**DRAUGHT (DRAFT) SURVEY**

1. **THEORY OF THE DRAUGHT (DRAFT) SURVEY**

The essence of the draft survey is the determination of the weight of the cargo according to the drafts of the ship. At first, it is necessary to determine t*he Constant (Const.)* When the ship is empty, the weight of cargo *Pcargo= 0.* Displacement *Do* can be calculated using (1) Formula:

*Do = 0 + ( Phfo + Pmdo + Plo) + (Pbw + Pfw) + Lightship + Const.*

*Const. = Do – ( Phfo + Pmdo + Plo) – (Pbw + Pfw) – Lightship*

**Cargo weight determination**.

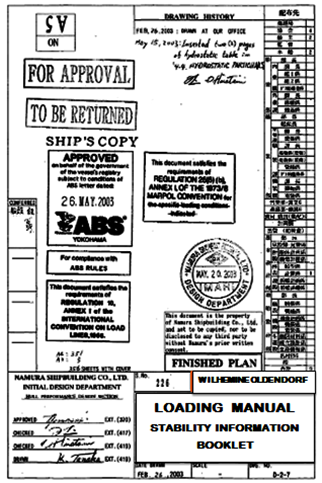
When the ship is loaded, the displacement *Dc* can be calculated using (2) Formula:

*Dc = Pcargo + ( Phfo + Pmdo + Plo) + (Pbw + Pfw) + Lightship + Const.*

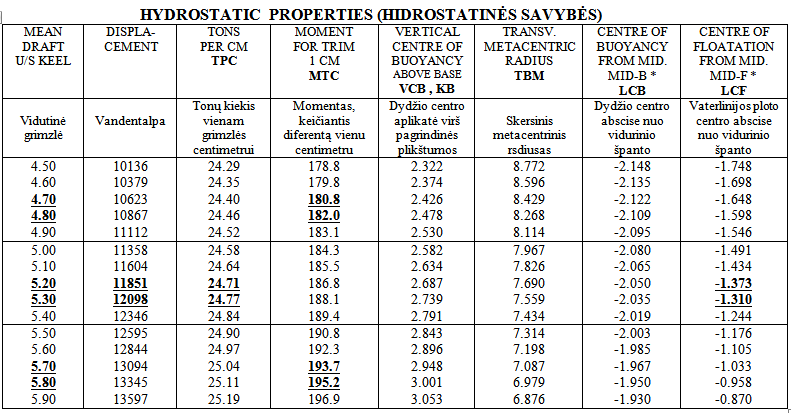
*Pcargo = Dc – ( Phfo + Pmdo + Plo) – (Pbw + Pfw) – Lightship – Const.*

UNECE - Draught Survey Code. *UN ECE - United Nations Economic Commission for Europe.* Code of Uniform Standards and Procedures for the Performance of DRAUGHT SURVEYS of Coal Cargoes

The Main Documents are Loading Manual, Stability Information Booklet, The Table of Hydrostatic Properties (see below).



**Figure 1.** Loading Manual (Stability Information Booklet)



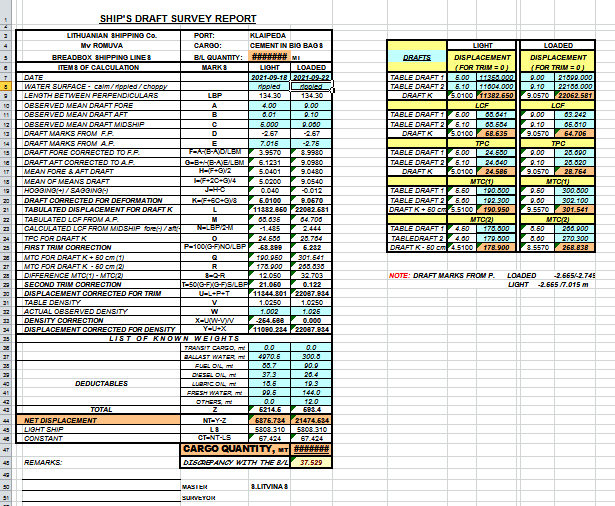
**Figure 2.** The Table of Hydrostatic Properties

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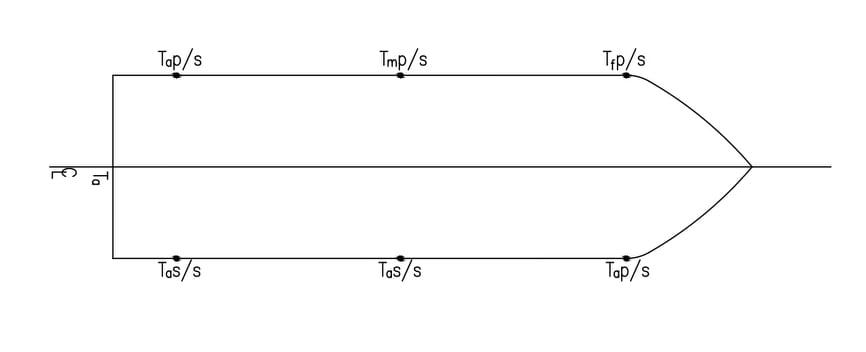
**Figure 3.** The draft survey report

1. **UNIVERSAL PROGRAM FOR DRAUGHT SURVEY, ADOPTED BY UNECE**



Steps and Formulas for Draught Survey that are adopted by UNECE.

