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## 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.

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

**2 NOV 1989**

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

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A																										
B		1	1		1		1	1		1		1		1		1		1								
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• NON-STANDARD DISTRIBUTION:

TRIM  
AND  
STABILITY BOOKLET  
FOR  
SINGLE SCREW CARGO VESSEL  
**S.S. AMERICAN MARINER**

C4-S-1a

NAME -

OFFICIAL NO.

PREPARED BY  
DIVISION OF PRELIMINARY DESIGN  
OFFICE OF SHIP CONSTRUCTION  
MARITIME ADMINISTRATION  
U.S. DEPARTMENT OF COMMERCE

APPROVED BY

\_\_\_\_\_  
CHIEF, DIVISION OF PRELIMINARY DESIGN      DATE

## TABLE OF PRINCIPAL CHARACTERISTICS

LENGTH, OVERALL	563'-7 <sup>3</sup> / <sub>4</sub> "	PASSENGERS	12
LENGTH, B.P.	528'-0"	CREW	58
LENGTH, 20 STATIONS	520'-0"	GRAIN CUBIC	837,305 CU. FT.
BEAM, MOLDED	76'-0"	BALE CUBIC	736,723 "
DEPTH TO MAIN DK., MLD. AT SIDE	44'-6"	REEFER CUBIC	30,254 "
DEPTH TO 2ND. DK., MLD. AT SIDE	35'-6"	FUEL OIL (D.B.'S + SETTLERS)	2652 TONS
BULKHEAD DK.	2ND. DK	FUEL OIL (DEEP TANKS)	1156 "
MACHINERY	TURBINE	FUEL OIL, TOTAL	3808 "
DESIGNED SEA SPEED	20 KNOTS	FRESH WATER	257 "
SHAFT HORSEPOWER, NORMAL	17,500	NO. OF HOLDS	7
SHAFT HORSEPOWER, MAXIMUM	19,250	GROSS TONNAGE	9215
FULL LOAD DRAFT, MLD.	29'-9"	NET TONNAGE	5367
FULL LOAD DISPLACEMENT	21,093 TONS		
LIGHTSHIP	7,675 "		
LIGHTSHIP VCG	31.5'		
LIGHTSHIP LCG AFT F.P.	276.5'		

C4-S-1a

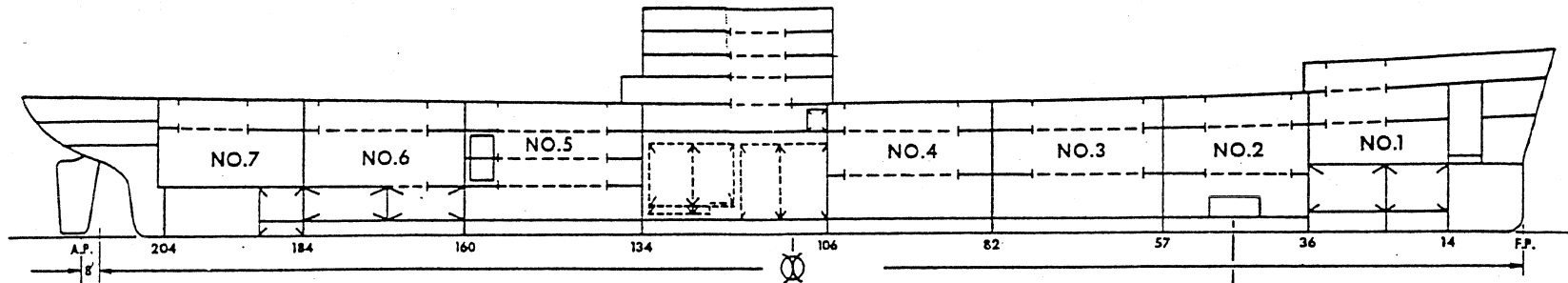


TABLE OF CORRECTIONS IN INCHES TO DRAFT FORWARD AND AFT FOR EACH 100 TONS LOADED AT ANY DISTANCE FROM AMIDSHIPS.

