case of second pumping re-sampling should be carried out both on the vessel and the barge to ensure no contaminants like sludge/water is been delivered to the vessel
- Fuel contamination amongst other things can create problems with the fuel injection system and exhaust valves with costly repairs
- Remember whenever in doubt or have concerns always issue a letter of protest

9. Questionable Tank Calibration Tables

Verify that the sounding / ullage tables are approved by the Class (Class Certified – with endorsement). Having more than one set of sounding book is not uncommon and having the tables modified to the supplier's advantage is always a possibility. Inserted pages, corrections, different print/paper type are all indications of tampering. Sometimes the barge may have a new calibration table (with the old one being obsolete). This calibration could be following modification of the tanks internal structure during a dry dock repair or simply because the original calibration tables would have been incorrect.

Always find out the reason for new calibration table and making sure it's Class Certified.

The same could be said for the list / trim correction tables which could be easily modified again to the supplier's advantage.

Key Notes:

- Look for Class Approved calibration tables with endorsement
- Remember whenever in doubt or have concerns always issue a letter of protest

10. Tampering with Gauging Equipment

Always verify the condition of sounding tape. Sounding tapes could be tampered with in many ways:

- Tampering with gauging element
- Deliberate altering of sounding tapes and using wrong size of bobs
- Sounding bobs from tapes that have been switched over
- Cutting the tape and re-joining resulting in non-linear tape

Key Notes:

- Check for calibration certificate for the gauging equipment in use
- Use a ruler to ascertain the precise sounding/ullage when below the 20 cm mark
- Use own sounding / ullage tapes
- Pay particular attention to 'millimeter' soundings especially when the tanks are full and taking ullages as small errors will have a big impact on the total bunker quantity.
- Remember whenever in doubt or have concerns always issue a letter of protest

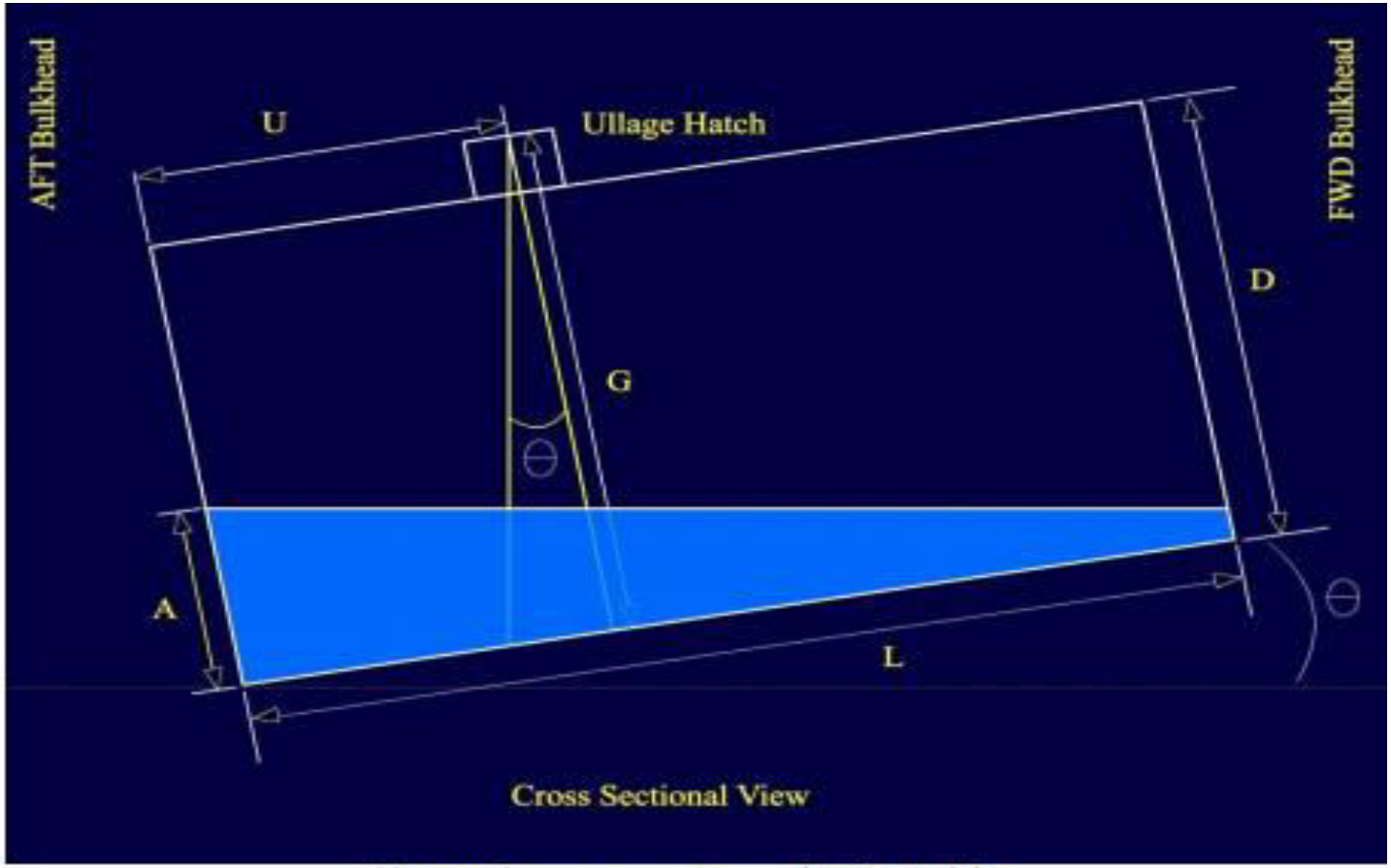
11. Empty Tanks : Un-pumpable Fuel (Zero Dip Volume Application)

In an event of a short delivery be wary that empty tanks may not be empty even with zero dip and that substantial pumpable may exist. Verify the tanks claimed to be empty – don't take the supplier's word for it.

