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*Working copies of these pages are available to the candidate.

U.S. Department of Transportation
United States Coast Guard

Commandant (G-MVP)
United States Coast Guard

MAILING ADDRESS:
Washington, DC 20593-0001
Phone: (202) 267-2705

COMDTPUB P16721.31

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COMMANDANT PUBLICATION P16721.31

Subj: Merchant Marine Deck Examination Reference Book, STABILITY DATA REFERENCE BOOK.

1. PURPOSE. This publication contains reference material that may be needed by an applicant during an examination for a merchant marine deck license.

2. DISCUSSION.

   a. Applicants for merchant marine deck licenses taking an examination to determine their professional qualifications may be required to answer examination questions which are based on the material in this publication.

   b. The Coast Guard has converted to a computerized random generation system for creating examination modules. To streamline the process of creating module test booklets, where possible, the reference material needed to answer exam questions has been incorporated in Deck Examinations Reference Books. This allows applicants to view both the exam question and the reference material at the same time.

   c. Copies of this publication will be provided by the Regional Examination Centers (RECs) when applicants take an examination. This publication is available to the general public but only copies provided by the RECs may be used when completing an examination.

   d. The August 1989 edition of this publication contains all material required by questions in the question bank as of August 1989.

DISTRIBUTION - SDL No. 128

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A																										
B		1	1		1		1	1		1		1		1		1		1								
C					*								*													
D																										
E																										
F																										
G																										
H																										

* NON-STANDARD DISTRIBUTION:

INSTRUCTIONS

1. Some of the questions in the deck examination booklets require the use of trim and stability reference material to answer the question. All of the material necessary to these questions is contained in the appropriate Merchant Marine Deck Examination Reference Book.

2. If a question requires the use of trim / stability reference materials, it will be specifically stated in the stem of the question. For example, if the question in your examination booklet is, "The sailing drafts are: FWD 24' - 03", AFT 25'-03" and the GM is 5.5 feet. Use the information in Section 1, the blue pages of the Stability Data Reference Book, to determine the available righting arm at 30 degrees inclination.", you must use Section 1 (the blue pages) of The Merchant Marine Deck Examination Reference Book, STABILITY DATA REFERENCE BOOK to answer the question.

3. The Merchant Marine Deck Examination Reference Book, STABILITY DATA REFERENCE BOOK, has three (3) sections. Each section has its own index and is color coded as follows:

1. Selected Stability Curves.....Blue Pages
2. Trim and Stability Book - S.S.American Mariner...White Pages
3. Trim and Stability Book - S.S.Northland.....Salmon Pages

4. Applicants taking an examination who wish to make a comment or protest concerning any material in this publication should complete a Comment/Protest form for the question involved and give it to the examiner.

5. Individuals not taking an examination who wish to make a comment on any material in this publication should send a written comment, citing this publication and the appropriate page, and paragraph or illustration commented on, to:

Commandant (G-MVP-5)
U.S. Coast Guard
STABILITY DATA REFERENCE BOOK
2100 Second Street SW
Washington, DC 20593-0001

All written comments submitted by the general public will be reviewed prior to revising this publication. A heavy workload precludes the Merchant Marine Examination Branch from discussing comments over the telephone or responding to written comments. Your comments are welcomed and you will receive a letter or postcard indicating your comments were received.

APPROVED
Subject to comments in
Commander, 3rd Coast Guard District (nmmt)
letter of

JAN 26 1982

Chief, Merchant Marine Technical Branch
BY DIRECTION OF THE COMMANDER
3RD COAST GUARD DISTRICT

S/S NORTHLAND

LOADING, TRIM & STABILITY BOOKLET

DEDICATED CLEAN BALLAST TANK CONFIGURATION

IN ACCORDANCE WITH IMCO REGULATION 13A OF 1978 PROTOCOL TO MARPOL 1973

PRODUCTS LOADING CONDITIONS

CRUDE OIL LOADING CONDITIONS

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BLANK FORMS - SUMMARY, SHIP'S DEADWEIGHT, CARGO DETAILS, BALLAST DETAILS, STRENGTH	81A-81E

NOTES TO MASTER AND PRINCIPAL PARTICULARS

1. The following cargo tanks are piped for either crude oil or clean sea water ballast (after crude oil washing):
   Cargo Tank No. 6 P,S, & CL
   Cargo Tank No. 7 P&S
   Cargo Tank No. 8 CL
   Cargo Tank No. 9 CL

2. The above-noted tanks are NOT to be used for either products cargo or sea water ballast when carrying products.

3. A light ship plus clean sea water ballast condition is included herein to demonstrate compliance with the requirements of Regulation 13A of the International Conference on Tanker Safety and Pollution Prevention. 1978.