EXAMPLE-FIND THE CHANGE IN TRIM AFTER LOADING 100 TONS IN NO. 2 HOLD (160 FEET FORWARD AMIDSHIPS)

INITIAL DRAFT	FORWARD	19'-6"	AFT	20'-6"
CORRECTION	FORWARD	+7.6"	AFT	-4"
NEW DRAFT	FORWARD	20'-2"	AFT	20'-2"

30'-0" DRAFT

FOR'D	-5.3	-5.0	-4.7	-4.4	-4.1	-3.9	-3.6	-3.3	-3.0	-2.7	-2.5	-2.2	-1.9	-1.6	-1.3	-1.1	-0.8	-0.5	-0.2	+0.1	+0.4	+0.6	+0.9	+1.2	+1.5	+1.8	+2.0	+2.3	+2.6	+2.9	+3.2	+3.4	+3.7	+4.0	+4.3	+4.6	+4.8	+5.1	+5.4	+5.7	+6.0	+6.2	+6.5	+6.8	+7.1	+7.4	+7.6	+7.9	+8.2	+8.5	+8.5	+9.0	+9.0	FOR'D			
AFT	+7.1	+6.8	+6.6	+6.4	+6.1	+5.9	+5.7	+5.4	+5.2	+4.9	+4.7	+4.5	+4.2	+4.0	+3.8	+3.5	+3.3	+3.0	+2.8	+2.6	+2.3	+2.1	+1.9	+1.6	+1.4	+1.1	+0.9	+0.7	+0.4	+0.2	0	-0.3	-0.5	-0.8	-1.0	-1.2	-1.5	-1.7	-1.9	-2.2	-2.4	-2.7	-2.9	-3.1	-3.4	-3.6	-3.8	-4.1	-4.3	-4.6	-4.8	-5.0	-5.3	-5.3	-5.3	-5.3	AFT

20'-0" DRAFT

FOR'D	-7.2	-6.9	-6.5	-6.2	-5.8	-5.4	-5.1	-4.7	-4.4	-4.0	-3.7	-3.3	-3.0	-2.6	-2.3	-1.9	-1.6	-1.2	-0.9	-0.5	-0.1	+0.2	+0.6	+0.9	+1.3	+1.6	+2.0	+2.3	+2.7	+3.0	+3.4	+3.7	+4.1	+4.4	+4.8	+5.1	+5.5	+5.9	+6.2	+6.6	+6.9	+7.3	+7.6	+8.0	+8.3	+8.7	+9.0	+9.4	+9.7	+10.1	+10.4	+10.8	+11.1	FOR'D				
AFT	+9.6	+9.3	+9.0	+8.7	+8.4	+8.0	+7.7	+7.4	+7.1	+6.7	+6.4	+6.1	+5.8	+5.4	+5.1	+4.8	+4.5	+4.1	+3.8	+3.5	+3.2	+2.8	+2.5	+2.2	+1.9	+1.5	+1.2	+0.9	+0.6	+0.3	-0.1	-0.4	-0.7	-1.0	-1.4	-1.7	-2.0	-2.3	-2.7	-3.0	-3.3	-3.6	-4.0	-4.3	-4.6	-4.9	-5.3	-5.6	-5.9	-6.2	-6.6	-6.9	-7.2	-7.2	-7.2	-7.2	-7.2	AFT

- NOTES 1-THE CORRECTIONS HAVE BEEN COMPUTED FOR THE TWO DRAFTS 10 FEET APART TO FACILITATE INTERPOLATION, BUT IN PRACTICE IT WILL BE ACCURATE ENOUGH TO REFER TO THE TABLE NEAREST THE SHIP'S DRAFT.  
2-WHEN DISCHARGING, USE THE TABLE AS LOADING AND CHANGE THE PLUS AND MINUS SIGNS.

