DRAFT (DRAUGHT) SURVEY

Study material

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1. THEORY OF THE DRAFT (DRAUGHT) 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 $P_{cargo} = 0$. Displacement D_o can be calculated using (1) Formula:

(1)

$$D_o = 0 + (P_{hfo} + P_{mdo} + P_{lo}) + (P_{bw} + P_{fw}) + Lightship + Const.$$
$$Const. = D_o - (P_{hfo} + P_{mdo} + P_{lo}) - (P_{bw} + P_{fw}) - Lightship$$

Cargo weight determination. When the ship is loaded, the displacement D_c can be calculated using (2) Formula:

(2)

$$D_c = P_{cargo} + (P_{hfo} + P_{mdo} + P_{lo}) + (P_{bw} + P_{fw}) + Lightship + Const.$$
$$P_{cargo} = D_c - (P_{hfo} + P_{mdo} + P_{lo}) - (P_{bw} + P_{fw}) - Lightship - Const.$$

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 (Fig. 1, 2, 3).

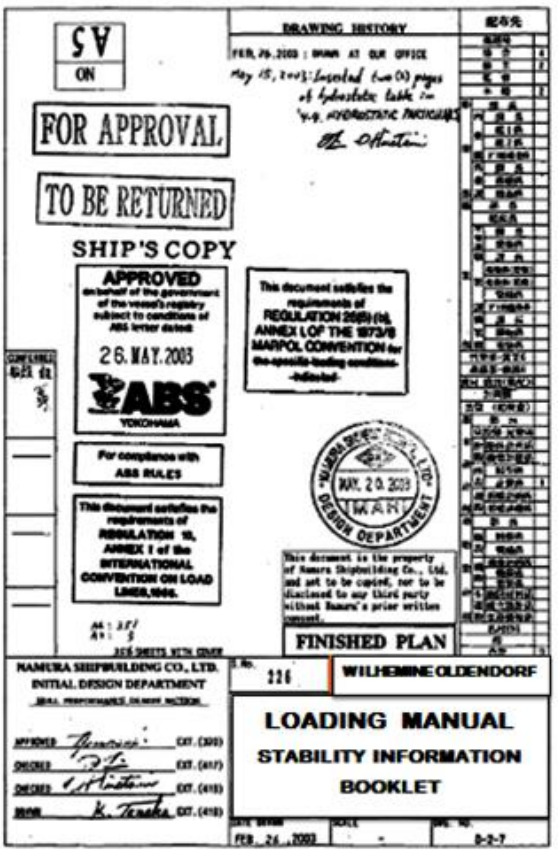
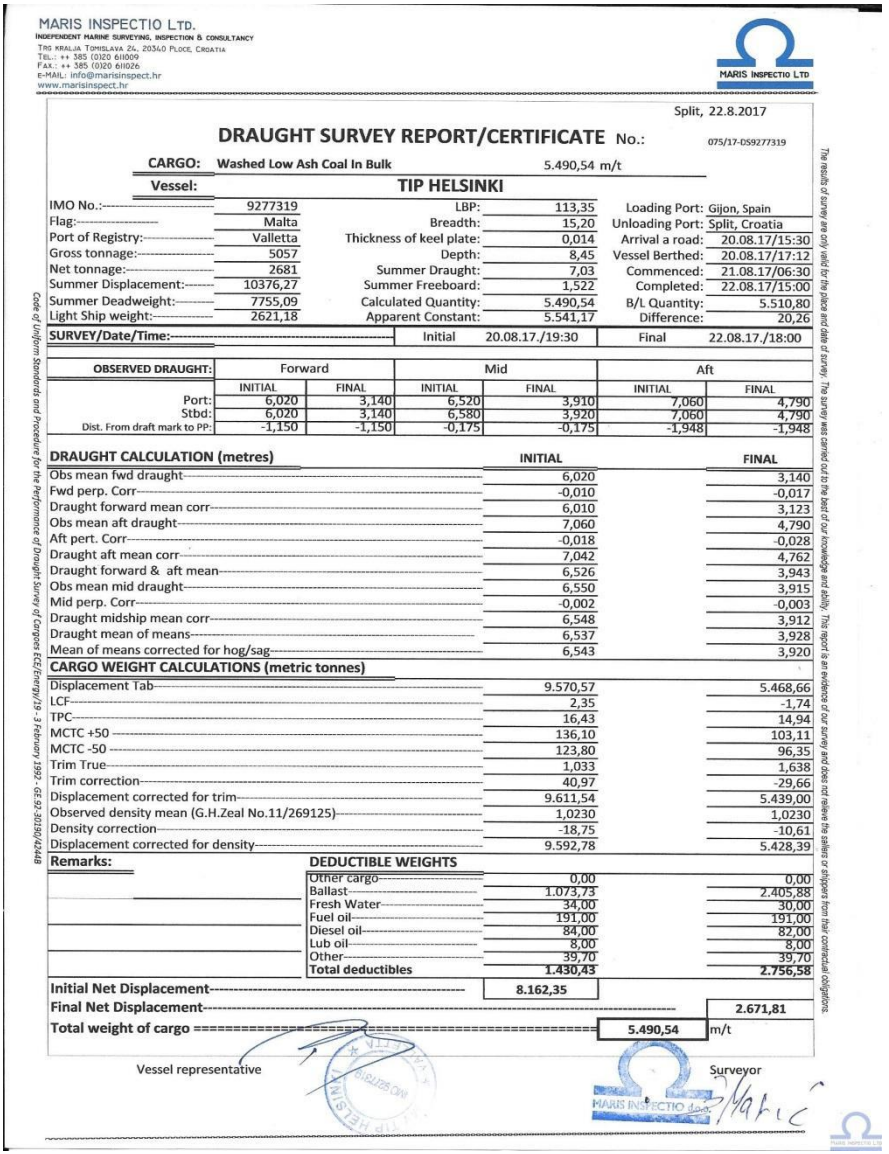