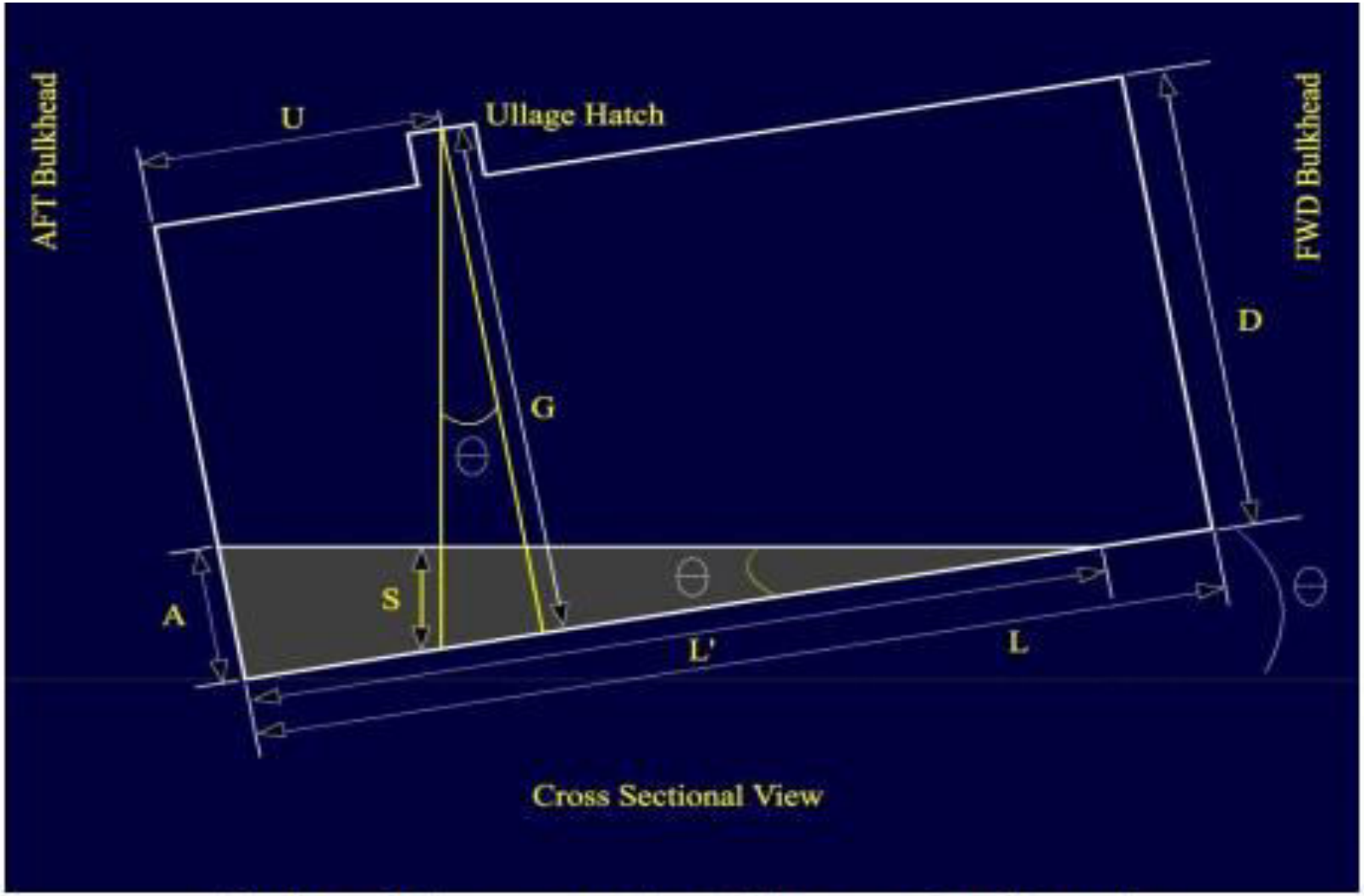
Zero dip volume application principle – The bunker surveyor or the vessel representative should notify the barge representative that the zero dip volume of the tank(s) shall be included in the bunker tanker calculations. The condition shall deemed to apply when the closing gauge would indicate no oil cut whereas the visual inspection of the bunker tanker cargo tank indicate free flowing oil at the aft of the tank. To avoid zero dip volume application, sufficient bunkers should be retained in cargo tanks such that it touches all four sides of the tank.

To apply zero dip correction – it is assumed that the tank is rectangular where the sounding is not constrained by a sounding pipe – i.e. sounding should be taken in an "open sounding" position (from the hatch) where the sounding tape bob is free to travel with the trim of the barge and not restricted by the sounding pipe. However, if the tape is used inside a sounding pipe this correction would be invalid.

Liquid cargo should only be trim and/or list corrected if the liquid is in contact with all bulkheads. When the liquid is not in contact with all bulkheads, a wedge correction should be applied.



No wedge – use normal trim tables



Wedge exists – use wedge tables or wedge formula

*Cut – The oil level on the tape or bob or the water level marking on a tape or bob coated with water indicating paste. “Taking a cut” is taking a measurement of the oil or water level.

Key Notes:

- Do not assume any tanks to be empty even when reaching stripping level
- Check tank calibration tables to verify the unpumpable
- Apply correct list / trim corrections during calculations
- Remember whenever in doubt or have concerns always issue a letter of protest

12. Inflated / Deflated Tank Volumes

Level of oil on the tape / bob should be clearly identifiable (same colour and viscosity as the rest of the oil in the tank).

Soundings can be inflated during opening gauging by pouring diesel oil into the sounding pipe just before gauging.

Sounding at the time of pouring diesel oil

Sounding re-checked after sometime

Another method of inflating the sounding is high pressure compressed air being injected directly into the sounding pipe, pressurizing the pipe and thus causing the level of oil to rise giving a higher reading without even frothing or creating bubbles. This would be done en-route to the vessel just before delivery.

The reverse is true – that is the soundings can be deflated during closing gauging by pouring copious amount of paint thinner into the sounding pipe just before gauging. The thinner washes off the oil level marking on the sounding tape to indicate less oil.

Key Notes:

- Always check the level on the sounding tape and if in doubt re-gauge the tank
- Remember whenever in doubt or have concerns always issue a letter of protest

13. Under-Declaring Actual ROB and Deliberate Short-Supplying of Fuel

Why it is important for the ship operators to ascertain the exact fuel quantity onboard prior stemming bunkers?

The malpractices during bunkering operations which we see and hear about though quite prevalent with bunker suppliers; but on many occasions it's found that the receiving vessel will be as much as involved as the supplier in these dubious practices. Ofte the vessel would under-declare fuel quantity which is then either sold back to the barge supplier or simply kept hidden on the vessel until an opportunity comes along to profit from this.

For example: An order for 1000 metric tons of FO is placed at the next bunkering port – the vessel has an excess of 50 metric tons (un-declared). Now when the supply barge

comes alongside (through prior negotiations) the vessel would deliberately short -receive (or barge will deliberately short-supply) 50 tons.

In other words the actual supplied quantity would be 950 tons but on the BDN it would be reported as 1000 tons and the operator will be invoiced based on this BDN quantity. The short-received (or short delivered bunker) profit will be shared between the supplier and the vessel. In the end it is the operator who is affected – suffering the loss twice (50 tons + 50 tons).