4. The Products Loading Conditions herein are predicated on a maximum draft at bow or stern of 38.50' for transit of the Panama Canal.

5. Principal Particulars:

Length Overall	736' - 3-3/4"
Length Between Perpendiculars	705' - 0"
Breadth Moulded	102' - 0"
Depth Moulded	50' - 0"
Full Load Draft Summer Freeboard	39' - 9-3/4"
Full Loaded Displacement	62,160
Deadweight	49,339

INSTRUCTIONS FOR COMPLETION OF TRIM AND STABILITY LOADING CONDITION FORM

1. Blank forms for calculation of trim and stability for conditions not covered by this booklet are:

   Sheet 81A Summary Sheet
   81B Details of Ship's Deadweight
   81C Details of Cargo Loading
   81D Details of Sea Water Ballast

2. Enter weights and free surface on Sheets 81B, 81C and 81D as applicable. Compute moments and totals and enter on Summary Form, Sheet 81A, and compute summary totals. Take care to enter longitudinal moments as + for Aft, - for Forward.

3. For the displacement, Sheet 81A, read mean draft from Sheet 7, Curves of Form. At this draft, read Curves of Form data for KM, LCB, MT 1" and LCF. Enter these data on Sheet 81A.

4. Transverse Stability
   Subtract the total VCG (=KG) from KM to obtain the GM uncorrected for free surface. Divide the total free surface by the displacement to obtain the free surface correction and subtract this value from the uncorrected GM. The final result is the GM corrected for free surface, which must be at least 1.2 FT (to suit max req'd weather criteria GM at IMCO Ballast Draft per superseded Stability Booklet).

5. Trim
   Subtract the total LCG from the LCB to obtain the trimming lever. Trim is by stern if LCG is aft of LCB and by bow otherwise. Compute trim by multiplying displacement by trimming lever and dividing by product (MT1 x 12") For drafts of 32 FT or greater and/or small trim, the effect of LCF on trim is small and forward and aft drafts can be computed by adding or subtracting (to suit trim by bow or stern) half the trim from the mean draft. For large trim at drafts less than 32 feet compute draft at bow = mean draft - trim X (352.5 - LCF)/705. The draft & LCF values are treated algebraically; i.e., the minus signs in the expression change to plus for trim by bow and/or LCF aft of amidships. Draft at stern is draft at bow - trim.

INSTRUCTIONS FOR COMPLETION OF FORMS TO DETERMINE HOGGING AND SAGGING NUMERALS

1. Sheet 81E is the form for computing longitudinal bending stress numerals. The resulting numeral should not exceed 100.

2. The weights entered on Sheets 81B, 81C and 81D, divided by 100 and as applicable, are entered in the "Tons/100" column of Sheet 81E for departure and arrival conditions. Multiply the "Tons/100" by the Hogging and Sagging Factors for all weights entered in lines 1-27 and enter totals on line 28, "Total Deadweight."

3. Line 29 gives the light ship value for "Tons/100" and the associated hogging and sagging numerals. The light ship value includes weights for spare tailshaft and stowage as given on Sheet 81B ([12821 + 29]/100 = 128.50). Add lines 28 and 29 to obtain line 30 displacement and hogging and sagging numerals for departure and arrival conditions.

4. Enter the "Tons/100" deadweight from line 28 in line 31 "Numeral" columns for both hogging and sagging, and subtract from line 30. The resulting values in line 32 must not exceed 100.

