INTERNATIONAL STANDARD

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Crude petroleum and petroleum products — Transfer accountability — Assessment of on board quantity (OBQ) and quantity remaining on board (ROB)

Pétrole brut et produits pétroliers — Prise en compte des quantités chargées ou déchargées — Détermination de la quantité à bord (OBQ) et de la quantité restant à bord (ROB)

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Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 8697 was prepared by Technical Committee ISO/TC 28, *Petroleum products and lubricants*, Subcommittee 6, *Bulk cargo transfer, accountability, inspection and reconciliation*.

This International Standard takes into account and supersedes ISO/TR 8338:1988, *Crude petroleum oil — Transfer accountability — Method for estimation on ships of total quantity remaining on board (ROB)*, which is withdrawn.

Annex A of this International Standard is for information only.

Introduction

This International Standard is intended to encourage uniformity of measurement, accounting and reporting procedures of “On Board Quantity” (OBQ) and the quantity “Remaining on Board” (ROB).

All safety precautions should be in accordance with the *International Safety Guide for Oil Tankers and Terminals* (ISGOTT) [4] and regulations specified by the vessel or terminal operator and any statutory authorities who may be concerned.

The inclusion of clingage, hydrocarbon vapours, and the contents of associated pipeline and pumps as part of OBQ and ROB, have been considered. However, methods for the calculation of those quantities are not sufficiently accurate to justify their inclusion in the assessment of OBQ or ROB.

Crude petroleum and petroleum products — Transfer accountability — Assessment of on board quantity (OBQ) and quantity remaining on board (ROB)

WARNING — The use of this International Standard may involve hazardous materials, operations and equipment. This International Standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this International Standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This International Standard specifies a method for assessing small volumes of material in the cargo tanks of marine tanker vessels prior to loading (OBQ) or upon completion of discharge (ROB) by manual gauging.

It is not applicable to the estimation of clingage, hydrocarbon vapours or the contents of associated pipelines or pumps.

2 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply.

2.1
clingage
material which adheres to the surface of tank walls and structures, both horizontal and vertical, within empty cargo tanks other than bottom surfaces

2.2
list
transverse inclination of a ship

2.3
on board quantity
OBQ
sum of liquid volume and non-liquid volume in cargo tanks just before loading, excluding clingage, hydrocarbon vapours and the contents of associated pipelines and pumps

2.4
quantity remaining on board
ROB
sum of liquid volume and non-liquid volume in cargo tanks just after completion of discharge, excluding clingage, hydrocarbon vapours and the contents of associated pipelines and pumps

2.5
liquid volume
measurable amount of material which is free-flowing at the time of measurement

NOTE The material can be oil or free water, or both.

2.6
non-liquid volume
measurable amount of material which is not free-flowing at the time of measurement

NOTE It can include any one or a combination of hydrocarbon waxes, water/oil emulsions, inorganic materials, or solidified cargo.

2.7
trim
difference between the fore and aft draught of the vessel

NOTE When the aft draught is greater than the forward draught, the vessel is said to be trimmed by the stern. When the aft draught is less than the forward draught, the vessel is said to be trimmed by the head.

2.8
wedge formula
mathematical means to assess small quantities of measurable liquid and/or non-liquid material which is in a wedge configuration and does not touch all the bulkheads of the vessel's tank

NOTE The formula is based on cargo compartments characteristics of cargo compartiments, vessel trim and the depth of the material.

2.9
wedge table
vessel's cargo tank volume table based on compartment characteristics, for use when cargo does not touch all the bulkheads of the tanks

3 Principle

The depth of any non-liquid, oil and water layers on the bottom of each tank is determined by manual gauging. Each layer in each tank is assessed to determine whether or not it is in the form of a wedge and the volume of each is calculated. The total volume of each layer in the ship is calculated and reported.

NOTE The configurations of layers (non-liquid, oil and water) that can be found are illustrated in annex A.

4 Procedure for collection of data

4.1 Measurement of OBQ shall be taken on tanks that are ready for loading on arrival of the vessel and/or presented ready for loading after deballasting operations.