# HYDROSTATIC PROPERTIES

C4-S-1a

MEAN DRAFT BOTTOM OF KEEL	TOTAL DISP. S.W. TONS	TRANSVERSE KM-MLD. FEET	TONS PER INCH IMMERSION	MOMENT TO TRIM 1" FT. TONS	L.C.B. AFT F.P. FEET	L.C.F. AFT F.P. FEET	MEAN DRAFT BOTTOM OF KEEL
30	21000	31.4	70	1950	269	282	30
29		31.3		1900		281	29
28	20000	31.2	69	1850	268	280	28
27		31.1		1800		279	27
26	19000	31.1	68	1750	267	278	26
25				17000		1700	277
24	18000	31.05	67	1650	266	276	24
23		16000		1600		275	23
22	17000	31.1	66	1550	265	274	22
21		15000		1500		273	21
20	14000	31.2	65	1450	264	272	20
19		13000				31.3	271
18	12000	31.4	64	1400	263	270	18
17		11000				31.5	269
16	10000	31.6	63	1350	262	268	16
15		9000				31.8	267
14	8000	32.0	62	1300	261	267	14
13		32.5				266	13
12	12000	33.0	61	265	265	12	

## TABLE FOR FREE SURFACE CORRECTION AND TANK CAPACITIES

C4-S-1a

TANK	FRAMES	TANK CAPACITY		FREE SURFACE CORRECTION		V.C.G.	LCG. F.P.
		F.O. TONS	S.W. TONS	i SLACK	i 97%		
D.B.1	€   14-24	48.2	52.8	106	67	4.5	39.9
D.B.1A	€   24-36	81.9	89.8	464	204	4.8	64.9
D.B.2	P   36-57	71.2	78.1	428	158	2.7	106.6
	S   36-57	71.2	78.1	428	158	2.7	106.6
D.B.3	€   57-82	227.6	249.5	3777	944	2.5	161.6
	P   57-82	55.6	61.0	300	120	3.0	169.2
	S   57-82	55.6	61.0	300	120	3.0	169.2
D.B.4	€   82-106	224.1	245.7	3626	943	2.5	222.0
	P   82-106	128.1	140.5	1138	364	2.6	223.8
	S   82-106	128.1	140.5	1138	364	2.6	223.8
D.B.5	€   106-127	196.2	215.1	3173	825	2.5	278.3
	P   106-134	178.0	195.2	2048	676	2.6	288.3
	S   106-134	180.0	197.4	2048	676	2.6	288.3
D.B.6	€   134-160	242.3	265.7	3928	1021	2.5	354.4
	P   134-160	87.0	95.4	615	221	2.8	348.2
	S   134-160	87.0	95.4	615	221	2.8	348.2
D.B.7	P   160-184	94.6	103.7	768	269	2.7	412.4
	S   160-184	94.6	103.7	768	269	2.7	412.4
D.T.1	€   14-24	125.3	137.4	134	130	16.5	40.3
D.T.1A	€   24-36	257.6	282.5	945	680	16.8	65.1
D.T.2	P   106-113	100.7		20	20	19.1	260.8
	S   106-113	100.7		20	20	19.1	260.8
D.T.3	P   113-119	86.1		17	17	19.1	277.0
	S   113-119	86.1		17	17	19.1	277.0
D.T.6	P   160-172	201.2	220.7	1242	634	11.4	401.2
	S   160-172	201.2	220.7	1242	634	11.4	401.2
D.T.7	P   172-184	128.8	141.2	618	358	11.7	430.7
	S   172-184	128.8	141.2	618	358	11.7	430.7
D.T.8	P   184-190	50.5	55.4	68	58	9.6	454.0
	S   184-190	50.5	55.4	68	58	9.6	454.0

TANK	FRAMES	TANK CAPACITY		F.S. CORR.	V.C.G.	LCG. F.P.
		F.W. TONS	S.W. TONS	i SLACK		
FORE PEAK	€   STEM-14		110.8		11.7	17.1
AFT PEAK	€   204-218		93.0		24.9	506.8
D.T.4	P/S   120-127	123.7		5575	21.3	296.0
D.T.5	P/S   127-133	108.4		4789	20.9	312.0
DIST. WATER	€   106-109	24.9		59	39.5	255.8

**NOTES:**

FUEL OIL AT 37.23 CU.FT./TON-97% FULL  
 FRESH WATER AT 36.0 CU. FT./TON-100% FULL  
 SALT WATER AT 35.0 CU. FT./TON-100% FULL

**FREE SURFACE CORRECTION PROCEDURE**

ADD QUANTITY IN COLUMN A FOR TANKS SLACK  
 ADD QUANTITY IN COLUMN B FOR TANKS 97% FULL  
 ADD QUANTITY IN COLUMN C FOR F.W. TANKS  
 IF ANY TANK IS EMPTY, OR PRESSED UP WITH WATER, USE ZERO FOR THAT TANK.