Fig. 1. Loading Manual (Stability Information Booklet)

MEAN DRAFT U/S KEEL	DISPLA-CEMENT	TONS PER CM **TPC**	MOMENT FOR TRIM 1 CM **MTC**	VERTICAL CENTRE OF BUOYANCY ABOVE BASE **VCB , KB**	TRANSV. METACENTRIC RADIUS **TBM**	CENTRE OF BUOYANCY FROM MID. MID-B * **LCB**	CENTRE OF FLOATATION FROM MID. MID-F * **LCF**
Vidutinė grimzlė	Vandentalpa	Tonų kiekis vienam grimzlės centimetrui	Momentas, keičiantis diferentą vienu centimetru	Dydžio centro aplikatė virš pagrindinės plikštumos	Skersinis metacentrinis rsdiusas	Dydžio centro abscise nuo vidurinio španto	Vaterlinijos ploto centro abscise nuo vidurinio španto
4.50	10136	24.29	178.8	2.322	8.772	-2.148	-1.748
4.60	10379	24.35	179.8	2.374	8.596	-2.135	-1.698
4.70	10623	24.40	**180.8**	2.426	8.429	-2.122	-1.648
4.80	10867	24.46	**182.0**	2.478	8.268	-2.109	-1.598
4.90	11112	24.52	183.1	2.530	8.114	-2.095	-1.546
5.00	11358	24.58	184.3	2.582	7.967	-2.080	-1.491
5.10	11604	24.64	185.5	2.634	7.826	-2.065	-1.434
5.20	**11851**	**24.71**	186.8	2.687	7.690	-2.050	**-1.373**
5.30	**12098**	**24.77**	188.1	2.739	7.559	-2.035	**-1.310**
5.40	12346	24.84	189.4	2.791	7.434	-2.019	-1.244
5.50	12595	24.90	190.8	2.843	7.314	-2.003	-1.176
5.60	12844	24.97	192.3	2.896	7.198	-1.985	-1.105
5.70	13094	25.04	**193.7**	2.948	7.087	-1.967	-1.033
5.80	13345	25.11	**195.2**	3.001	6.979	-1.950	-0.958
5.90	13597	25.19	196.9	3.053	6.876	-1.930	-0.870