If it is an operational requirement to commence loading prior to completion of all deballasting operations from cargo tanks, it is necessary to conduct OBQ measurement on those tanks that contain ballast at the appropriate intermediate stage in the operation.

Measurement of ROB shall be taken on tanks on completion of discharge operations and before ballasting operations.

If it is an operational requirement to commence ballasting some cargo tanks prior to completion of discharge of cargo from other tanks, it is necessary to carry out ROB measurements on tanks at the appropriate intermediate stage in the operation prior to ballasting the affected tank.

All measurements shall be taken with instruments calibrated with traceability to national or International Standards.

4.2 It shall be ascertained whether the vessel is provided with wedge-capacity tables.

NOTE The wedge-capacity tables should be independently certified.

If wedge-capacity tables are not available, the distance, Y, from the gauge position to the aft bulkhead of the tank shall be determined for wedge calculations. This distance may be established by reference to the vessel's plans or by direct measurement. The length, L_S, of the ship between perpendiculars shall be recorded from the vessel's plans. The length, L_t, of the tank shall be recorded.

4.3 Before taking any OBQ or ROB measurements, the vessel shall be required to eliminate list. The vessel's trim shall be determined and recorded.

4.4 Before taking any OBQ or ROB measurements, pipelines and pumps shall be drained. One of the vessel's tanks shall be designated to receive the material drained from all the lines and pumps. The designated tank shall be at the end of the vessel with the deepest draught and shall be the smallest cargo tank in which the material can be measured. The designated tank shall be gauged before and after line and pump draining and the measurements recorded. The measurements obtained after line and pump draining shall be used for the calculation of OBQ or ROB.

4.5 All tanks on board the vessel that may contain OBQ or ROB shall be gauged.

4.6 The OBQ or ROB quantities in each tank shall be measured from at least four positions.

If less than four positions are available, a note of protest shall be lodged with the vessel indicating that the vessel is inadequately equipped to allow measurement in accordance with this International Standard. In this case, the OBQ or ROB quantity in each tank shall be measured from all the available positions.

One of the positions shall be the reference gauging position as defined in the vessel's tank capacity table.

NOTE The other positions should be those which complement the reference gauging position so that measurement can be made close to the geometric centre of the tank and close to the suction in each tank.

4.7 All measurements shall be taken manually with a dip-tape and weight that is capable of measuring the material depth and overall height of the compartment. Electrical equipment shall not be used.

4.8 Measure the OBQ or ROB depth by direct dipping. At the same time, measure the overall height of the tank and record it. Compare the measured overall height with the tank height, H (which shall be also recorded), given in the vessel's capacity tables to check that the tank bottom has been reached.

If the tank bottom has not been reached, measurements from other positions are preferred. Alternatively, it may be necessary to rely on ullage(s).

NOTE Reference heights given in a vessel's tank-capacity tables can significantly change during a vessel's time in commission. It is generally the case that vessel tank capacity tables will only include a reference height for the reference gauging position. The use of ullage measurement for OBQ and ROB should therefore be treated with caution and only used if it can be established by reference to a loaded tank condition that there has been no change in the measured reference height.

4.9 The nature of the material on the dip-weight after dipping shall be visually examined to determine if liquid or non-liquid is present in each tank. If liquid is present, a water dip shall be taken. Record the depth(s) and the nature of the material(s). If both liquid and non-liquid material coexist in the same tank, record the depth of each.

NOTE Where liquid is lying on top of solidified material, careful assessment is needed as the liquid may run down and obscure that part of the dip-weight which should show solidified material.

It shall be ascertained whether solidified material (for example, crude oils with high pour points or heavy residues) is present. If solidified material is present and the trim of the vessel at the time of solidification is known, this trim shall be recorded (see 5.6).

4.10 If a sufficient oil depth is found, its temperature shall be measured and recorded.

NOTE 1 It is recommended that a portable electrical temperature probe be used to determine temperatures.

NOTE 2 The recorded temperature may be used if it is required to calculate oil volumes at a standard temperature, using the procedures given in ISO 91-1 [1] or ISO 91-2 [2].