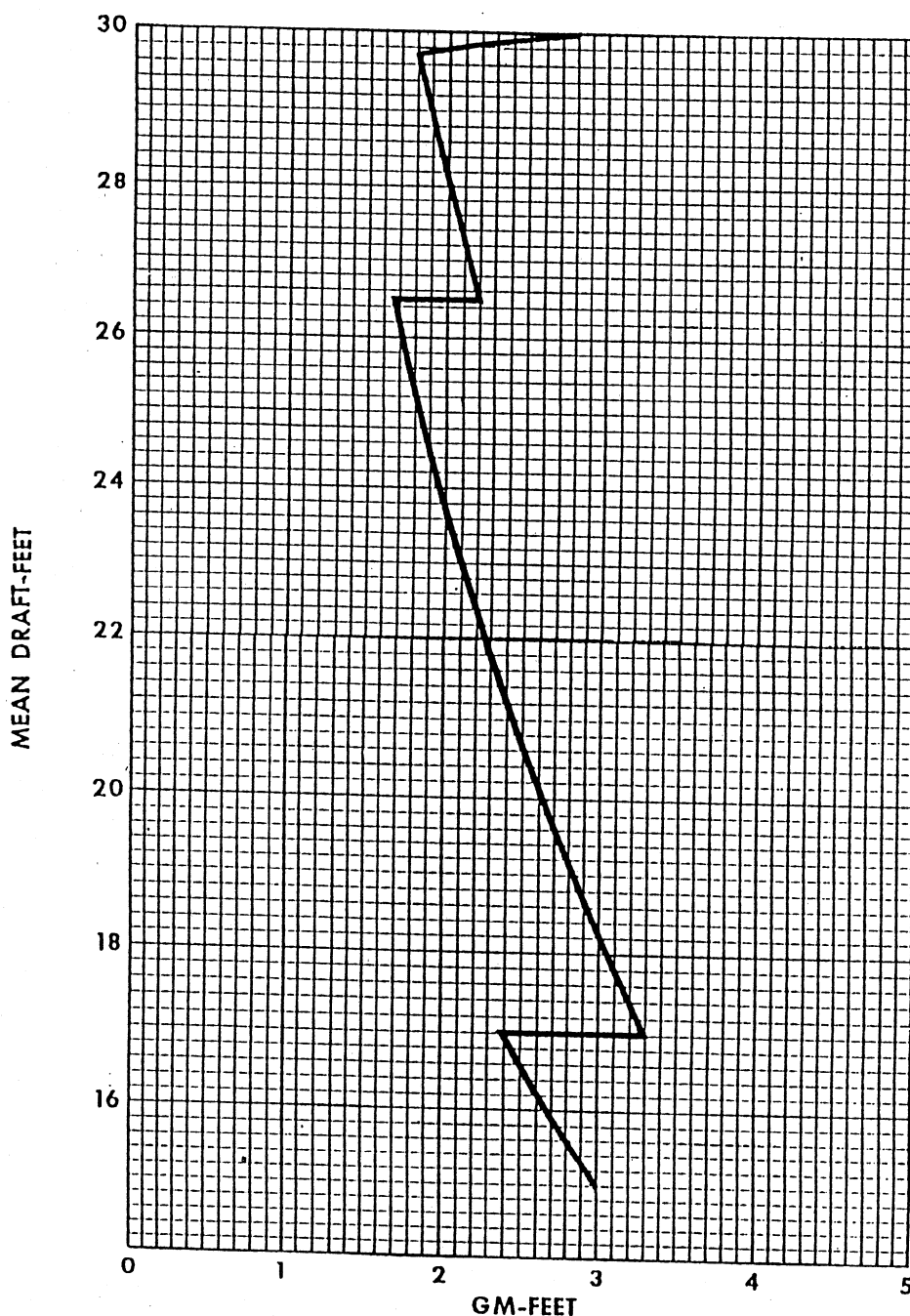
DIVIDE SUM TOTAL BY THE SHIP DISPLACEMENT IN TONS TO OBTAIN FREE SURFACE CORRECTION IN FEET.



