# Influence of squat phenomenon on the fuel oil stock on board.

Despite of slump in prices the fuel oil control on board of the vessels and the fuel oil delivery continue to occupy one of the first places the Charterer expenses optimization. In most cases, special attention is paid to control the amount of fuel oil delivered from the barge. Sounding of ship's tanks is an integral procedure of bunkering. Cases when surveyors find surplus or shortage of fuel oil are not very rare. The number of surplus/shortage may vary depending on the quality of survey, volume of tanks, etc.

The reasons of excess or shortage of fuel are:
- Incorrect management of fuel oil on board
- Manipulation with fuel.

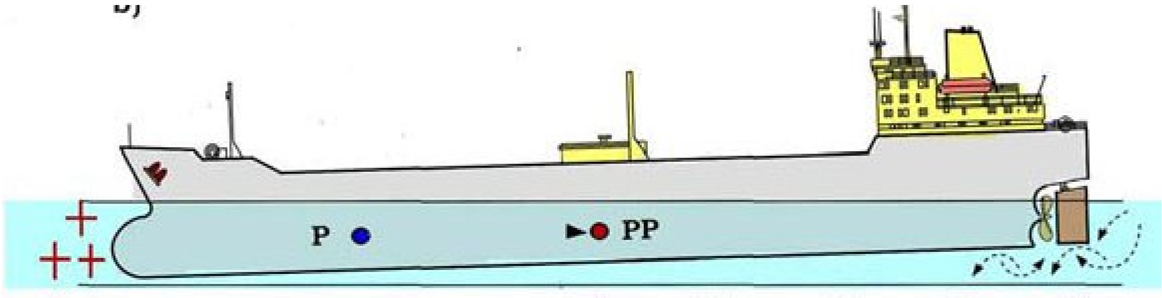
Discussing of the wrong fuel accounting, we are confronted with squat phenomenon.

Squat is a sinkage phenomenon that occurs when a change in pressure is caused on the ship's hull due to acceleration of water as it flows past the ship. The squat phenomenon is defined as the increase in the ship's draft due to combined sinkage, pitch and roll. Squat is directly related to the UKC (under keel clearance) and calculated by navigators to determine whether the safe passage of a vessel in the specific areas of navigation (shallow water).

There are three main effects of squat:
- A decrease in under keel clearance;
- A trimming effect, generally by the bow for vessels with a Cb of more than 0.7, or by the stern for finer lined ships
- Listing if shallow water is passed on one side of the vessel only. This can result of grounding at the turn of the bilge.

There are several factors which determine the amount of squat likely to be experienced: The speed of the vessel through the water (or the water past the vessel);
The blockage factor – which is the ratio between the cross sectional area of the vessel to the cross sectional area of the waterway;
The vessel’s block coefficient - Cb.
Note:
The Cb of large tankers will be between 0.80 and 0.85.
The Cb of smaller tankers will be less and for fine lined gas carriers will be between 0.65 and 0.70.
The Cb of cargo and passenger vessels will normally fall within the 0.65 to 0.8 range.

Speed is the most influential factor governing squat so if any of the above tendencies are observed a reduction in speed will be the most prudent course and will have an immediate effect.
Generally a vessel will experience squat more at the bow than at the stern.




Squat information relevant to the vessel for both loaded and ballast passages should be readily available on the bridge in tabular form.

Squat can be calculated using a variety of formulae, most of which require information which is not readily available to the mariner.
A simple method of calculating maximum squat is:
In confined waters: Cb x V2 / 50
In open waters: Cb x V2 / 100

Where:
V is the speed in knots
Cb is the displacement / L x B x D
L is the length between perpendiculars
B is the extreme breadth underwater
D is the draft corresponding to the displacement

Very often chief engineers do not take into account the influence of the squat on the vessel's trim, which leads to errors in the calculation of the amount of fuel on board at the time of sea passage.
Three common mistakes:
-squat is not considered at all. Control measurements of the fuel are produced according to the times the draught of the vessel at the time of the departure from the port of loading;
-squat is taken into account on approximate manner (by eye);
-squat is considered, but it is used incorrectly.

While the vessel (Cb > 0.7) sails with squat at bow a fuel oil accumulates in the forward part of the fuel tank. During the measurement of the fuel oil level through the sounding pipe at the aft side of the tank crew acknowledges that the level has dropped. Shortage of fuel in the tank is discarded by increased fuel oil consumption of the main engine. The control sounding of the tanks before bunkering operations shows that "shortage" pops up as surplus, because the squat phenomenon has tendency to reduce when vessel decreases speed or stops.
If the error is small, the surplus fell within the permitted limit of 20 Mt (1% for 2000 mt of FO and 0.5% - over 2000 mt). In case of exceeding the allowed limit, the excess must be declared and inserted in the engine log book.