4.11 If sufficient OBQ or ROB depth is found, a sample shall be obtained. If a sample is taken, this shall be recorded and reported. The sample(s) shall be retained to assist in the resolution of any dispute.

NOTE Samples should be obtained from liquid and non-liquid material. If sufficient material is available, sampling should be carried out in accordance with ISO 3170 [3].

5 Calculations

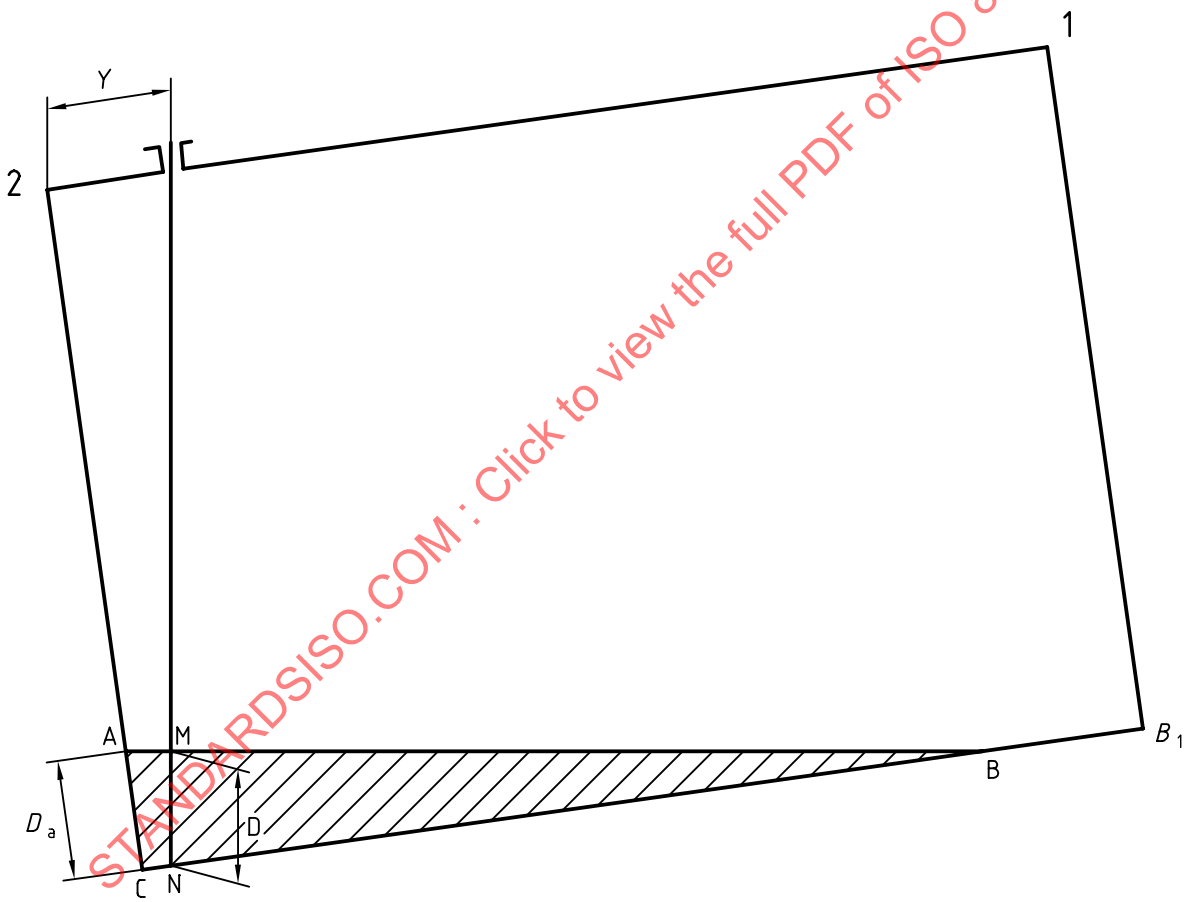
5.1 General

Small volumes of liquid which do not contact all the bulkheads form a wedge on the tank bottom as illustrated in Figure 1. The quantity is calculated using a wedge table (see 4.2) or, if this not available, the calculations in 5.3, 5.4, and 5.5 (referred to as the “wedge formula”) shall be used.