Contributing factors for the loss:

- Too much reliance on the vessel's staff
- No bunker stem audits are conducted which involves elaborate detective work carried out by independent third party surveying firms
- Ignoring non-nominating (non-receiving) tanks to be included in the overall tank measurements during stem operations

Most shipping companies will engage the services of an independent surveyor to protect their interest in case of a large discrepancy in the final figures between the

barge and the vessel; however, how many companies actually give clear instructions to the attending surveyor to measure all non-nominated tanks (non-receiving tanks)? Or how many surveying firms actually carry out the measurements diligently? Failing to do so leaves the operator vulnerable.

This is further illustrated as follows:

Scenario 1: Under-declaring - To Ship Owners Advantage

Bunker stemmed by the vessel operator	1500.00	MT
ROB as per log book (arrival bunkering port)	350.00	MT
Un-declared fuel onboard	**53.00**	MT
Actual Bunker stemmed	1500.00	MT
Quantity declared on BDN	1500.00	MT
Final ROB declared in log book after bunkering	1850.00	MT
However, Actual ROB would be	1903.00	MT
Fuel Cost $ USD /MT	650.00	USD
Losses for the Operator	**-34,450.00**	USD

The excess 53 MT of fuel oil will be in favor of the owners with a loss to the charterers

Scenario 2: Under-declaring - With the Aim to Profit for Personal Gain

Bunker stemmed by the vessel operator	1500.00	MT
ROB as per log book (arrival bunkering port)	350.00	MT
Un-declared fuel onboard	**53.00**	MT
Actual Bunker Stemmed (deliberate short supply)	1447.00	MT
Quantity (incorrectly) declared on BDN	1500.00	MT
Final ROB declared in log book after bunkering	1850.00	MT
Actual ROB would also be	1850.00	MT
So where did 53 MT disappear?	You guessed it!	
Fuel Cost $ USD /MT	650.00	USD
Losses for the Operator will be double		
• for under-declared fuel	**-34,450.00**	USD
• for the short-supply fuel	**-34,450.00**	USD
	-68,900.00	USD

Key Notes:

- Carry out regular 'bunker stem audits' – in a large fleet this is an indispensible loss control tool
- Measure all non-nominated tanks prior to stemming operations and again after bunkering is completed
- Always engage the services of a reputable bunker stem surveying firm during stem operations

3. Understanding Malpractice Of Bunker Gravitating

What is 'gravitating of fuel: Inter-tank transfers of liquids or 'gravitating' whether it may be ballast water, fresh water or fuel oil is a very common practice onboard ships. This process entails transferring liquids by "gravity" without the use of a pump.

Gravitating is carried out for various reasons – to balance out liquid levels in tanks either to reduce the free surface effect, achieving a desired list/trim and in oil tankers reducing the level of a full cargo tank (dropping the level) as a precaution against inadvertently overflowing and for priming the cargo pumps and suction lines before discharging and for various other reasons.

Since the liquid is essentially 'dropped' under gravity from a high level to a lower level – the total liquid or cargo quantity remains unchanged after gravitating because the liquids are only transferred internally in a closed system. This technique though very useful in day to day ship operations could be used during stemming bunkers by the supplier resulting in substantial shortage for the vessel.

How Gravitating Of Bunker Fuel Is Achieved By An Unscrupulous Supplier?

During the opening gauge the fuel could be transferred from high level to a low level or empty / slack tank by gravity. For example a barge may have four tanks 1P/1S, 2P/2S, 3P/3S and 4P/4S. The opening gauge starts from say forward tanks 1P/1S. While the gauging is underway, the tank level of 1P/1S is dropped under gravity (note this tank has already been just gauged) to a slack or empty tank aft for example to 4P/4S. Thus, essentially when the 4P/4S is gauged the same fuel quantity is measured twice.

This method is still in use and if not detected the barge can claim that full quantity was delivered to the vessel with the vessel suffering a substantial shortfall in bunker quantity received onboard. Once the bunkering has commenced it is too late to do anything and it will be virtually impossible to trace the ‘missing’ fuel.

A thorough investigation will be needed to determine the exact SMR (stock movement record) and full disclosure from the supplier which can take many months/years of legal action and still the matter may not be resolved.

How Do You Prevent This Mal-practice?

As a precaution against gravitating, it is imperative that the attending surveyor or vessel's representative gauges the tanks in the following sequence:

If the initial gauging is forward to aft, in our example 1P/1S, 2P/2S, 3P/3S, 4P/4S then after gauging the last tank (4P/4S) the surveyor or vessel's representative should re-gauge all tanks from aft to forward. The ullages or soundings should be exactly the same.

Also as an additional precaution, at the commencement of bunker transfer, the surveyor or vessel's representative should re-gauge the first tank(s) used to transfer fuel oil to the vessel. The reading should match that taken during the initial gauging.

Will This Precaution Prevent Bunker Shortage?

The answer is no. This article highlights one of the many techniques used to short supply bunkers. Shortages occur due to number of reasons.

A success of any bunker dispute claim will largely depend on the detailed contemporaneous written evidence by the shipboard personnel at the time the supply is made.

4. Understanding Cappuccino Effect

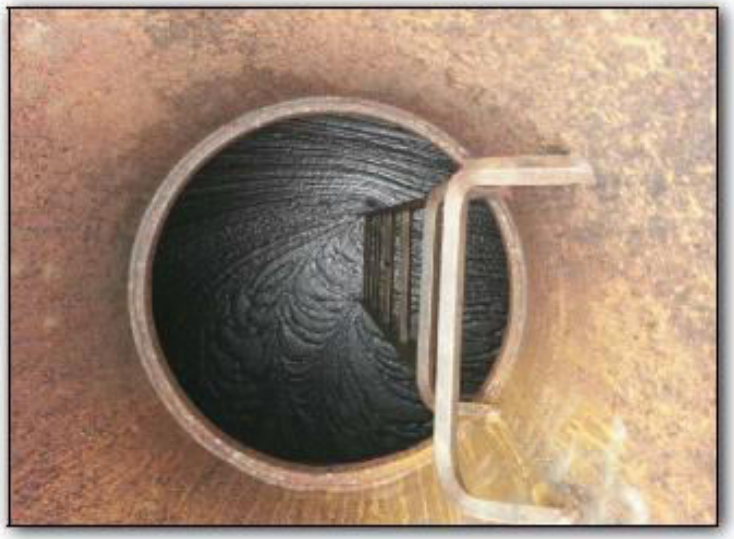
Cappuccino effect essentially may be described as frothing/bubbling effect caused by compressed air blown through the delivery hose. The aerated bunkers when sounded will give the impression that the fuel is delivered as ordered. In fact after sometime when the entrapped air in suspension settles out of the fuel oil the oil level drops and a short fall is discovered. In large bunker deliveries this could be considerable with huge financial implications.