TANK CAPACITIES AND CENTERS OF GRAVITY

CARGO TANKS	FRS	BBLS 98% FULL	VCG ABV. MLD BL	LCG FROM @
NO. 1 CL	102-107	15,878	26.13	227.5F
NO. 1 P/S	102-107	15,460	27.53	226.4F
NO. 2 CL	97-102	15,878	26.13	187.5F
NO. 2 P/S	97-102	18,244	26.33	187.1F
NO. 3 CL	93-97	15,878	26.13	147.5F
NO. 3 P/S	93-97	20,094	25.93	147.5F
NO. 4 CL	89-93	15,878	26.13	107.5F
NO. 4 P/S	89-93	20,254	25.93	107.5F
NO. 5 CL	85-89	15,866	26.13	67.5F
NO. 5 P/S	85-89	20,254	25.93	67.5F
NO. 6 CL	81-85	15,855	26.13	27.5F
NO. 6 P/S	81-85	20,254	25.93	27.5F
NO. 7 CL	77-81	15,867	26.13	12.5A
NO. 7 P/S	77-81	20,254	25.93	12.5A
NO. 8 CL	73-77	15,867	26.13	52.5A
NO. 8 P/S	73-77	20,254	25.93	52.5A
NO. 9 CL	69-73	15,850	26.13	92.5A
NO. 9 P/S	69-73	20,066	25.95	92.5A
NO.10 CL	65-69	15,857	26.13	132.5A
NO.10 P/S	65-69	19,364	26.23	132.3A
NO.11 CL	61-65	15,850	26.13	172.5A
NO.11 P/S	61-65	17,244	26.93	171.9A
		386,956	26.2	26.4F

FUEL OIL TANKS	FRS	CAPACITY CUBIC FT	F.O-TONS 37.23 CU.FT./LT 98% FULL	VCG ABV. MLD BL	LCG FROM @
SETTLER (P)	58-60	8459	222.5	37.83	205.3A
SETTLER (S)	58-60	8441	222.5	37.83	205.3A
DEEP TANK (P)	58-60	17436	459.0	29.83	203.8A
DEEP TANK (S)	58-60	17436	459.0	29.83	203.8A
DEEP TANK (P)	108-120	52426	1354.0	29.53	267.6F
DEEP TANK (S)	108-120	57457	1513.0	28.13	265.1F
		161655	4230.0	29.7	114.6F

FRESH WATER TANKS	FRS	CAPACITY CUBIC FT	TONS 100% FULL	VCG ABV. MLD BL	LCG FROM @
POTABLE (P)	13-17	1569.5	43.60	48.53	322.4A
POTABLE (S)	13-17	1118.9	31.08	48.53	321.5A
POTABLE CL	88-90	1089.0	30.25	57.43	90.0F
DISTILLED (P)	39-45	2160.0	60.00	42.73	258.5A
		5937.4	164.93		

BALLAST TANKS					
FORE PEAK	Stem-130	26198	748.5	22.03	323.0F
AFT PEAK	Stern-17	13801	394.3	36.53	333.8A
DEEP TANK (P)	120-130	30623	874.9	29.13	295.1F
DEEP TANK (S)	120-130	30521	872.0	29.13	295.1F

COFFERDAMS					
FWD	(P) 107-108	4703	134.4	27.93	249.0F
FWD	(S) 107-108	7134	203.8	27.93	249.0F
AFT	(P) 60-61	4190	119.7	31.13	194.0A
AFT	(S) 60-61	4190	119.7	31.13	194.0A

NOTES: VCG's of slack cargo & deep tanks are obtained by multiplying the VCG's shown by % fullness of tank.