Fig. 2. The Table of Hydrostatic Properties



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MARIS INSPECTIO LTD

Split, 22.8.2017

DRAUGHT SURVEY REPORT/CERTIFICATE No.: 075/17-DS9277319

CARGO:	Washed Low Ash Coal In Bulk		5.490,54 m/t		
Vessel:	**TIP HELSINKI**				
IMO No.:	9277319	LBP:	113,35	Loading Port:	Gijon, Spain
Flag:	Malta	Breadth:	15,20	Unloading Port:	Split, Croatia
Port of Registry:	Valletta	Thickness of keel plate:	0,014	Arrival a road:	20.08.17/15:30
Gross tonnage:	5057	Depth:	8,45	Vessel Berthed:	20.08.17/17:12
Net tonnage:	2681	Summer Draught:	7,03	Commenced:	21.08.17/06:30
Summer Displacement:	10376,27	Summer Freeboard:	1,522	Completed:	22.08.17/15:00
Summer Deadweight:	7755,09	Calculated Quantity:	5.490,54	B/L Quantity:	5.510,80
Light Ship weight:	2621,18	Apparent Constant:	5.541,17	Difference:	20,26
SURVEY/Date/Time:		Initial	20.08.17./19:30	Final	22.08.17./18:00

OBSERVED DRAUGHT:	Forward		Mid		Aft	
	INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL
Port:	6,020	3,140	6,520	3,910	7,060	4,790
Stbd:	6,020	3,140	6,580	3,920	7,060	4,790
Dist. From draft mark to PP:	-1,150	-1,150	-0,175	-0,175	-1,948	-1,948

DRAUGHT CALCULATION (metres)	INITIAL	FINAL
Obs mean fwd draught	6,020	3,140
Fwd perp. Corr	-0,010	-0,017
Draught forward mean corr	6,010	3,123
Obs mean aft draught	7,060	4,790
Aft pert. Corr	-0,018	-0,028
Draught aft mean corr	7,042	4,762
Draught forward & aft mean	6,526	3,943
Obs mean mid draught	6,550	3,915
Mid perp. Corr	-0,002	-0,003
Draught midship mean corr	6,548	3,912
Draught mean of means	6,537	3,928
Mean of means corrected for hog/sag	6,543	3,920
CARGO WEIGHT CALCULATIONS (metric tonnes)		
Displacement Tab	9.570,57	5.468,66
LCF	2,35	-1,74
TPC	16,43	14,94
MCTC +50	136,10	103,11
MCTC -50	123,80	96,35
Trim True	1,033	1,638
Trim correction	40,97	-29,66
Displacement corrected for trim	9.611,54	5.439,00
Observed density mean (G.H.Zeal No.11/269125)	1,0230	1,0230
Density correction	-18,75	-10,61
Displacement corrected for density	9.592,78	5.428,39

Remarks:	**DEDUCTIBLE WEIGHTS**		
	Other cargo	0,00	0,00
	Ballast	1.073,73	2.405,88
	Fresh Water	34,00	30,00
	Fuel oil	191,00	191,00
	Diesel oil	84,00	82,00
	Lub oil	8,00	8,00
	Other	39,70	39,70
	Total deductibles	**1.430,43**	**2.756,58**

Initial Net Displacement	8.162,35		
Final Net Displacement			2.671,81
Total weight of cargo		5.490,54	m/t

Vessel representative

Surveyor

MARIS INSPECTIO LTD

Code of Uniform Standards and Procedure for the Performance of Draught Survey of Cargoes EEC/Energy/19 - 3 February 1992 - GE.92-30190/42448

The results of survey are only valid for the place and date of survey. The survey was carried out to the best of our knowledge and ability. This report is an evidence of our survey and does not relieve the sellers or shippers from their contractual obligations.

Fig. 3. The draft survey report

2. UNIVERSAL CALCULATIONS OF THE DRAFT SURVEY

An example of the draft survey report provided in the Fig. 4.