It is often asked why the flow meter cannot detect the air being introduced in the system and compensate accordingly. Well, most flow meters in use today are of either the wrong type or the wrong size.

In other words are not technologically advanced. All the standard flow meters will only measure the volume of throughput and not the actual mass of fuel being delivered. As a result when is air introduced into the system, which is essentially 'small air bubbles' – the flow meter will register it as volume.

However, there are flow meters out in the market which are capable of measuring the true quantity (mass) of the fuel delivered. One such meter is the 'Coriolis Mass Meter' – it has been in existence for quite some time now and only getting better. Coriolis meters take direct mass flow measurements using the Coriolis Effect (a deflection of moving objects when they are viewed in a rotating reference frame.) Coriolis meters are less sensitive to pressure, temperature, viscosity, and density changes, allowing them to measure liquids, slurries and gases accurately without the need for compensation.

1- Entrained air / froth seen immediately following bunkering - ullage 139 cm



2- Entrained air / froth seen immediately following bunkering - ullage 171 cm

3- Two hours after bunkering - lot of bubbles seen

4- Two hours after bunkering - lot of bubbles seen

5- About 6 hours after bunkering - only light air bubbles seen - ullage 150 cm

5- About 6 hours after bunkering - only light air bubbles seen - ullage 184 cm

7- Bubbles seen on sounding tape

8- Bubbles seen on sounding bob

9- Bubbles seen on sounding bob

10- No bubbles seen. Clear reflection is an indication of good bunker supply

11- No bubbles seen

12- No bubbles seen

Before Fuel Transfer – At the time of opening gauge fuel oil should be observed from ullage hatches for any foam on the surface of the bunkers. Foam may also be detected on the ullage tape. If there is no foam then the oil level on the tape should appear distinct with no entrained bubbles. If by observation of the tape and the surface of the fuel you suspect entrained air then obtain a sample of the fuel by lowering a weighted bottle into the tank. Pour the sample into a clean glass jar and observe carefully for signs of foam or bubbles.

If these observations show entrained air the Chief Engineer should not allow the bunkering to start and notify the Owners / Charterers immediately. The barge master should be issued with a letter of protest. If the barge master decides to disconnect from the ship and go to another location then the agent should immediately inform the port authority and try to establish where the barge has gone.

All relevant times and facts should be recorded in the deck log book. During fuel transfer If the Chief Engineer has not observed any entrained air during the initial barge survey it is still possible that air can be introduced to the barge tanks or the delivery line during the pumping period for example by introducing air into the system by crack opening the suction valve of an empty bunker tank while pumping from other tanks.

Hence it is important for the Chief Engineers to continue gauging the ship's receiving tanks while the bunkering is in progress as air bubbles would be readily seen on the sounding tape.

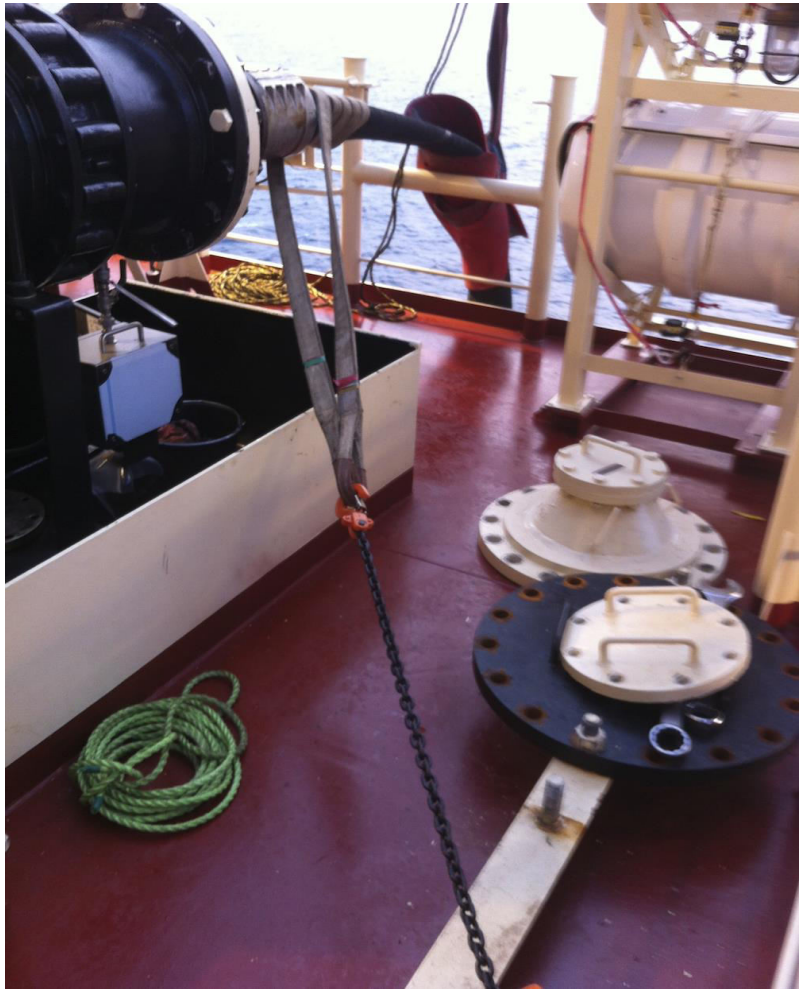
The Singapore Bunkering Procedure SS 600 prohibits the use of compressed air from bottles or compressors during the pumping period or during stripping and line clearing. It should be confirmed with the barge master that he will follow this procedure (Reference SS600 paragraphs 1.12.10/11/12/13).

Stripping of barge tanks can also introduce air and stripping should only be performed at the end of the delivery for a short period of time. The barge master must agree to inform the Chief Engineer when he intends to start stripping and when it has been completed.

Ship's crew and surveyor need to be alert during bunkering and check for the following signs:

- Bunker hose jerking or whipping around

- Gurgling sound when standing in vicinity of bunker manifold.
- Fluctuations of pressure indication on manifold pressure gauge
- Unusual noises from the bunker barge



After Fuel Transfer- It is also possible to introduce air into the delivery line during blowing through at high pressure.

Therefore it is imperative that the barge informs the ship before and after blowing through is completed so that the ship crew can be extra vigilant during this period.

The ship's bunker manifold valve should be checked shut before gauging of the vessel's tanks.