VERTICAL MOMENTS OF FREE SURFACE OF LIQUIDS - FT TONS

CARGO TANKS

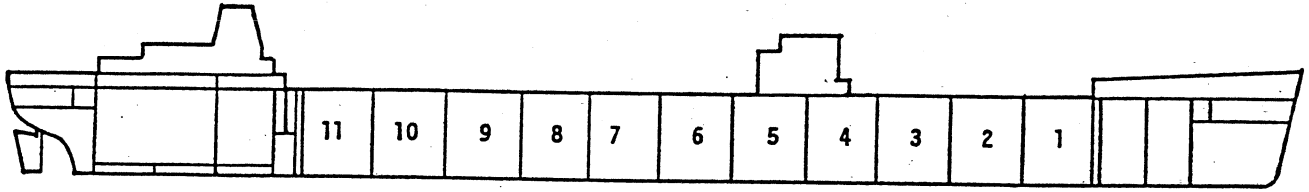
NO.	$I(FT^4)$	61° API (48.93) (CF/T) I/δ	40° API (43.58) (CF/T) I/δ	30° API (41.04) (CF/T) I/δ	14° API (36.97) (CF/T) I/δ	S.W. (35.00) (CF/T) I/δ
1 CL	283,940	5804	6515	6920	7682	8114
1 (P) OR (S)	52,000	1060	1190	1264	1403	1482
2 CL	283,940	5804	6517	6920	7682	8114
2 (P) OR (S)	77,000	1588	1783	1893	2102	2220
3 CL	283,940	5804	6517	6920	7682	8114
3 (P) OR (S)	81,100	1658	1862	1977	2195	2318
4 CL	283,940	5804	6517	6920	7682	8114
4 (P) OR (S)	81,290	1662	1866	1982	2200	2323
5 CL	283,940	5804	6517	6920	7682	8114
5 (P) OR (S)	81,290	1662	1866	1982	2200	2323
6 CL	283,940	5804	6517	6920	7682	8114
6 (P) OR (S)	81,290	1662	1866	1982	2200	2323
7 CL	283,940	5804	6517	6920	7682	8114
7 (P) OR (S)	81,290	1662	1866	1982	2200	2323
8 CL	283,940	5804	6517	6920	7682	8114
8 (P) OR (S)	81,290	1662	1866	1982	2200	2323
9 CL	283,940	5804	6517	6920	7682	8114
9 (P) OR (S)	81,290	1662	1866	1982	2200	2323
10 CL	283,940	5804	6517	6920	7682	8114
10(P) OR (S)	81,100	1658	1862	1977	2195	2318
11 CL	283,940	5804	6517	6920	7682	8114
11(P) OR (S)	77,930	1593	1789	1900	2109	2227

FUEL, FRESH WATER, BALLAST & WASH WATER

		$I(FT^4)$	I/δ
FUEL OIL			
SETTLER (P) OR (S)	FR. 58-60	11,450	308
AFT BUNKER (P) OR (S)	FR " "	30,500	819
FWD BUNKER (P)	FR.108-120	160,051	4299
FWD BUNKER (S)	FR. " "	160,051	4299
FRESH WATER			
STEERING RM (P)	FR. 13-17	15,768	438
STEERING RM (S)	FR. " "	10,728	298
DISTILLED (P)	FR. 37-45	9,324	259
UNDER BRIDGE	FR. 88½-90½	2,160	60
S.W. BALLAST			
FORE PEAK	Stem FR. - 130	109,060	3,116
AFT PEAK	FR. 17 - Stern	160,335	4,581
BALLAST (P)OR(S)	FR.120-130	55,510	1,586

1. To obtain the free surface correction to GM in any condition of loading, add the I/δ values of all slack tanks and divide by the displacement of vessel.

2. Values of I/δ for different API cargo may be obtained by either dividing tabular values of $I(FT^4)$ by corresponding density of cargo in tank, or by interpolation.



37'-0" DRAFT

FWD	-2.0	-1.7	-14	-1.1	-.9	-.7	-.3	0	+.3	+.6	+1.0	+1.3	+1.6	+1.9	+2.2	+2.6	+2.9	+3.1	+3.3	FWD
AFT	+3.4	+3.1	+2.8	+2.5	+2.3	+2.1	+1.8	+1.4	+1.1	+.8	+.5	+.2	-.2	-.5	-.8	-1.1	-1.4	-1.7	-1.9	AFT

27'-0" DRAFT

FWD	-2.4	-2.1	-17	-14	-12	-.9	-.6	-.2	+.2	+.5	+.9	+1.3	+1.6	+2.0	+2.4	+2.7	+3.1	+3.3	+3.6	FWD
AFT	+4.0	+3.7	+3.4	+3.0	+2.8	+2.5	+2.1	+1.7	+1.3	+1.0	+.6	+.2	-.2	-.6	-1.0	-1.3	-1.7	-2.0	-2.3	AFT

