U.S. Department of Transportation

United States Coast Guard

Merchant Marine Deck
Examination Reference Material

STABILITY DATA REFERENCE BOOK

Aug
1989

This publication contains information to be used in examinations for merchant marine licenses and documents.

COMDTPUB P16721.31

U.S. Department of Transportation
United States Coast Guard

Commandant (G-MVP)
United States Coast Guard

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Washington, DC 20593-0001
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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

	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:

2 NOV 1989

3. PROCEDURE. This publication will be made available to applicants taking a deck merchant marine examination. Applicants who have purchased copies of this publication from the Government Printing Office (GPO) may not use their personal copies during examinations. Each REC is to allow only the REC copies of this publication to be used in the exam room. The covers of this publication held by the RECs will be gray; the covers of this publication available to the public through GPO will be yellow.

4. ORDERING INFORMATION.

   a. Regional examination centers will be provided with an initial supply of this publication. Replacement and additional copies are available from Commandant (G-MVP-5), FTS 267-2705.

   b. The public and other Coast Guard units may order copies of this publication from the GPO at the following address:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

J. D. SIPES
Rear Admiral, U.S. Coast Guard
Chief, Office of Marine Safety,
Security and Environmental Protection

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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.

TABLE OF CONTENTS

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

DEADWEIGHT SCALE

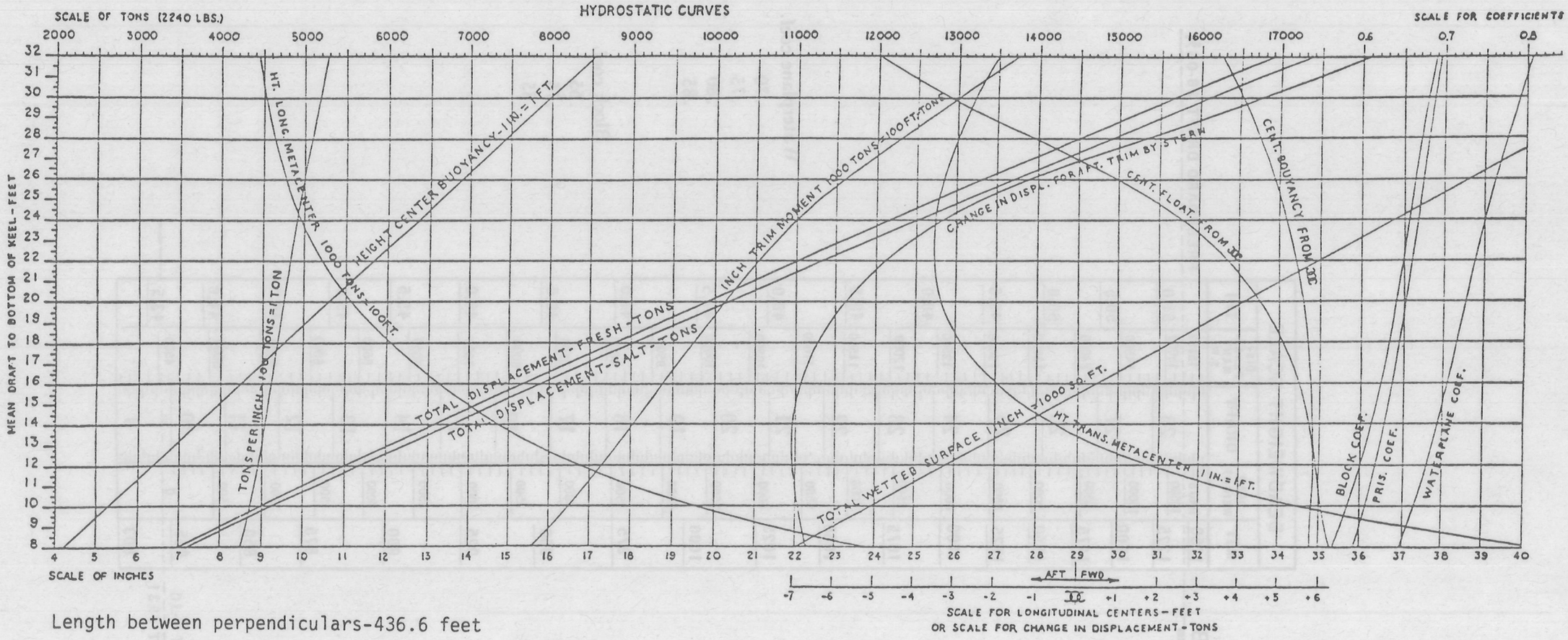
MTI	DEAD WEIGHT	DRAFT	DISPLACEMENT S.W.	TPI
1250	10678		15199	
	10500	28	15000	51.0
1225				
	10000		14500	
1200		27		50.5
	9500		14000	
1175		26		50.0
	9000		13500	
1150		25		49.5
	8500		13000	
1125		24		
	8000		12500	49.0
1100		23		
	7500		12000	
1075		22		48.5
	7000		11500	
1050		21		
	6500		11000	
1025		20		48.0
	6000		10500	
1000		19		47.5
	5500		10000	
975		18		47.0
	5000		9500	
950		17		46.5
	4500		9000	
925		16		46.0
	4000		8500	
900		15		45.5
	3500		8000	
875		14		45.0
	3000		7500	
850		13		44.5
	2500		7000	
825		12		44.0
	2000		6500	
803		11		43.5
	1500		6000	
		10		
	1000		5500	
		9		
	500		5000	
	0		4500	