DISPLACEMENT 100 TONS	GAIN IN GM BY BALLASTING (FEET) C4-S-1a													
	TANK	D.B.1	D.B.1A	D.B.2	D.B.3	D.B.4	D.B.5	D.B.6	D.B.7	D.T.1	D.T.1A	D.T.6	D.T.7	D.T.8
	TONS	52	89	156	371	526	607	456	207	137	282	441	282	110
85		.05	.05	.20	.40	.60	.65	.55	.20	-.10	-.15	.05	0	0
90		"	"	"	.45	"	.70	"	"	-.05	-.10	.10	.05	"
95		"	.10	"	"	.65	"	"	.25	"	"	.15	"	"
100		"	"	"	"	"	.75	.60	"	0	-.05	"	.10	.05
105		"	"	"	.50	.70	"	"	"	"	0	.20	"	"
110		"	"	"	"	"	.80	"	"	"	"	.25	.15	"
115		"	"	"	"	"	"	"	"	.05	.05	.30	"	.10
120		"	"	"	"	"	.85	"	"	"	"	"	.20	"
125		"	"	"	"	"	"	.65	.30	"	.10	.35	"	"
130		"	"	"	"	"	"	"	"	"	"	"	"	"
135		"	"	"	"	"	"	"	"	"	"	"	"	"
140		"	"	"	"	"	"	"	"	"	.15	"	"	"
145		"	"	.25	"	"	"	"	"	"	"	"	.25	"
150		"	"	"	"	"	"	"	"	.10	"	.40	"	"
155		"	"	"	"	"	"	"	"	"	"	"	"	"
160		"	"	"	"	"	"	"	"	"	"	"	"	"
165		"	"	"	"	"	"	"	"	"	"	"	"	"
170		"	"	"	"	"	"	"	"	"	"	"	"	"
175		"	"	"	"	"	"	"	"	"	.20	"	"	"
180		.10	"	"	"	"	"	"	"	"	"	"	"	"
185		"	"	"	"	"	"	"	"	"	"	"	"	"
190		"	"	"	"	"	"	"	"	"	"	"	"	"
195		"	"	"	"	"	"	"	"	"	"	"	"	"
200		"	"	"	"	"	"	"	"	"	"	"	"	"
205		"	"	"	"	"	"	"	"	"	"	"	"	.15
210		"	"	"	"	"	"	"	"	"	"	"	.30	"
213		"	"	"	"	"	"	"	"	"	"	"	"	"
215		"	"	"	"	"	"	"	"	"	"	"	"	"

# REQUIRED GM CURVE

C4-S-1a



THE REQUIRED GM VALUES GIVEN IN THIS DIAGRAM MUST BE MAINTAINED IN ORDER TO ENABLE THE SHIP UNDER AVERAGE OPERATING CONDITIONS, TO SUSTAIN DAMAGE IN ANY ONE COMPARTMENT WITHOUT REACHING A CONDITION OF NEGATIVE STABILITY AFTER DAMAGE, AND WITHOUT HEELING WHICH MIGHT RESULT IN FLOODING AN UNDAMAGED COMPARTMENT.

# LOADING TABLE

C4-5-1a

VOYAGE NO.