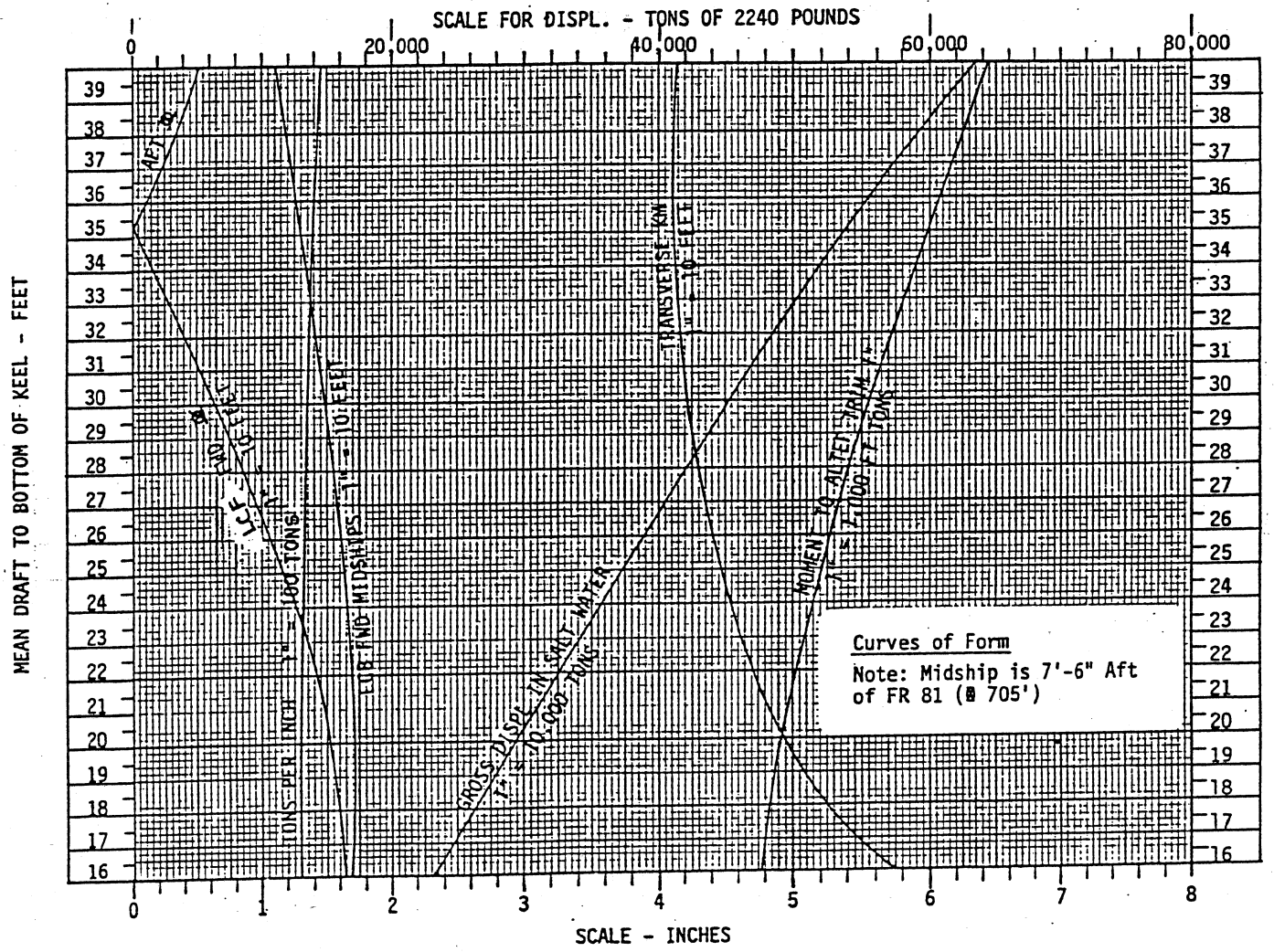
CHANGE IN DRAFTS IN INCHES FOR EACH 100 TONS ADDED

EXAMPLE: Add 500 Tons in No. 11 Tank

Original Drafts	FWD	34'-6"	AFT	33'-6"
Correction	5(-0.7)=	-3½"	5(+2.1)=	+10½"
New Drafts	FWD	34'-2½"	AFT	34'-4½"

NOTE

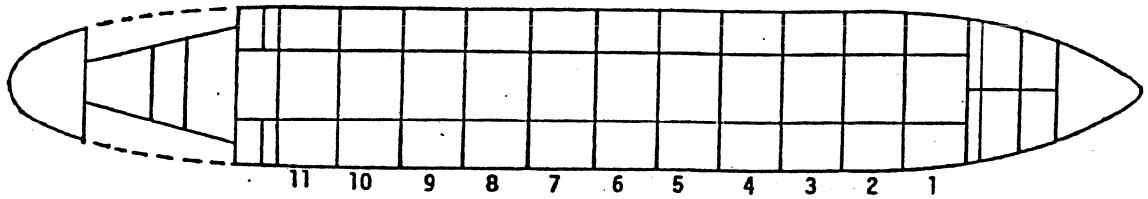
1. For discharging, reverse + and - signs in the table
2. Corrections for intermediate drafts may be interpreted from the table.