Identifying Cappuccino Bunkers

- Signs of froth/foam on the surface of the fuel in the barge tanks during opening gauge
- Excessive bubbles on the sounding tape prior to, during and after bunkering
- Bunker hose jerking or whipping around
- Slow delivery rates then what has been agreed
- Gurgling sound in vicinity of bunker manifold and unusual noises from the bunker barge
- Fluctuations of pressure on manifold pressure gauge
- Note that hose jerking or evidence of sporadic bubbles superficial in nature after line blowing or stripping of tanks is fairly common and should not be construed as evidence of mal-practice

5. Coriolis Flow Meters

There are lot of discussions going on for adopting the mass flow metering system known as the Coriolis flow meters (based on the Coriolis Principle – named after Gustave Coriolis, a French mathematician) in the bunkering industry to improve upon existing measurement technologies and to prevent fuel-pilferage.

Thousands of vessels stem bunkers around the world every day and every now and then we come across news about bunker theft either by the supply vessel (bunker tanker or barge) as described in 'malpractices in bunkering operations' or the receiving vessel under-declaring the transferred fuel.

What is the Coriolis Principle?

In order to understand how the Coriolis flow meter work, we first need to understand the Coriolis Principle. The Coriolis flow meters work on a basic principle of Coriolis Effect or 'Force' – which is essentially a veering or deflection of a moving object when viewed from a rotating reference frame.

In the Northern Hemisphere a moving object will appear to deflect to the right (facing the direction of motion) and vice versa in the Southern Hemisphere. Note that Coriolis force is actually not a force but since the objects tend to veer to the left or right of its path, it is assumed that a force has acted upon it to cause this deflection because of the Earth's movement underneath it.

A good example of this would be to consider an airplane flying from Madrid to New York. Both places share almost the same latitude – so it would make sense for the pilot to set a course due West (2700). However because of the Coriolis Effect if constant course corrections are not applied the plane will probably end up somewhere in Canada (i.e. right to the intended path in the Northern Hemisphere).

Mass flow meters are based on this principle and a simplified explanation is as follows: Imagine a jet of water e.g. from a pressure hose pointed straight ahead – the jet of water will move in a straight line but when viewed from a rotating reference the jet will appear to be veering to the right or left depending on the hemisphere.

If the same jet of water was now enclosed in a measuring tube rotating around a fixed point with its axis perpendicular to the direction of flow of water; the measuring tube would appear to twist/deform due to the change in angular velocity from the Coriolis Effect.

However, it's not practical to make the tube rotate so instead, the tube is oscillated electromagnetically causing it to vibrate achieving the same effect as if the tube was rotating. This twisting/deformation of the tube results in a phase difference (time lag) which is registered by use of special sensors and thus form the basis of the mass flow measuring in the system.

The mass flow meters come in different varieties – such as straight tube type, twin tube type, bent tube type – with each having its own advantages and disadvantages.

Volumetric Flow Meters vs. Coriolis Flow Meters:

The question we all face today is whether the Coriolis meters could be an alternative solution to existing volumetric flow meters (also called positive displacement meters) and manual measurements (where a bunker surveyor would measure the quantity of fuel transferred using the 'dip' method and look-up tables).

The issues primarily faced today are:

1) **Experience of the surveyor / ship crew to carry out accurate calculations** – there are many factors that can contribute to errors like incorrect temperature, density etc. and these errors can be compounded quickly giving rise to large errors in the final quantity of mass delivered. In other words, the final results will only be as good as the surveyor who performed the calculations.

   Whereas the Coriolis mass flow meters measures the mass directly taking into account various temperature and pressure change automatically and thus eliminating any guess work and need for any look-up tables, trim corrections etc.

2) **Faulty Moving Parts of Volumetric Type Meters** - Existing flow meters i.e. volumetric type meters have moving parts which can be degraded / clogged over time and thus give inaccurate readings. Whereas the mass flow meters have no moving parts and thus does not require much maintenance. This inherent advantage is shared among all mass flow meters currently available from several manufacturers'.

3) Gauge Glasses of Flow Measurement Systems Can be Tampered With: Existing flow measurement systems will have a separate temperature and pressure gauges where these could easily be tampered with or gauges not being accurate like non-aqueous liquid filled gauges with glycerine and silicone oils often seen with broken sight glass. The whole purpose of a liquid filled gauge is for the liquid to absorb vibrations, thus providing a dampening effect to enable accurate readings and also to reduce wear and tear by lubricating all moving parts – in other words this affects the integrity and reliability of the gauge readings over time.

On the other hand, mass flow meters have another inherent advantage of measuring temperature, pressure, temperature and density simultaneously via built-in sensors and displayed on an LCD display.

4) Inability Of Volumetric Meters to Detect Entrained Air in the System: Amongst other things, one major flaw in volumetric meters is and will always remain – is its inability to detect entrained air in the system which may be introduced inadvertently like during tank stripping, changing tanks, leaking valves to an empty tank; turbulence during high loading rates or deliberately leaving a valve open to an empty tank or blowing compressed air into the system through the delivery hose.

This malpractice is known as ‘cappuccino bunkers’.

The ‘cappuccino’ or aerated bunkers (often with froth and bubbles) when sounded will give the impression that the fuel is delivered as ordered. In fact after sometime when the entrapped air in suspension settles out of the fuel oil the fuel level drops and a short fall is discovered. In other words the existing flow meters in use today will only measure the volume of throughput and not the actual mass of fuel being delivered.

As a result when air introduced into the system, which is essentially ‘small air bubbles’ – the flow meter will register it as volume and when this volume converted to mass (because fuel is always sold by weight but delivered by volume) will result in a substantial loss, especially in large bunker deliveries this could be considerable, with huge financial implications.

Whereas in the case of Coriolis mass meters, manufacturers’ have been claiming that these are much better in handling the ‘cappuccino’ bunkers but not all Coriolis meters have the ability to deal with entrained air which can still pose a challenge.

Manufacturers' have various varieties of mass flow meters available today however, what is not clear is how these meters would cope with the presence of entrained air or two-phase flow (gas + fuel oil) because any flow meter's (whether volumetric or mass) basic function is to measure what goes through it and if a mixture of air and fuel is present then how it's going to differentiate the two?

Further, the entrained air is also likely to produce a lot of additional noise and since the Coriolis meters flow measurement is based on signal processing this will tend to interfere with the readings and thus further reduce the accuracy of flow measurement.

In short, even if the manufacturers claim to have solved the entrained air problem; we believe this issue is here to stay. Because even though Coriolis mass flow meters will outperform any other volumetric meter type on the market, it would be extremely difficult for the manufacturers to claim 100% accuracy and reliability of the measurement in the presence of entrained air.