SHIP'S DRAFT SURVEY REPORT

LITHUANIAN SHIPPING Co.	PORT:	KLAIPEDA	
Mv ROMUVA	CARGO:	CEMENT IN BIG BAGS	
BREADBOX SHIPPING LINE S	B/L QUANTITY:	####### MT	
ITEMS OF CALCULATION	MARKS	LIGHT	LOADED
DATE		2021-09-18	2021-09-22
WATER SURFACE - calm / rippled / choppy		rippled	rippled
LENGTH BETWEEN PERPENDICULARS	LBP	134.30	134.30
OBSERVED MEAN DRAFT FORE	A	4.00	9.00
OBSERVED MEAN DRAFT AFT	B	6.01	9.10
OBSERVED MEAN DRAFT MIDSHIP	C	5.000	9.060
DRAFT MARKS FROM F.P.	D	-2.67	-2.67
DRAFT MARKS FROM A.P.	E	7.015	-2.75
DRAFT FORE CORRECTED TO F.P.	F=A-(B-A)D/LBM	3.9570	8.9980
DRAFT AFT CORRECTED TO A.P.	G=B+(B-A)E/LBM	6.1231	9.0980
MEAN FORE & AFT DRAFT	H=(F+G)/2	5.0401	9.0480
MEAN OF MEANS DRAFT	I=(F+2C+G)/4	5.0200	9.0540
HOGGING(+) / SAGGING(-)	J=H-C	0.040	-0.012
DRAFT CORRECTED FOR DEFORMATION	K=(F+6C+G)/8	5.0100	9.0570
TABULATED DISPLACEMENT FOR DRAFT K	L	11382.650	22062.581
TABULATED LCF FROM A.P.	M	65.635	64.706
CALCULATED LCF FROM MIDSHIP fore(-) / aft(+)	N=LBP/2-M	-1.485	2.444
TPC FOR DRAFT K	O	24.556	28.764
FIRST TRIM CORRECTION	P=100(G-F)NO/LBP	-58.398	5.232
MTC FOR DRAFT K + 50 cm (1)	Q	190.950	301.641
MTC FOR DRAFT K - 50 cm (2)	R	178.900	266.535
DIFFERENCE MTC(1) - MTC(2)	S=Q-R	12.050	32.703
SECOND TRIM CORRECTION	T=50(G-F)(G-F)S/LBP	21.060	0.122
DISPLACEMENT CORRECTED FOR TRIM	U=L+P+T	11344.801	22087.934
TABLE DENSITY	V	1.0250	1.0250
ACTUAL OBSERVED DENSITY	W	1.002	1.025
DENSITY CORRECTION	X=U(W-V)/V	-264.588	0.000
DISPLACEMENT CORRECTED FOR DENSITY	Y=U+X	11080.234	22087.934
LIST OF KNOWN WEIGHTS			
DEDUCTABLES — TRANSIT CARGO, mt		0.0	0.0
DEDUCTABLES — BALLAST WATER, mt		4970.5	300.5
DEDUCTABLES — FUEL OIL, mt		55.7	90.9
DEDUCTABLES — DIESEL OIL, mt		37.3	25.4
DEDUCTABLES — LUBRIC.OIL, mt		15.6	19.3
DEDUCTABLES — FRESH WATER, mt		99.5	144.0
DEDUCTABLES — OTHERS, mt		0.0	12.0
TOTAL	Z	5214.6	593.4
NET DISPLACEMENT	NT=Y-Z	5875.734	21474.534
LIGHT SHIP	LS	5808.310	5808.310
CONSTANT	CT=NT-LS	67.424	67.424
	CARGO QUANTITY, MT		#######
REMARKS:	DISCREPANCY WITH THE B/L		37.529
	MASTER	S.LITVINAS	
	SURVEYOR		

DRAFTS	LIGHT		LOADED	
	DISPLACEMENT (FOR TRIM = 0)		DISPLACEMENT (FOR TRIM = 0)	
TABLE DRAFT 1	5.00	11365.000	9.00	21999.000
TABLE DRAFT 2	5.10	11504.000	9.10	22155.000
DRAFT K	5.0100	11382.650	9.0570	22062.581
	LCF		LCF	
TABLE DRAFT 1	5.00	65.641	9.00	63.242
TABLE DRAFT 2	5.10	65.554	9.10	65.510
DRAFT K	5.0100	65.635	9.0570	64.706
	TPC		TPC	
TABLE DRAFT 1	5.00	24.550	9.00	28.690
TABLE DRAFT 2	5.10	24.640	9.10	28.820
DRAFT K	5.0100	24.586	9.0570	28.764
	MTC(1)		MTC(1)	
TABLE DRAFT 1	5.50	190.500	9.50	300.500
TABLE DRAFT 2	5.60	192.300	9.60	302.100
DRAFT K + 50 cm	5.5100	190.950	9.5570	301.541
	MTC(2)		MTC(2)	
TABLE DRAFT 1	4.50	178.500	5.50	266.900
TABLEDRAFT 2	4.60	179.500	5.60	270.300
DRAFT K - 50 cm	4.5100	178.900	5.5570	268.838

NOTE: DRAFT MARKS FROM P. LOADED -2.665/-2.745
LIGHT -2.665 /7.015 m

Fig. 4. Ships draft survey report example

Steps and Formulas for Draft (Draught) Survey that are adopted by The United Nations Economic Commission for Europe UNECE.