SCALE FOR DISPL. - TONS OF 2240 POUNDS
0
20,000
40,000
60,000
80,000
MEAN DRAFT TO BOTTOM OF KEEL - FEET
39
38
37
36
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
AFT
FWD
LCF
LCB
TONS PER INCH
CUB FND MIDSHIPS
TRANSVERSE KM
MOMENT TO ALTER
CROSS CURVES OF STABILITY
SCALE - INCHES
0
1
2
3
4
5
6
7
8
Curves of Form
Note: Midship is 7'-6" Aft
of FR 81 (@ 705')

SHEET 7

LOADING SUMMARY

CONDITION:



LEGEND

- CARGO
- BALLAST WATER
- FRESH WATER
- FUEL OIL

DESCRIPTION	L. TONS	VCG ABOVE BL (FT)	VERTICAL MOMENT (FT TONS)	LCG FROM ▮ FT (+ = AFT)	LONGITUDINAL MOMENT (FT TONS)	FREE SURFACE (FT TONS)
LIGHT SHIP	12821	32.23	413,221	23.06 A	295,652.	
SHIP'S DEADWEIGHT - SHEET 81B						
CARGO - SHEET 81C						
CLEAN S.W. BALLAST- SHEET 81D						
TOTALS						

STABILITY

MEAN DRAFT AT LCF	FT =
KM	FT =
KG	FT =
GM (uncorr)	FT =
F.S. correction	FT =
GM AVAILABLE	FT =

TRIM

LCF	=
LCB	=
LCG	=
TRIM LVR	=
MT 1"	FT TONS =
TRIM	=
DRAFT - FP =	=
DRAFT - AP =	=

DETAILS OF SHIP'S DEADWEIGHT - CONDITION _____

DESCRIPTION	L. TONS	VCG ABOVE BL (FT)	VERTICAL MOMENT (FT TONS)	LCG FROM ℄ FT (+ = AFT)	LONGITUDINAL MOMENT (FT TONS)	FREE SURFACE (FT TONS)
CREW & EFFECTS - DECK HOUSE	3	68.23	205	90.0 F	- 270	-
CREW & EFFECTS - AFT HOUSE	7	56.23	394	256.0 A	1792	-
SPARE TAIL SHAFT & STOWAGE	29	8.23	239	298.5 A	8656	-
TOTAL CONSTANTS	(39)	21.5	(838)	261.0 A	(10178)	-
STORES - FORWARD		54.23		307.0 F		-
- DECK HOUSE		54.23		90.0 F		-
- AFT HOUSE		54.23		276.3 A		-
FRESH WATER - UNDER BRIDGE		57.43		90.0 F		
- DISTILLED		42.73		258.5 A		
- STEERG GR RM (P)		48.53		322.4A		
- STEERG GR RM (S)		48.53		321.5A		
FUEL OIL - AFT BUNKER (P)		29.83		203.8A		
- AFT BUNKER (S)		29.83		203.8A		
- SETTLER (P)		37.83		205.3A		
- SETTLER (S)		37.83		205.3A		
- FWD BUNKER (P)		29.53		267.6F		
- FWD BUNKER (S)		28.13		265.1F		
TOTALS						

CARGO - @ _____ °API (0._____SP.GR.)

DESCRIPTION	L. TONS	VCG ABOVE BL (FT)	VERTICAL MOMENT (FT TONS)	LCG FROM ℄ FT (+ = AFT)	LONGITUDINAL MOMENT (FT TONS)	FREE SURFACE (FT TONS)
NO.1 CL		26.13		227.5 F		
NO.1 P/S		27.53		226.4 F		
NO.2 CL		26.13		187.5 F		
NO.2 P/S		26.33		187.1 F		
NO.3 CL		26.13		147.5 F		
NO.3 P/S		25.93		147.5 F		
NO.4 CL		26.13		107.5 F		
NO.4 P/S		25.93		107.5 F		
NO.5 CL		26.13		67.5 F		
NO.5 P/S		25.93		67.5 F		
NO.6 CL		26.13		27.5 F		
NO.6 P/S		25.93		27.5 F		
NO.7 CL		26.13		12.5 A		
NO.7 P/S		25.93		12.5 A		
NO.8 CL		26.13		52.5 A		
NO.8 P/S		25.93		52.5 A		
NO.9 CL		26.13		92.5 A		
NO.9 P/S		25.93		92.5 A		
NO.10 CL		26.13		132.5 A		
NO.10 P/S		26.23		132.3 A		
NO.11 CL		26.13		172.5 A		
NO.11 P/S		26.93		172.9 A		
TOTALS						