FREEBOARD DRAFT 28-06¾

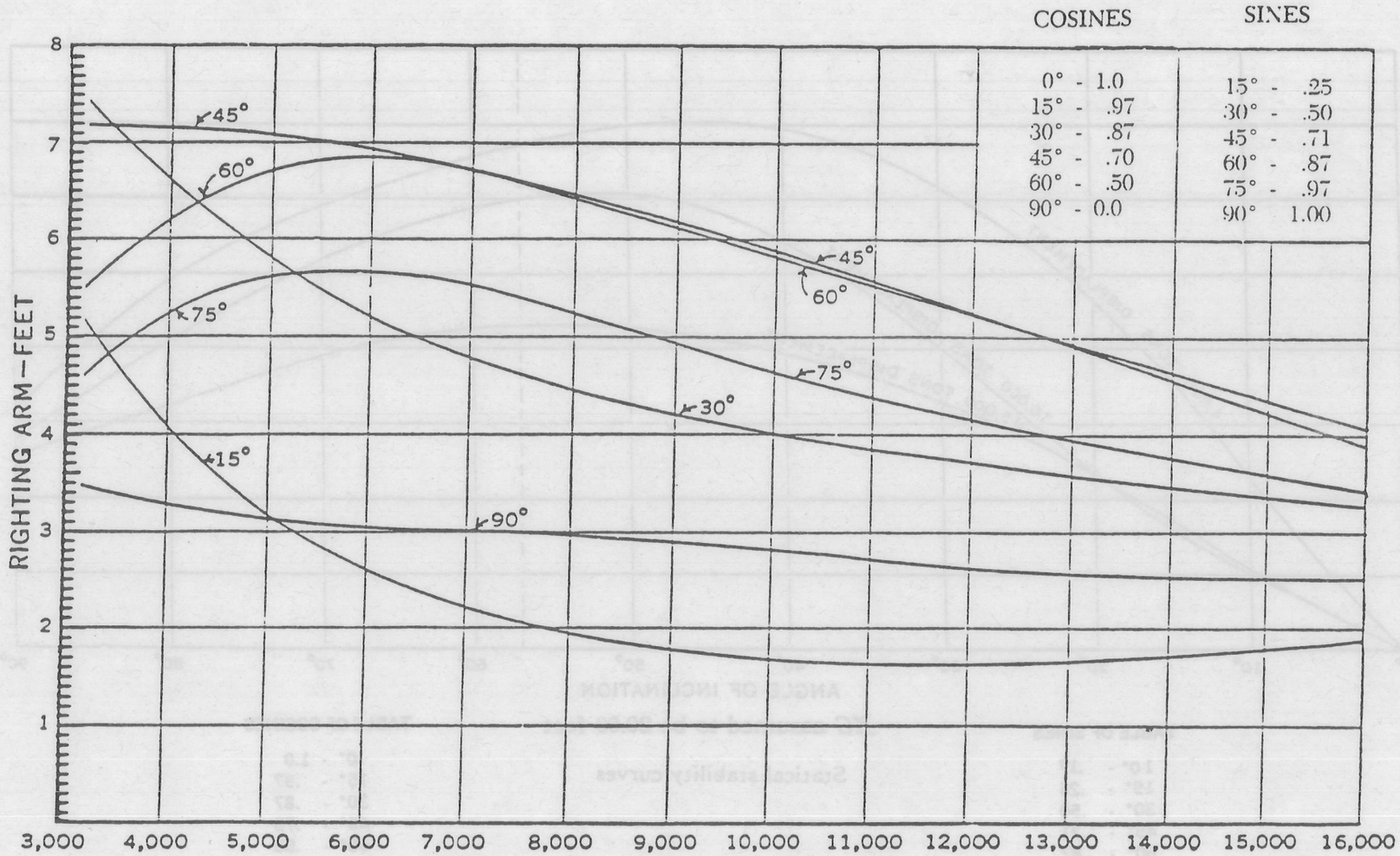
LIGHT DRAFT 9-10
DISPLACEMENT 4521

Waterplane coef.	*k*
.70	.042
.75	.048
.80	.055
.85	.062

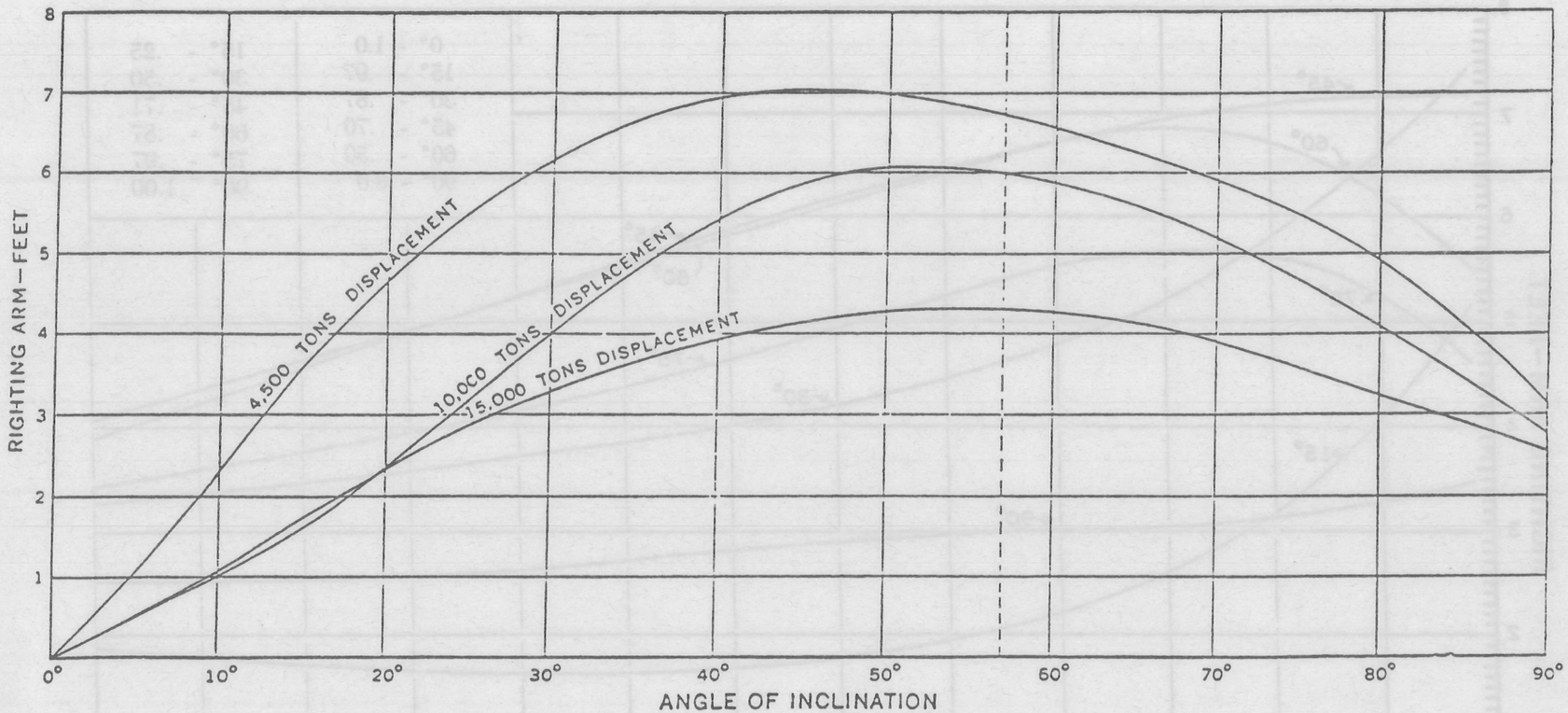
Block coef.	*k*
.65	28
.75	30
.85	32



Length between perpendiculars-436.6 feet



KG assumed to be 20.00 feet



KG assumed to be 20.00 feet