## DRY CARGO

HOLD	BALE CUBIC	TONS	KG	MOMENT	LCG F.P.	MOMENT
NO.1-MAIN DK.	16085		55.6		59.2	
NO.1-2ND DK.	18140		45.2		54.8	
NO.1-3RD DK.	12210		31.9		56.6	
NO.2-2ND DK.	29255		43.0		104.4	
NO.2-3RD DK.	34592		29.1		105.3	
NO.2-TANKTOP	25476		13.1		106.2	
NO.3-2ND DK.	42000		41.3		161.3	
NO.3-3RD DK.	58150		28.3		161.6	
NO.3-TANKTOP	51375		12.7		162.7	
NO.4-2ND DK.	40255		40.3		221.5	
NO.4-3RD DK.	60020		27.7		221.9	
NO.4-TANKTOP	61140		12.5		223.1	
NO.5-2ND DK.	41775		40.5		356.5	
NO.5-26'-6" FLAT £	16388		30.8		350.2	
NO.5-3RD DK. £	16022		21.4		351.0	
NO.5-TANKTOP	38135		10.9		353.6	
NO.6-2ND DK.	38610		41.0		416.5	
NO.6-3RD DK.	65850		26.9		415.5	
NO.6-DEEP TANK P/S	11930		11.2		402.6	
NO.7-2ND DK.	25095		41.8		469.6	
NO.7-3RD DK.	34220		28.4		469.4	
TOTAL	736723					

## REEFER CARGO

HOLD	REEFER CUBIC	TONS	KG	MOMENT	LCG F.P.	MOMENT
NO.5-26'-6" FLAT P/S	16256		30.7		354.4	
NO.5-3RD DK. P/S	13998		21.8		353.4	
TOTAL	30254					

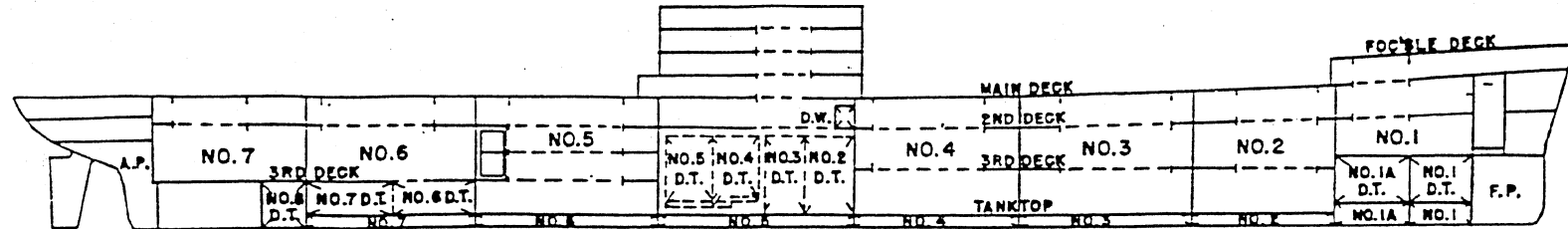
## FUEL OIL OR BALLAST

TANK	F.S.	TONS FO-S.W.	KG	MOMENT	LCG F.P.	MOMENT
NO.1-D.B. £			4.5		39.9	
NO.1A-D.B. £			4.8		64.9	
NO.2-D.B. P/S			2.7		106.6	
NO.3-D.B. £			2.5		161.6	
NO.3-D.B. P/S			3.0		169.2	
NO.4-D.B. £			2.5		222.0	
NO.4-D.B. P/S			2.6		223.8	
NO.5-D.B. £			2.5		278.3	
NO.5-D.B. P/S			2.6		288.3	
NO.6-D.B. £			2.5		354.4	
NO.6-D.B. P/S			2.8		348.2	
NO.7-D.B. P/S			2.7		412.4	
NO.1-D.T. £			16.5		40.3	
NO.1A-D.T. £			16.8		65.1	
NO.2-D.T. P/S			19.1		260.8	
NO.3-D.T. P/S			19.1		277.0	
NO.6-D.T. P/S			11.4		401.2	
NO.7-D.T. P/S			11.7		430.7	
NO.8-D.T. P/S			9.6		454.0	
FORE PEAK			11.7		17.1	
AFTER PEAK			24.9		506.8	
TOTAL						

## FRESH WATER

TANK	F.S.	TONS F.W.	KG	MOMENT	LCG F.P.	MOMENT
NO.4 D.T. P/S			21.3		296.0	
NO.5 D.T. P/S			20.9		312.0	
DIST. WATER			39.5		255.8	
TOTAL						

VOYAGE NO.