1st Step - to observe six drafts (Fig. 5): $T_{f\,s/s}$, $T_{f\,p/s}$, $T_{m\,s/s}$, $T_{m\,p/s}$, $T_{a\,s/s}$, $T_{a\,p/s}$

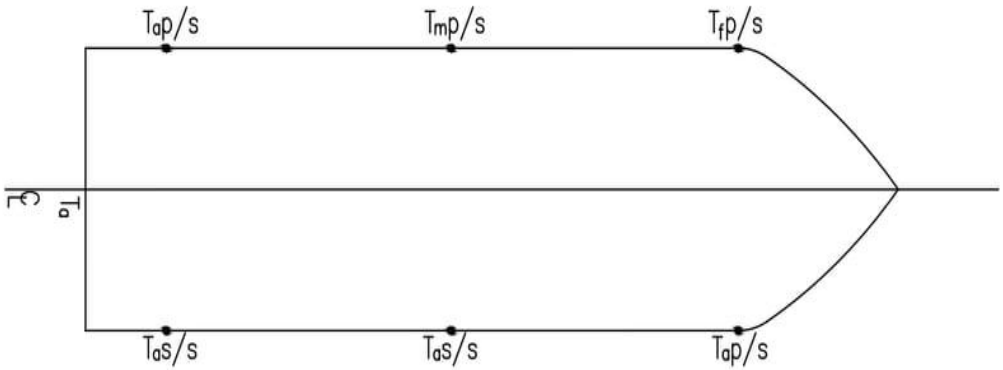

Fig. 5. Ships draft

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

3rd Step. To calculate observed mean draughts T_f, T_a and T_m.

Observed Mean Draft Fore: $T_f = (T_{f\,s/s} + T_{f\,p/s}) / 2$

Observed Mean Draft Aft $T_a = (T_{a\,s/s} + T_{a\,p/s}) / 2$

Observed Mean Draft Midship $T_m = (T_{m\,s/s} + T_{m\,p/s}) / 2$

4th Step. To find from the "Stability Information Booklet" - X_f - the distance of fore draft marks from forward perpendicular (*FP*), X_a - the distance of aft draft marks from aft perpendicular (*AP*).

