Exceeding Expectations

In a perfect world, the product level of vessels upon completion of load / discharge would be perfectly level. Since we don't live in a perfect world, the product level line of vessels upon completion of load / discharge can be shifted in any direction. Trim is the condition of a vessel with reference to its longitudinal position in the water. It is the difference between forward and aft drafts and is expressed as vessel being "by the head" or "by the stern." Trim forward is called 'by the head' and trim aft is called 'drag'.

Gauging product volumes under these conditions requires the use of what the industry terms a wedge formula or a trim correction.

Wedge formula: An equation relating the volume of liquid material in a ship's tank to the dip, ship's trim, dipping point location and the tank's dimensions when the ship's calibration tables cannot be applied. To derive the equation, assumptions have to be made. The major assumption in the derivation is that the material is free flowing and will accumulate in the aft end of a tank when the ship is trimmed by the stern. The wedge formula is to be used only when the liquid does not touch all bulk heads of the vessel's tanks.

Trim Correction - The trim correction applied to the observed gauge or observed volume in a vessel's tank when a vessel is not on an even keel provided that the liquid is in contact with all bulkheads in the tank. Correction for trim may be made by referencing trim tables for each tank or by mathematical calculation.

Trim or Wedge corrections… when and when not to use them.

Corrections on loaded vessels:

Gauging procedures are not altered for vessels which are out of trim. In situations where both trim and list exist, every effort should be made to eliminate one or both conditions. On vessels where the reference gauge points are located at the center of the tank, trim will not significantly affect the gauge readings or the reference heights. Where the reference gauge points are located toward the after or forward ends of the tanks, trim corrections must be applied to obtain the correct volumes. Apply the trim correction by using the trim correction tables or instructions listed in the vessel's official Capacity Tables. If the necessary information is not listed in the Capacity Tables, manual calculations will be required.

Gauging for free water on out of trim vessels presents special problems because free water may not be measureable at the usual gauging points. If, for example, the vessel is trimmed by the stern, and the gauge points are located at the forward end of the tank, free water will have moved in the general direction of the trim and thus may not be detected. If free water is detected, the gauge reading will need to be corrected for trim. This can be done in the usual manner by reference to the Trim Correction Tables. However, great care should be exercised when correcting free water gauges from trim tables. If the trim correction is greater than the innage at the reference gauge point, the wedge formula should be used to calculate the free water volume. Where a vessel is out of trim and listed, more extensive methods may need to be used to obtain a gauge of free water. This could involve, but is not limited to, gauging from locations other than the reference gauge point.

A Basic trim correction calculation:

$$Sc = S \pm \left\{ \frac{(L \times T)}{LBP} - \frac{(D - S) \times T^2}{(LBP)^2} \right\}$$

Where:

D	tank height from the reference gauge point
S	observed gauge
L	distance of the gauge point from the center of tank
Sc	trim corrected gauge
LBP	length between perpendicualrs
T	trim of vessel

Note: The bracketed quantity is added when the gauge point is forward and subtracted when aft of the center of the tank.

Gauging for OBQ/ROB:

Before taking any OBQ/ROB measurements, record the trim and list of the vessel. The vessel should be requested to eliminate or minimize any list.

All spaces on board the vessel that could contain OBQ/ROB shall be gauged and quantified prior to loading and after discharge.

Gauging OBQ/ROB at several points in a vessel compartment is very useful to establish whether material is or is not evenly distributed across a tank bottom. When multiple gauging points in a compartment are available, manual gauges from each gauge point should be taken and recorded.

OBQ/ROB Characteristics:

Care must be taken to determine the liquid or non-liquid nature of OBQ/ROB. Keep in mind that both liquid and non-liquid material may co-exist in the same vessel compartment.

Liquid material may include any one or a combination of liquid petroleum, suspended sediment and water, or free water. The free water interface can often be measured with water-finding paste or an electronic interface detector.
When a vessel is not on an even keel, liquid volume must be quantified by trim correction, wedge table, or wedge formula. When liquid contacts all bulkheads, a trim correction must be applied to the vessel tank calibration tables, or a trim table must be used. If liquid does not contact all bulkheads, a wedge table or the wedge formula must be used. In addition liquid may lie on top of non-liquid in the same compartment. When gauging indicates the presence of both liquid and non-liquid material, the liquid volume is calculated by subtracting the non-liquid volume from the total observed volume.

Non-liquid material may also be in a wedge condition. Multipoint gauging is recommended to determine if a wedge condition exists. If the material measured is not a wedge, the average of the multiple readings should be used for volume determination. However, if only one gauge point is available, the material shall be assumed to be evenly distributed over the tank bottom.

There are many different configurations that may be present in cargo tanks during an OBQ/ROB inspection:

a) Non-liquid only
b) Single liquid in contact with all four bulkheads
c) Single liquid in contact with three bulkheads only
d) Single liquid above non-liquid
e) Two liquids (oil and water)
f) Two liquids (oil and water) with a non-liquid lower layer

Basic Wedge Formula Calculation

Calculate the adjusted Sounding

Step 1: "A"

$A = \{ (U - (D \times F)) \times F\} + S$

Where:

A = adjusted innage at aft bulkhead

U = distance from aft bulkhead to Gg. Pt.

DF = ref. gauge height (D) x trim factor (F)

F = trim factor ÷ LBP

S = observed innage gauge

Verify the existance of wedge

Step 2: condition

$\frac{A}{F}$ = length of wedge

(if result is greater than tk length wedge does not exist)

Step 3:

Divide "A" by 2 and extract volume from vessel strapping base on even keel.

Step 4: Calculation of wedge volume

$$\frac{Tv \times A}{L \times F} = \text{Wedge Volume}$$

Where:

Tv = table volume (vessel ullage tables)

A = adjusted innage at aft bulkhead

L = length of compartment (tank)

F = trim factor (trim divied by LBP)

If you think this is confusing, please see attachment…, it gets even more involved.

Due to the complexity of this subject matter, anyone requiring further information, please call us at 1(800) 286-2208 and ask for Jimmy Cormier or email Jimmy direct jcormier@amspecllc.com