CONDITION:

DETAILS OF CLEAN SEA WATER BALLAST

DESCRIPTION	L. TONS	VCG ABOVE BL (FT)	VERTICAL MOMENT (FT TONS)	LCG FROM @ FT (+ = AFT)	LONGITUDINAL MOMENT (FT TONS)	FREE SURFACE (FT TONS)
ORIGINAL CLEAN BALLAST TANKS:						
FORE PEAK		22.03		323.0 F		
AFT PEAK		36.53		333.8 A		
DEEP TANK, P/S		29.13		295.1 F		
NO. 6 SIDE TANK P/S		25.93		27.5 F		
TANKS CONVERTED TO CLEAN BALLAST:						
NO. 6 TANK, CL		26.13		27.5 F		
NO. 7 SIDE TANK, P/S		25.93		12.5 A		
NO. 8 TANK, CL		26.13		52.5 A		
NO. 9 TANK, CL		26.13		92.5 A		
FORWARD COFFERDAM		27.93		249.0 F		
AFT COFFERDAM		31.13		194.0 A		
TOTALS						

CONDITION:

LONGITUDINAL BENDING STRESSES (PSI)

DESCRIPTION	DEPARTURE					ARRIVAL				
	TONS/100	HOGGING		SAGGING		TONS/100	HOGGING		SAGGING	
		FACTOR	NUMERAL	FACTOR	NUMERAL		FACTOR	NUMERAL	FACTOR	NUMERAL
1. FORE PEAK		1.64		0.30			1.64		0.30	
2. DEEP TANK P/S		1.53		0.42			1.53		0.42	
3. FWD STORES		1.51		0.44			1.51		0.44	
4. FWD BUNKERS		1.43		0.54			1.43		0.54	
5. FWD COFFERDAM		1.36		0.61			1.36		0.61	
6. #1 CARGO TANK		1.28		0.70			1.28		0.70	
7. #2 CARGO TANK		1.14		0.86			1.14		0.86	
8. #3 CARGO TANK		1.00		1.02			1.00		1.02	
9. #4 CARGO TANK		0.85		1.18			0.85		1.18	
10. BRIDGE CREW		0.78		1.25			0.78		1.25	
11. BRIDGE STORES		0.78		1.25			0.78		1.25	
12. BRIDGE F.W.		0.78		1.25			0.78		1.25	
13. #5 CARGO TANK		0.70		1.35			0.70		1.35	
14. #6 BALLAST TANK		0.56		1.51			0.56		1.51	
15. #7 CARGO/BALLAST TANK		0.51		1.57			0.51		1.57	
16. #8 CARGO/BALLAST TANK		0.67		1.43			0.67		1.43	
17. #9 CARGO/BALLAST TANK		0.83		1.28			0.83		1.28	
18. #10 CARGO TANK		1.00		1.14			1.00		1.14	
19. #11 CARGO TANK		1.16		0.99			1.16		0.99	
20. AFT COFFERDAM		1.26		0.90			1.26		0.90	
21. AFT BUNKERS		1.28		0.88			1.28		0.88	
22. AFT SETTLERS		1.29		0.87			1.29		0.87	
23. DISTILLED WATER		1.51		0.67			1.51		0.67	
24. AFT STORES		1.56		0.61			1.56		0.61	
25. AFT CREW		1.50		0.68			1.50		0.68	
26. F.W. AFT		1.77		0.44			1.77		0.44	
27. AFT PEAK		1.82		0.40			1.82		0.40	
28. TOTAL DEADWEIGHT										
29. LIGHT SHIP	128.50		83.63		14.01	128.50		83.63		14.01
30. DISPLACEMENT										
31. DEADWEIGHT CORRECTION -LINE 28 WEIGHT										
32. NUMERAL (MAY NOT EXCEED 100)										