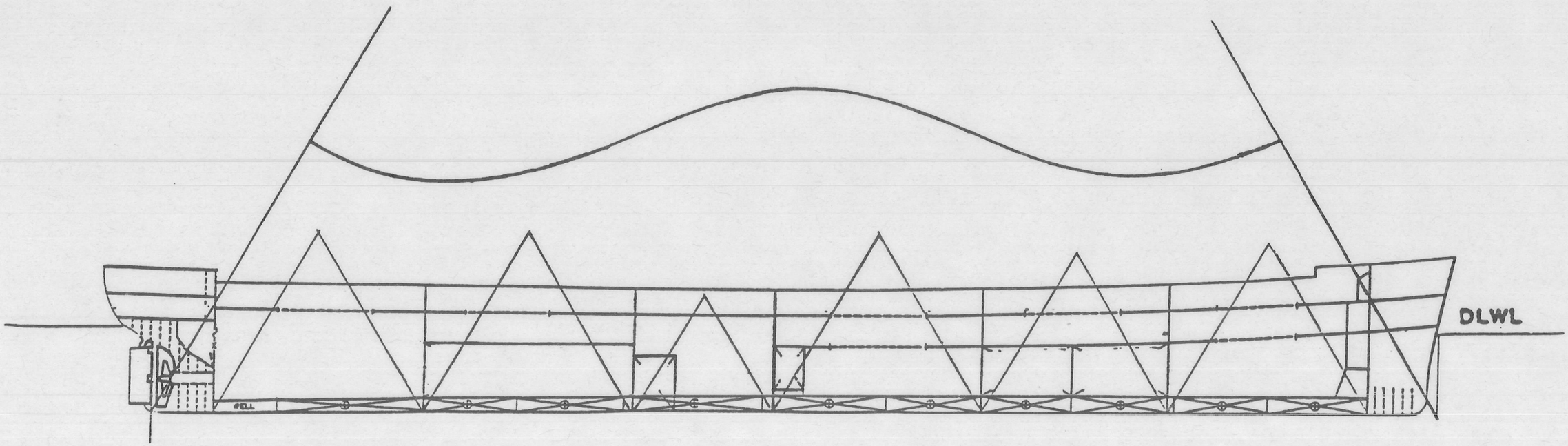
Statical stability curves

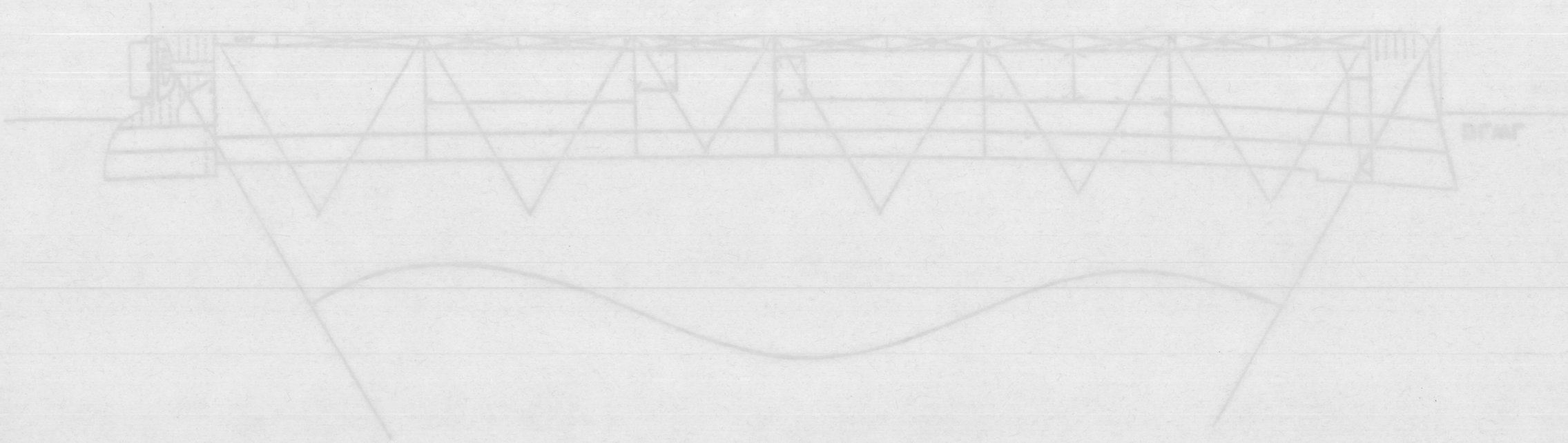
TABLE OF SINES

10° · .17
15° · .25
30° · .50
45° · .71
60° · .87
75° · .97
90° · 1.00

TABLE OF COSINES

0° · 1.0
15° · .97
30° · .87
45° · .70
60° · .50
90° · 0.0


DLWL



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 3/4"	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