The wedge-formula calculation ascertains whether a liquid volume forms a wedge on the tank bottom or on a non-liquid layer by examination of a calculated coefficient K (see 5.3.2). The situation of “liquid wedge on a non-liquid layer” requires usage of the wedge formula to obtain the required quantity. The special case where there may be a non-liquid wedge is covered in 5.6.

It is assumed that for non-liquid material, although lying in irregular depths on the tank bottom, an average value for the depth can be obtained from multiple readings.

All units shall be consistent.



Key

1 Forward

2 Alf

L_t = length of tank = CB_1

D = observed dip = MN

D_a = corrected dip (AC for triangle ABC)

Y = distance between measurement point and aft bulkhead

NOTE The wedge is represented by the triangle ABC. The maximum wedge would occur when the length of the wedge extends to B_1, the position of the forward bulkhead.

Figure 1 — Illustration of material in a wedge configuration

5.2 Non-liquid material not forming a wedge

5.2.1 Determine the average depth of non-liquid material by calculating the arithmetic average of all the observed dips of the non-liquid material taken at each position in the tank. If only one position was available, the measured dip shall be taken as the average depth.

5.2.2 Determine the non-liquid volume by entering the relevant tank capacity table using the average depth obtained in 5.2.1, without applying any trim correction.

5.3 Total liquid material

5.3.1 Subtract the average non-liquid depth calculated in 5.2.1 from the total dip determined at the aft-most hatch to give the observed liquid dip at this hatch.

5.3.2 If wedge-capacity tables (4.2) are available, they shall be used to determine the total volume of liquid material in the tank.

If wedge-capacity tables are not available, the total volume of liquid material in the tank shall be calculated using the following procedure.

Calculate the corrected liquid dip, D_a, at the aft end using the following equation:

$$D_a = D + F(Y - HF)$$

where

D is the observed liquid dip at the aft end, obtained in 5.3.1;

Y is the distance of the dip hatch from the aft-end bulkhead of the tank;

H is the reference tank height;

F is the trim correction factor defined as T_s/L_s;

T_s is the trim of the ship;

L_s is the length of the ship between perpendiculars.

NOTE For vessels trimmed by the head, the value for Y is the distance from the dip hatch to the forward bulkhead as opposed to the aft bulkhead. This calculation is termed a reverse wedge.

Calculate the tank constant, C_t, using the following equation:

$$C_t = \frac{1}{F \times L_t}$$

where L_t is the length of the tank.

Calculate the coefficient, K, from the corrected dip, D_a, using the following equation:

$$K = D_a \times C_t$$

If $K \geqslant 1{,}0$, there is no wedge.

If $K < 1{,}0$, there is a wedge.

If $K \geqslant 1{,}0$, calculate the volume of liquid contained in the tank from the tank-capacity table, if necessary applying the trim correction.

If $K < 1{,}0$, calculate $D_a/2$.

Enter the calculated value, $D_a/2$, into the tank-capacity table without applying any trim correction, to obtain the volume, V_o.

The liquid wedge volume is equal to $V_o \times K$.

5.4 Free-water volume

5.4.1 Subtract the average non-liquid depth calculated in 5.2.1 from the water dip determined at the aft-end hatch to give the observed water dip at this hatch.

5.4.2 If wedge-capacity tables (4.2) are available, they shall be used.

If wedge-capacity tables are not available, the volume of free water in the tank shall be calculated using the following procedure.

Calculate the corrected water dip, D_{aw}, at the aft end using the following equation:

$$D_{aw} = D_w + F(Y - HF)$$

where D_w is the observed water dip at the aft end, obtained in 5.4.1.

Calculate the tank constant, C_t, in accordance with 5.3.2.

Calculate the coefficient, K, from the corrected dip, D_{aw}, in accordance with 5.3.2.

If $K \geqslant 1{,}0$, calculate the free-water volume of liquid contained in the tank from the tank-capacity table, if necessary applying the trim correction.

If $K < 1{,}0$, calculate $D_{aw}/2$.