5) Traditional Methods of Surveying Can Give Less Quantity Tolerance Level: Lot of manufacturers' of mass flow meters claim a quantity tolerance level of less than 0.5% and some stating tolerance levels to be as low as 0.1%. Considering a stem of 2000 tons of bunker; 0.5% would mean a loss of 10 tons (in a large fleet this can easily be compounded to a huge loss –10 t x $600 = $6000 per vessel) whereas comparing this to traditional method of surveying can give errors of less than 0.1% or most of the time.

6) Vibrations Can Affect Coriolis Meters: Coriolis meters would also need to be compensated against external vibrations and be corrosion resistant. Because flow rates are measured by vibrating tubes; therefore the readings could be affected by external forces or vibrations transmitted through pipelines and also due to the operating environment where pitting, cracking, coating erosion is common place; corrosion resistant meters would need to be considered like stainless steel, titanium etc.

Again some of the manufacturers' claim to have solved this issue but will this hold up to the harsh marine environment and constant vibrations that is felt on a vessel during cargo operations etc.

In conclusion, Coriolis meters will definitely reduce the amount of bunker quantity disputes as these meters are less prone to tampering and can be used as an anti-pilferage tool in deterring cappuccino bunkers and at the same time increase the transparency during a stem operation.

The present method of manually gauging the tanks and calculations are of course not only more prone to error but also time consuming especially in an event of a dispute but when diligently carried out the quantity tolerance can be less than 0.1% most of the time.

As technology advances and mass flow meters are more perfected (quantity tolerance-wise) vessel operators and bunker suppliers will see tangible benefits in form of high level of transparency, efficiency and faster turnaround times for the vessel.

Because everyone in this industry is well aware that in case of a major dispute a success of a claim will largely depend on the nature and the quality of evidence gathered at the time the supply is made. Without detailed contemporaneous written evidence, the party affected is likely to lose the claim or it could be many years before the dispute is settled!

To achieve global acceptability manufacturers' may need to provide and install these meters at own cost on vessels and barges in order to conduct trials and document results. Some manufacturers' are already engaged in trials with ship operators and suppliers but more needs to be done in order to win the confidence and trust of the end users.

Unless the use of mass flow meters is mandated disputes could still arise. For example, a vessel is fitted with a mass flow meter but the barge is not and in case of a short delivery (caused other than the cappuccino effect or other dubious practices); the barge could still stand ground that the full ordered quantity was delivered! What would you do in a situation like this? Therefore until such time, the use of mass flow meter should complement the existing method of manual surveying.

Lastly, even though often the buyers (ship operators) may be tempted to buy bunkers from those offering the lowest price per ton; they should continue to use only the most trusted and reliable bunker suppliers.

6. Methods & Techniques to Detect Bunker Fuel Concealment

Some of the main methods used to detect bunker fuel concealment are:

Trim & List:

The perfect time for bunker quantity measurement is when no cargo and ballast operations are taking place and when the vessel is on even keel with no list. However, this is not always practical as such but it is important to check for list and trim accurately before and after the soundings. Take average trim/list and always use the corrected trim for calculations.

Falsifying Documentation Onboard:

1. Questionable Tank Sounding (Calibration) Tables: Verify that the sounding tables are approved and endorsed by the Class or recognized Authority. Having more than one set of sounding book is not uncommon and having the tables modified to their advantage is always a possibility. Inserted pages, corrections, different print/paper type are all indications of tampering. Sometimes the vessel may have a new calibration table (with the old one being obsolete).

This could be following modification of the tanks internal structure during a dry dock repair or simply because the original calibration tables would have been incorrect. Always find out the reason for new calibration table and making sure it's Class Certified.

2. Overstating Fuel Consumption: Verify fuel consumptions for last 30 days or as required from the engine's log book / noon reports / deck log abstracts. Example engine over consumption could be shown due to alleged heavy weather during the voyage or boiler over consumption shown even when the vessel would have been idle at anchorage for significant period of time in hot weather. These are all tell-tale signs of fuel misappropriation.

3. Incorrect Fuel Densities and Missing BDN Records: Fuel densities given by the Chief Engineer should be verified against Fuel Laboratory Analysis Reports for the most recent bunker stem and if not readily available then densities stated in the BDN (Bunker Delivery Note) should be used.

   Since BDN must be retained on board for 3 years from the date of fuel supply and should be readily available for inspection by port state control and relevant

authorities (because non-compliance with fuel oil sulphur limits could lead to fines/detention of the vessel) as such there is no excuse for not maintaining a file for previous and current BDNs.

4. Oil Record Book (ORB): ORB should be scrutinized for last sludge / bilge transfer operations; retention of oil residues (sludge); identity and capacities of tanks; records of collection and disposal oil residue to shore facility etc. This will give an idea of the vessel's sludge and waste oil management systems. On many occasions concealed bunkers have been found in waste tanks transferred via an unauthorized connection like a rubber hose!

Soundings:

Verify the condition of sounding tape; deliberate altering of sounding tapes and using wrong size of bobs. Always use own sounding tape and a ruler to report exact sounding or ullage especially if it is below the 20 cm mark.

Note down the reference heights / gauge heights of each tank in a note book and check the same against reference height noted by physical measurement of the tanks.

The reference heights will differ if some foul play is involved like blocking the bottom of the sounding pipes with bobs later to be fished out. In cases like these investigate further and take the entire missing length as “full sounding”.

Pay particular attention to ‘millimeter’ soundings especially when the tanks are full and taking ullages as small errors will have a big impact of the total bunker quantity.

Bunker Tanks:

Verify the number and location of all bunker tanks onboard including overflow tank; sludge tank etc., ensuring it corresponds with the tank capacity diagram.

Note: Refer to supplements to Marpol I/VI Certificates. This will indicate the exact number and capacities of sludge tank, drain tank, residue tank, waste oil tank, bilge tank etc.

A surveyor might come across some tanks as being declared empty. Then there are all sorts of excuses like: The tank is not in use as it contains only sludge or the heating coils have been damaged and the tank emptied out and not in use (check paper trail to find out if the operators have been informed of this or any repair work scheduled for dry dock, check log books etc.)

In any case investigate further by opening manhole covers for tanks that have been declared empty or containing sludge or other reasons.

Temperatures:

Accurate temperature recording is crucial. Verify temperature on the surface of the sounding tape just before it is being pulled out (this may not be very accurate but will give a general idea of the average tank temperatures).