**1-st step** - to observe six drafts:  *Tf s/s, Tf p/s,Tm s/s, Tm p/s,Ta s/s, Ta p/s*



**2-nd Step.** To measure the density of the outer water *γ*

**3-rd Step.** To calculate observed mean draughts *Tf, Ta* and *Tm*.

Observed Mean Draft Fore: Tf = ( Tf s/s + Tf p/s) / 2

 Observed Mean Draft Aft Ta = ( Ta s/s + Ta p/s) / 2

Observed Mean Draft Midship Tm = ( Tm s/s + Tm p/s) / 2

**4-th Step.** To find from the “Stability Information Booklet” - *Xf* - the distance of fore draft marks from forward perpendicular (*FP), Xa* - the distance of aft draft marks from aft perpendicular (*AP).*

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**5-th Step.** To calculate the drafts on perpendiculars *Tfp*, *Tap* andfind from the “Stability information booklet”

the *LBP* – Length Between Perpendiculars and calculate the *LBM* – Length Between Marks.

Draft fore corrected to forward perpendicular *Tfp = Tf – ΔTf* ,

where *Tf – { [( Ta – Tf ) \* Xf ] / LBM }*. Minus because of Perpendicular Fore from Mark

*ΔTf =* ***–*** *{[( Ta – Tf ) \* Xf ] / LBM }*

Draft Aft Corrected to Aft Perpendicular:

*Tap = Ta + ΔTa =* *Ta + { [( Ta – Tf ) \* Xa ] / LBM }*

Plus because of Perpendicular to Aft from Mark

*ΔTa = + {[( Ta – Tf ) \* Xa ] / LBM },*

where Length Between Marks (*LBM) = LBP – ( Xf + Xa )* = *LBP –Xf –Xa*

**6-th Step.** To calculate mean Draft on Perpendiculars *Tfap* and determinate if there is hogging ( + ) or Sagging ( – )

*Tfap = ( Tap + Tfp ) / 2*

**7-th Step.** To calculate: *Tmm* - mean Corrected Draft

*Tmm = ( Tfp + 2Tm + Tap ) / 4*

**8-th Step.** To calculate mean of means *T*

*T = ( Tfp + 6Tmm + Tap ) / 8*

**9-th Step.** To determinate 1-st Correction.  According to calculated *T* (Mean of Means) it is necessary using Hydrostatic Properties to determinate by Interpolation. *LCF* = Centre of Flotation from Mid. (Longitudinal Centre of Flotation) and*TPC* = Tons per Centimeter of Immersion”

*1-st Corr. =*

**10-th Step.** To determinate 2-nd Corr. MTC = Moment for Trim 1 centimeter. Using Hydrostatic Properties it is necessary to determinate by Interpolation:

**MTC(T+50cm)** = The MTC for *T(Mean of Means)*and plus 50 centimeters ( T + 50 )

**MTC(T – 50cm)** = The MTC for *T(Mean of Means)*and minus 50 centimeters ( T – 50 )

*2-nd Corr. =*

**11- th Step.** To calculate the Displacement Corrected for Trim *Dt*

***D(T)*** = the Displacement from Hydrostatic Properties determinated for T (Mean of Means) by Interpolation

*Dt = D(T) + 1-st Corr. + 2-nd Corr.*

**12 – Step.** To calculate density Correction *Dγ* **,** where ***γ*** - measured Water Density, **γt** = Table Density found from Stability Information Booklet (International Meaning) **γt** = 1,025 t/cub.m. )

***Dγ*** *= Dt \* ( γ – γt ) / γt*

**13 – Step.** To Calculate Final Displacements *Do* or *Dc*

Displacements Corrected for Density:

***Do*** *= Dt + Dγ* or***Dc*** *= Dt + Dγ*

*Constant =* ***Do*** *– ( Phfo + Pmdo + Plo) – (Pbw + Pfw) – Lightship*

*Pcargo =* ***Dc*** *– ( Phfo + Pmdo + Plo) – (Pbw + Pfw) – Lightship – Const.*

1. **DRAUGHT SURVEYS PRACTICE**

The master of the vessel should be advised in advance that a draught survey will be carried out. If this is an initial survey of a lightship, he should be asked, subject to the safety of the vessel, to ensure that the individual ballast tanks are either completely full or empty that the vessel stands upright and has a trim that is within the tank calibration tables. It is essential that cooperation between independent surveyors and ship officers takes place during draught surveys. Before carrying out the survey it is recommended that the surveyor takes time to examine the general layout plan to confirm the number and location of the various ballast, freshwater and oil bunker tanks on the ship. Equipment that can be used in the survey (www.bulkcarrierguide.com):

1. Strong torch
2. Patented draught mark indicator or measuring devices (tubes, indicators, etc.)
3. Calibrated inclinometer or manometer
4. Steel tape measure with plumb bob / stainless steel tape measure with brass plumb bob (preferably calibrated)
5. Sufficient volume bucket for seawater sampling
6. Calibrated patent hydrometer for draft survey
7. Calibrated salinity refractometer
8. Ballast water sampling device
9. Computer/calculator.

A well-conducted draught survey under reasonable prevailing conditions is capable of achieving an absolute accuracy of +/- 0.5%

**References:**

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4. UNECE (1992). *Standards and Procedures for the Performance of Draught Surveys of Coal.* <https://unece.org/fileadmin/DAM/energy/se/pdfs/coal/1992_UNECE_Draught_> Survey\_Code\_January\_1992\_E.pdf