ITEM	TONS	KG	MOMENT	L.C.G. F.P.	MOMENT	F.S.
LIGHTSHIP	7675	31.5	241763	276.5	2122138	X
CREW & STORES	50	43.7	2185	276.5	13825	
LUBE OIL	13	25.8	335	317.5	4128	9
FUEL OIL & SALT WATER						
FRESH WATER						
DRY CARGO						
REEFER CARGO						
DECK CARGO						
TOTAL						

- DRY OR REEFER CARGO
- FRESH WATER
- FUEL OIL
- SALT WATER

MEAN S.W. DRAFT (SEE SHEET 3) \_\_\_\_\_  
 KM (SEE SHEET 3) \_\_\_\_\_  
 KG \_\_\_\_\_  
 GM \_\_\_\_\_  
 CORR. FOR F.S. \_\_\_\_\_  
 GM AVAILABLE \_\_\_\_\_  
 GM REQUIRED (SEE SHEET 6) \_\_\_\_\_

LCG - F.P. \_\_\_\_\_  
 LCB (SEE SHEET 3) \_\_\_\_\_  
 TRIM LEVER FWD, AFT \_\_\_\_\_  
 MOMENT TO TRIM 1" \_\_\_\_\_  
 TRIM IN INCHES FWD, AFT \_\_\_\_\_

LCF - F.P. (SHEET 3) \_\_\_\_\_  
 DRAFT FWD. \_\_\_\_\_  
 DRAFT AFT \_\_\_\_\_

**DOUBLE BOTTOM TANKAGE REQUIREMENTS IN TONS TO MEET ONE COMPARTMENT DAMAGE  
FOR NORMAL CONDITIONS OF LOADING**

TOTAL CARGO PLUS D.T. 1, IA, 6, 7 & 8 (COL 1+2+3)	EXCESS OF HOLD WEIGHT OVER UPPER TWEEN DECK WEIGHT IN TONS (COL 3 - COL 1)						ADDITIONAL D.B. TANKAGE PER 100 TONS OF DECK CARGO
	+1500	+1000	+500	0	-500	-1000	
1000		0	0	75	475	850	150
2000	0	0	0	800	1225	1600	140
3000	0	150	550	950	1350	1750	130
4000	0	325	675	1050	1400	1775	120
5000	50	400	750	1100	1425	1775	110
6000	100	400	725	1050	1350	1650	100
7000	50	350	650	950	1275	1600	90
8000	0	200	500	800	1100	1400	80
9000	0	0	325	650	1000	1600	70
10000	0	250	500	800	1050	1325	60
11000	0	50	325	575	825	1100	50
12000	0	0	0	275	625		

THE FOLLOWING FORMS MAY BE USED TO DETERMINE THE REQUIRED DOUBLE BOTTOM TANKAGE  
FROM THE ABOVE TABLE.

COL. 1		COL. 2		COL. 3	
UPPER TWEEN DK LAYER	TONS	LOWER TWEEN DK. LAYER	TONS	HOLD LAYER	TONS
NO. 1 MAIN DK.		NO. 1 3RD. DK.		NO. 1 DEEP TANK &	
" 2 ND. "		" 2 "		" 1A "	
" 3 "		" 3 "		" 2 TANKTOP	
" 4 "		" 4 "		" 3 "	
" 5 "		" 5 26'-6" FLAT DRY & REEFER		" 4 "	
" 6 "		" 5 3RD. DK.		" 5 "	
" 7 "		" 6 "		" 6 DEEP TANK P/S	
" 8 "		" 7 "		" 7 "	
" 9 "		" 8 "		" 8 "	
TOTAL		TOTAL		TOTAL	

SUMMARY	
ITEM	TONS
TOTAL COL. 1	
" COL. 2	
" COL. 3	
TOTAL COL. 1+2+3	
" COL. 3 - COL. 1	

REQUIRED TANKAGE (FROM TABLE)	
DECK CARGO IN TONS =	TONS
REQUIRED D.B. TANKAGE FOR DK CARGO	
TOTAL REQUIRED D.B. TANKAGE	