In case of unusual high temperatures reported by the chief engineer attached manual thermometer to the tape bobs to ascertain the exact temperature. Investment in a good digital thermometer may be worthwhile. These can be dipped directly into the tanks through the sounding pipe.

Note the body temperature of fuel oil transfer pumps before and after the soundings/measurements to eliminate any transfer of fuel oil and / or re-inspecting engine room tanks after completing the soundings. For this reason it is advisable to start the soundings of the tanks located on the deck and working your way to the tanks in the engine room.

Settling / Service Tanks:

Service and settling tanks are another convenient and effective method to hide bunkers; however, the quantity hidden will be limited by the tank capacity. Under normal conditions the quantities of fuel oil in settling tanks should not be less than 60-80% of the capacity and in case of service tanks not less than 80-85% capacity.

This is because usually the fuel pump would be set to fill up the tank automatically when below 60%. In any case, investigate further if the volume of the tanks (from the gauge meter/level indicator) is less than 2/3 of the tank capacity. Another method is to verify low level alarms of the tanks if the level is less than as indicated above.

Whenever in doubt check every service and settling tank with float gauge by independent means of a full depth sounding or top ullage, even if it takes additional time.

Doctored Tank Gauges:

Verify working of the tank gauges. There are different types of gauges but the most commonly found are:

a. Float type liquid level gauges (by Semco) – also called mechanical/analog type gauges

b. Flat type glass level gauges (by Hanla)

c. Marine float type (by Hanla)

d. Magnetic float type level gauges with brightly colored flags (by Hanla)

e. Tabular glass type (by Hanla)

f. Self-powered content gauge also called a Pressure Gauge (by Hanla)

g. Dial type float level gauges are composed of float (by Hanla)

Verify that:

- The floats are not jammed / stuck by opening the gauge
- Tanks declared empty are verified by opening the drain valve
- The inlet valve to the oil column (level flooding tube) from the settling/service tank is in open position (we often find this in shut position thus giving inaccurate readings in the glass tubing)

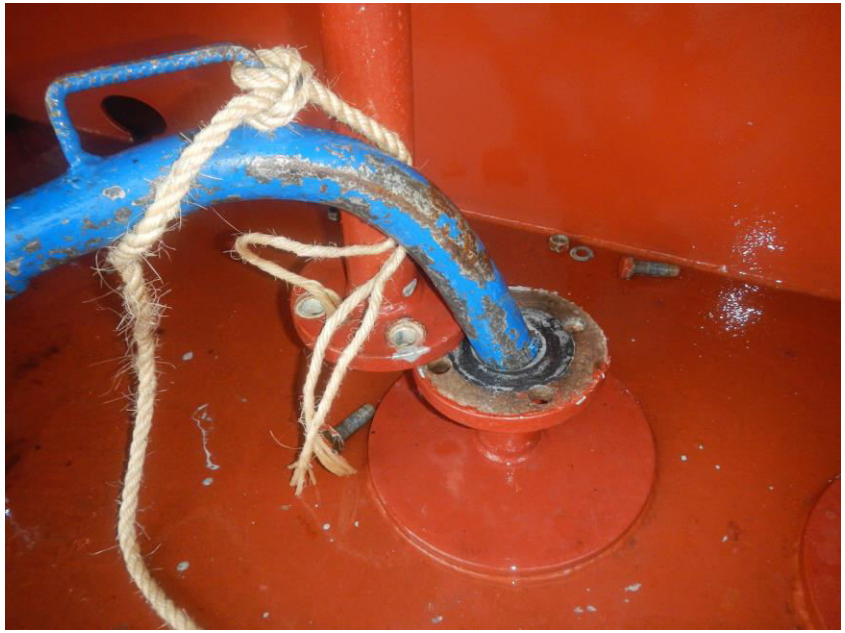
- Where applicable compare physical gauge data obtained with the reading on the engine control room panel. (Most new vessels will have 'online' readings of fuel oil temperatures and volume in the engine control room)

For fuel oil settling/service tanks (since these are always being heated) one method is to use the infrared thermometer to scan the tank bulkhead (surface) to find the approximate level of fuel oil inside the tanks.

Magic Pipes:

Magic pipe is a terminology used when finding conceal bunkers. If used properly – to an untrained eye – it can be hard to detect and thus making bunker fuel disappear just like 'magic'.

These magic pipes are fabricated onboard by engineers and designed to fit tightly inside the actual sounding pipe. The bottom end of the magic pipe is closed and the pipe pushed through the fuel to the bottom of the tank. During sounding, the tank thus appears empty or gives false soundings.



Note ‘magic pipe’ is also the term used to bypass the OWS (Oily Water Separator) connection in order to dump oil overboard. Unlike the use of magic pipe for bunker concealment, use of magic pipes to bypass the OWS is a criminal offense and heavy fines and penalties may be imposed and / or imprisonment.

Magic pipe is also the most convenient and effective method to conceal bunkers. The ship’s staff usually has no trouble finding the right materials to fabricate a magic pipe onboard. Look for tell-tale signs-

- Tampering with flange bolts, especially under the engine room floor plating (these are the easiest to play around with without detection if one is not careful)
- Excessive oil stains or evidence of fresh paint on the flanges

- Look for dissimilar metals like galvanized or bronze pipe inserted within the sounding pipe. if in doubt ask for a bucket of gas oil and pour into the sounding pipe. if there is no foul play then of course the gas oil will find its way into the tank (in case of foul play radical change in sounding or overflow will occur).

- Use of fiber-glass tubes is not uncommon

Another method used to conceal bunker is by lengthening the sounding pipe and blocking the bottom by similar length using some sort of an obstruction like a sounding bob etc. This will give the correct reference height even though the pipe has been tampered. That is why it is very important to closely examine pipe flange/coupling leading through the engine room floor plating for any evidence of tampering.

If a sounding pipe is in a location which is directly underneath the engine room ladder (of the bottom engine room platform) check for any evidence of scratches, excessive oil stains and/or fresh paint (to cover up) as these may indicate pulling out/inserting a magic pipe.

7. Bunker Surveys

Considering the present bunker fuel prices, “bunker stem survey” are absolutely necessary, in order to make sure that the quantities as mentioned on the Bunker Delivery Note (BDN) are true and correct. However, there are many ship operators who leave the above procedure to the Chief Engineer to save on survey cost with the vessel often ending up with an incorrect supplied quantity and a commercial loss of thousands of dollars for the operators.

It is important to note that when a surveyor is appointed by the charterers / owners to oversee the stemming operation, the Master/Chief Engineer is still in charge of ensuring proper steps have been taken to prevent such malpractices and that the surveyor should be assisting and working under the Chief Engineer’s supervision and not the other way around.