In case of detection that some amount of fuel oil was hidden the serious disciplinary sanctions against of responsible person can be undertaken.

To avoid this situation, Chief Engineer in the calculation of the amount of fuel in the absence of the necessary data on draught, must request information from the bridge, where it is placed in tabular forms.

In Appendix 1 below the text the operator can find some useful information related to squat phenomenon .

The lack of attention to this phenomenon from chief engineer can cause some operational problems such as:

- The crew unable to take all requested bunker in case of bunkering vessel's tanks to 98% due to fact that surplus of fuel oil suddenly appeared in the tanks
- Disciplinary sanctions from Charterer if hidden fuel oil was found on board

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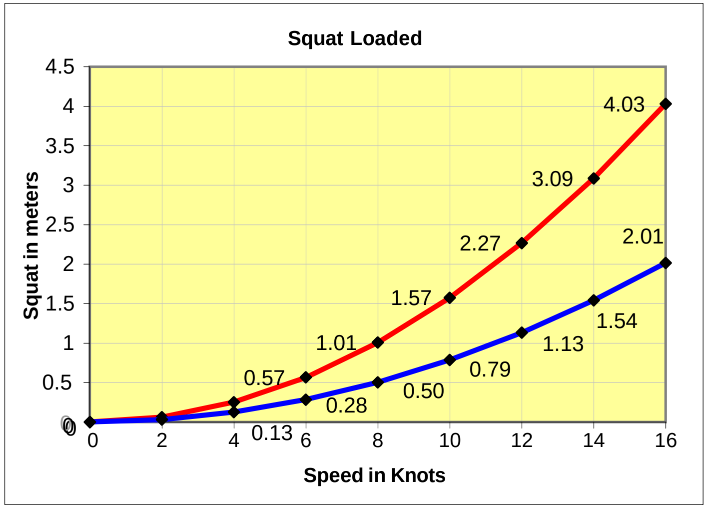
## Appendix 1:

# Squat Calculation Display

| | | | | | |
|---|---|---|---|---|---|
| Vessel: | Containership | Displ. Loaded: | 17,000 | Length: | 120 |
| Date: | 01-May-15 | Displ. Ballast: | 8,000 | Breadth: | 20 |

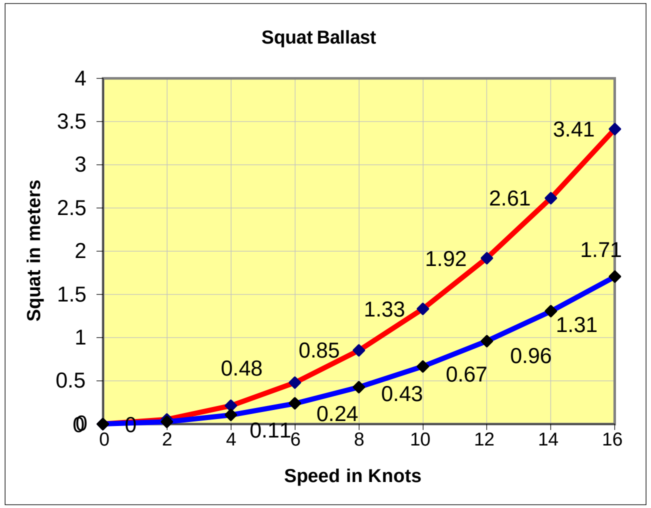
| | |
|---|---|
| Loaded Draft: | 9 |
| Ballast Draft: | 5 |




| **Squat Loaded** | | Speed | **Squat Ballast** | |
|---|---|---|---|---|
| Confined | Open | knots | Confined | Open |
| 0 | 0 | 0 | 0 | 0 |
| 0.06 | 0.03 | 2 | 0.05 | 0.03 |
| 0.25 | 0.13 | 4 | 0.21 | 0.11 |
| 0.57 | 0.28 | 6 | 0.48 | 0.24 |
| 1.01 | 0.50 | 8 | 0.85 | 0.43 |
| 1.57 | 0.79 | 10 | 1.33 | 0.67 |
| 2.27 | 1.13 | 12 | 1.92 | 0.96 |
| 3.09 | 1.54 | 14 | 2.61 | 1.31 |
| 4.03 | 2.01 | 16 | 3.41 | 1.71 |

**Calculated $C_b$ (loaded) =** 0.7870

**Calculated $C_b$ (ballast) =** 0.6667



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