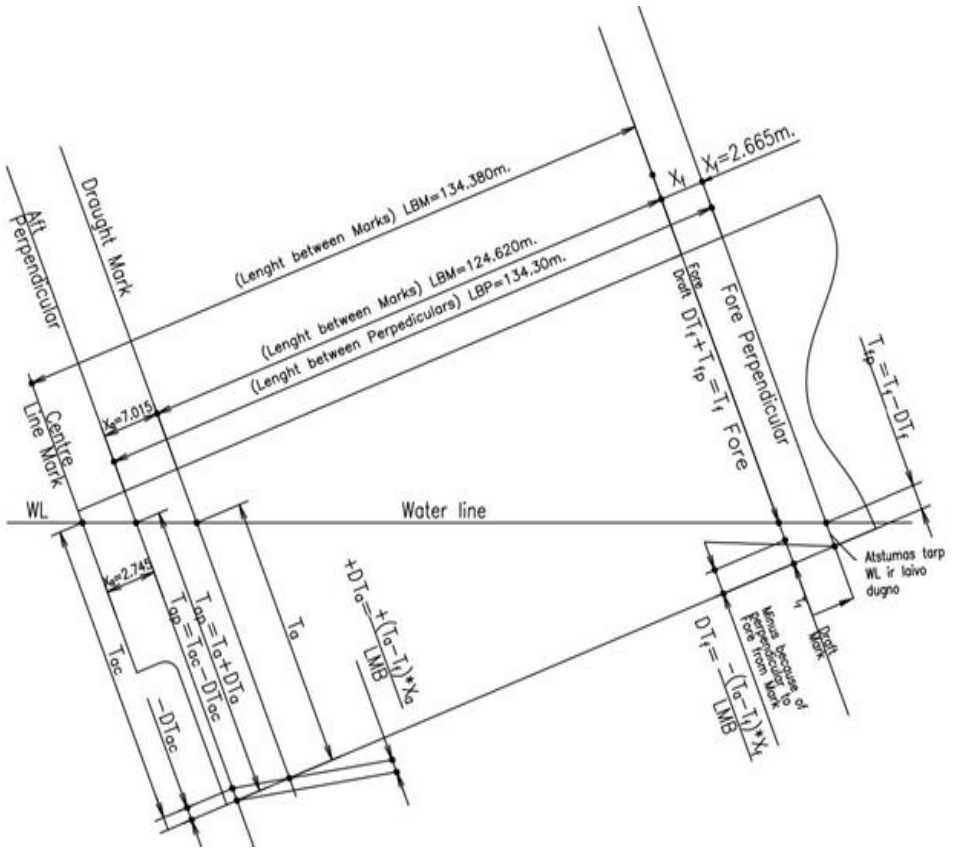

Fig. 5. Distances of the ship

5th Step. To calculate the drafts on perpendiculars T_{fp}, T_{ap} and find from the "Stability information booklet" the *LBP* – Length Between Perpendiculars and calculate the *LBM* – Length Between Marks. Draft fore corrected to forward perpendicular $T_{fp} = T_f - \Delta T_f$, where T_f – $\{ [(T_a - T_f) * X_f] / LBM \}$. Minus because of Perpendicular. Fore from Mark (3).

(3)

$$\Delta T_f = - \{ [(T_a - T_f) * X_f] / LBM \}$$

Draft Aft Corrected to Aft Perpendicular (4).

(4)

$$T_{ap} = T_a + \Delta T_a = T_a + \{ [(T_a - T_f) * X_a] / LBM \}$$

Plus because of Perpendicular to Aft from Mark (5).

(5)

$$\Delta T_a = + \{[(T_a - T_f) * X_a] / LBM \},$$

Where Length Between Marks (6).

(6)

$$(LBM) = LBP - (X_f + X_a) = LBP - X_f - X_a$$

6th Step. To calculate mean Draft on Perpendiculars T_{fap} and determinate if there is hogging (+) or Sagging (–) (7).

(7)

$$T_{fap} = (T_{ap} + T_{fp}) / 2$$

7th Step. To calculate: T_{mm} - mean Corrected Draft (8)

(8)

$$T_{mm} = (T_{fp} + 2T_m + T_{ap}) / 4$$

8th Step. To calculate mean of means T (9).

(9)

$$T = (T_{fp} + 6T_{mm} + T_{ap}) / 8$$

9th 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 (10).

(10)

$$1\text{-st Corr.} = \frac{100 \cdot (T_{ap} - T_{fp}) \cdot LCF \cdot TPC}{LBP}$$

10th Step. To determinate 2nd Corr. MTC = Moment for Trim 1 cm. Using Hydrostatic Properties it is necessary to determinate by Interpolatio (11), (12), (13).

(11)

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

(12)

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

(13)

$$2\text{-nd Corr.} = \frac{50 \cdot TRIM^2 \cdot [MTC_{T+50} - MTC_{T-50}]}{LBP}$$

11th Step. To calculate the Displacement Corrected for Trim D_t (14).

$\boldsymbol{D_{(T)}}$ = the Displacement from Hydrostatic Properties determinated for T (Mean of Means) by Interpolation

(14)

$$D_t = D_{(T)} + 1\text{-st Corr.} + 2\text{-nd Corr.}$$

12th Step. To calculate density Correction D_γ **,** where γ - measured Water Density, γ_t = Table Density found from Stability Information Booklet (International Meaning) γ_t = 1,025 t/cub. m) (15).

(15)

$$\boldsymbol{D_\gamma} = D_t * (\gamma - \gamma_t) / \gamma_t$$

13th Step. To Calculate Final Displacements D_o or D_c
Displacements Corrected for Density (16).

(16)

$$\boldsymbol{D_o} = D_t + D_\gamma \text{ or } \boldsymbol{D_c} = D_t + D_\gamma$$

(17)

$$Constant = \boldsymbol{D_o} - (P_{hfo} + P_{mdo} + P_{lo}) - (P_{bw} + P_{fw}) - Lightship$$

(18)

$$P_{cargo} = \boldsymbol{D_c} - (P_{hfo} + P_{mdo} + P_{lo}) - (P_{bw} + P_{fw}) - Lightship - Const.$$

3. 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%

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