Enter the calculated value, $D_{aw}/2$, into the tank capacity table without applying any trim correction, to obtain the volume, V_w.

The free-water wedge volume is equal to $V_w \times K$.

NOTE If the total liquid material forms a wedge then any free water lying underneath an oily layer also forms a wedge.

5.5 Liquid oil volume

Calculate the liquid oil volume by subtracting the free-water volume determined in 5.4 from the total liquid material determined in 5.3.

5.6 Non-liquid material forming a wedge

Non-liquid material can be in a wedge condition if the material solidified when the vessel was trimmed. It is only possible to determine the volume using the wedge formula if the trim of the vessel at the time of solidification is available. If that trim is available (see 4.9), the procedure specified in 5.3 shall be used.

If the trim at the time of solidification is not available, the volume shall be considered as lying in irregular depths and determined using the procedure specified in 5.2.

NOTE It is assumed that any non-liquid material will be in contact with the bottom of the tank and that there will be no free water underneath the non-liquid material.

5.7 Calculation of OBQ or ROB

The volume of each of the following:

a) free water;

b) liquid oil;

c) non-liquid.

in all the individual tanks in the vessel shall be summed.

NOTE OBQ and ROB volumes are commonly reported at the observed temperature. Their magnitude and disposition in a tank will often preclude obtaining reliable actual temperatures and densities for conversion of volumes to standard conditions.

6 Expression of results

Report the following as either the OBQ or ROB of the vessel in cubic metres, to the nearest 0,1 m^3:

a) the total free-water volume;

b) the total liquid-oil volume;

c) the total non-liquid volume;

If the results are also expressed in other units, a similar level of significance shall be applied.

7 Report of assessment

The assessment report shall contain at least the following information:

a) a reference to this International Standard;

b) all details necessary to identify the vessel assessed;

c) all observed measurements;

d) all details necessary to identify the location of the measured volumes;

e) details of any samples taken (see 4.11);

f) the results of the assessment (see clause 6);

g) details of any notes of protest issued;

h) any deviation, by agreement or otherwise, from the procedure specified;

i) the date and time of the assessment.

Annex A
(informative)

Examples of configurations of the layers on the tank bottom

The layers of non-liquid, oil and water can be found in several combinations and configurations. Examples of some of the configurations that can be found are illustrated in Figures A.1 to A.11.

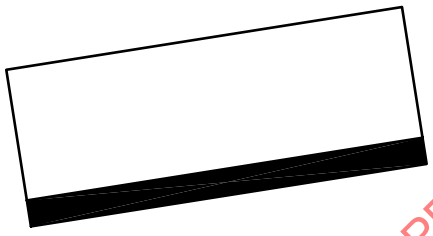


Figure A.1 — Example of a non-liquid layer only in contact with all four bulkheads

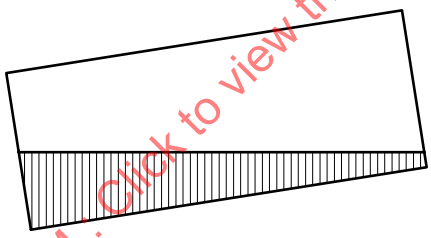


Figure A.2 — Example of a single liquid in contact with all four bulkheads

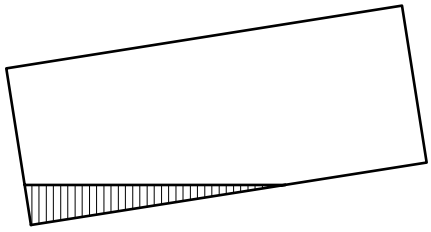


Figure A.3 — Example of a single liquid in contact with only three bulkheads

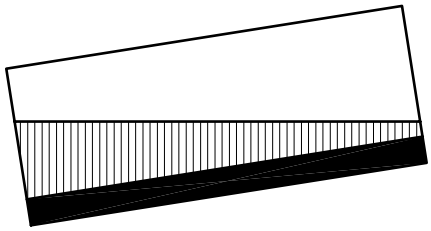


Figure A.4 — Example of a single liquid above non-liquid layer — Liquid in contact with all four bulkheads