‘Unfortunately ‘stealing bunker fuel’ for profit due to increasing fuel prices is here to stay for a long time to come’. Loss prevention during bunker stemming largely depends on the hands-on approach and practical experience of bunker surveyors.

What is a Bunker Stem Audit?

To simply put it – these audits are undertaken onboard the vessel prior to stemming bunkers to prevent bunker misappropriation. At the present market rate, bunker cost is one of the largest operating expense incurred in a T/C voyage. With such high costs involved, it becomes imperative for the charterers to know the exact bunker quantity onboard at the time of supplying bunkers.

How the Audits are conducted?

Bunker Stem Audits are carried out by our experienced marine surveyors on behalf of ship operators to find conceal (hidden) bunker fuel onboard. To find concealed fuel someone qualified has to go on board the vessel and get their hands dirty essentially looking for magic pipes, unauthorized connections; tampered gauging equipment, doctored fuel gauges etc. In order to prevent fuel losses, experienced surveyors offer impartial, independent quantity measurement inspection services for marine fuels, issuing detailed bunker survey reports to ascertain the exact fuel quantity onboard at the time of survey and to report any bunker fuel shortages.

The following scenarios will indicate why a stem audit is an essential loss control tool – especially for operators with a large fleet.

Why Bunker Stem Audits are considered an indispensible loss control tool?

The mal-practices during bunkering operations which we see and hear about though quite prevalent with bunker suppliers; but on many occasion the receiving vessel will be as much as involved as the supplier in these dubious practices. Often it is found that the vessel would under-declare fuel quantity which is then either sold back to the barge supplier or simply kept hidden on the vessel until an opportunity comes along to profit from this.

For example: An order for 1000 metric tons of FO is placed at the next bunkering port - the vessel has an excess of 50 metric tons (un-declared). Now when the supply barge comes alongside (through prior negotiations) the vessel would deliberately short-receive (or barge will deliberately short-supply) 50 tons. In other words the actual supplied quantity would be 950 tons but on the BDN it would be reported as 1000 tons and the operator will be invoiced based on this BDN quantity. The short-received (or short-delivered bunker) profit will be shared between the supplier and the vessel. In the end it's the operator who is affected – suffering the loss twice (50 tons + 50 tons).

Contributing factors for the loss:

- Too much reliance on the vessel's staff

- No bunker stem audits are conducted which involves elaborate detective work carried out by independent third party surveying firms

- Ignoring non-nominating (non-receiving) tanks to be included in the overall tank measurements during stem operations.

Most shipping companies will engage the services of an independent surveyor to protect their interest in case of a large discrepancy in the final figures between the barge and the vessel; however, how many companies actually give clear instructions to the attending surveyor to measure all non-nominated tanks (non-receiving tanks)? Or how many surveying firms actually carry out the measurements diligently? Failing to do so leaves the operator vulnerable as explained above. This is further illustrated as follows:

Scenario 1: Under-declaring - To Ship Owners Advantage

Bunker stemmed by the vessel operator	1500.00	MT
ROB as per log book (arrival bunkering port)	350.00	MT
Un-declared fuel onboard	**53.00**	MT
Actual Bunker stemmed	1500.00	MT
Quantity declared on BDN	1500.00	MT
Final ROB declared in log book after bunkering	1850.00	MT
However, Actual ROB would be	1903.00	MT
Fuel Cost $ USD /MT	650.00	USD
Losses for the Operator	**-34,450.00**	USD

The excess 53 MT of fuel oil will be in favor of the owners with a loss to the charterers

Scenario 2: Under-declaring - With the Aim to Profit for Personal Gain

Bunker stemmed by the vessel operator	1500.00	MT
ROB as per log book (arrival bunkering port)	350.00	MT
Un-declared fuel onboard	**53.00**	MT
Actual Bunker Stemmed (deliberate short supply)	1447.00	MT
Quantity (incorrectly) declared on BDN	1500.00	MT
Final ROB declared in log book after bunkering	1850.00	MT
Actual ROB would also be	1850.00	MT
So where did 53 MT disappear?	You guessed it!	
Fuel Cost $ USD /MT	650.00	USD
Losses for the Operator will be double		
• for under-declared fuel	**-34,450.00**	USD
• for the short-supply fuel	**-34,450.00**	USD
	-68,900.00	USD

221B (or Bunker Detective) Surveys

221B or bunker detective surveys are carried out by marine surveyors on behalf of the charterers to find conceal (hidden) bunker fuel onboard.

To find concealed fuel someone qualified has to go on board the vessel and get their hands dirty. In order to prevent fuel losses, experienced surveyors offer impartial, independent quantity measurement inspection services for marine fuels, issuing detailed bunker survey reports to confirm fuel delivery and report any bunker fuel shortages.

Why are they called 221B Surveys?

The term is derived from an historic reference to the fictional detective Sherlock Holmes' London residence where he ran his consulting detective business - 221B Baker Street.

Remember a bunker surveyor is trying to find something in a very short time that the ship's staff have planned and devised during the entire voyage. Surveyors may find resistance and abuse to demands like opening manholes, dismantling pipes etc., but it is important to conduct oneself professionally and courteously at all times. Do a good job with integrity, impartiality and honestly, protect your findings and leave!

Disclaimer: This guide is based on the author's own research, knowledge and experience in the subject matter and references used from various P&I LP bulletins and should only be used for reference rather than being taken as a legal advice for any particular case or used for any other purpose.

Image Credits - Courtesy of Capt. S.Q. Navqi (Exclusive Associate of Bunker Detective) & Bunker Detective

Bunker Detective - a marine surveying and consultancy firm, is an exclusive division of AVA Marine Group Inc. (incorporated in 2012 in British Columbia) which is able to provide 211B Surveys (also commonly known as Bunker Detective Surveys) in order to find conceal bunkers onboard and at the same time ensuring that only the best marine surveying and business ethics are practiced.

Bunker Detective is primarily aimed at providing ship charterers' & bunker brokers deal with bunker quantity disputes (which does not fall under P&I cover for charterers'), however, it also provide an exclusive service to ship charterers' dealing with and intervening in an event of 'Bad' Bunker dispute claims i.e. bunker contamination and consequential liabilities arising from the supply of off- specification fuels which may give rise to P&I related claims.

The company provides a comprehensive range of specialist marine surveying & consultancy services and can arrange survey needs anywhere in Canada or overseas. It could also be deployed globally at a short notice should it be required.

Bunker Detective is also a corporate member of The International Bunker Industry Association (IBIA).

Special thanks to

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The Bunker Detectives®

www.bunkerdetective.com