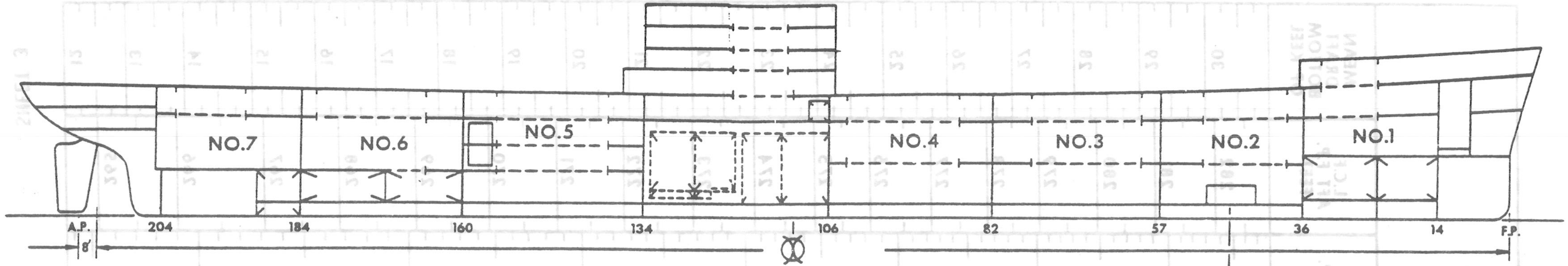


TABLE OF CORRECTIONS IN INCHES TO DRAFT FORWARD AND AFT FOR EACH 100 TONS LOADED AT ANY DISTANCE FROM AMIDSHIPS.

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		20'-2"		20'-2"

30'-0" DRAFT FOR'D	30'-0" DRAFT AFT	20'-0" DRAFT FOR'D	20'-0" DRAFT AFT
-5.3	+7.1	-7.2	+9.6
-5.0	+6.8	-6.9	+9.3
-4.7	+6.6	-6.5	+9.0
-4.4	+6.4	-6.2	+8.7
-4.1	+6.1	-5.8	+8.4
-3.9	+5.9	-5.4	+8.0
-3.6	+5.7	-5.1	+7.7
-3.3	+5.4	-4.7	+7.4
-3.0	+5.2	-4.4	+7.1
-2.7	+4.9	-4.0	+6.7
-2.5	+4.7	-3.7	+6.4
-2.2	+4.5	-3.3	+6.1
-1.9	+4.2	-3.0	+5.8
-1.6	+4.0	-2.6	+5.4
-1.3	+3.8	-2.3	+5.1
-1.1	+3.5	-1.9	+4.8
-0.8	+3.3	-1.6	+4.5
-0.5	+3.0	-1.2	+4.1
-0.2	+2.8	-0.9	+3.8
+0.1	+2.6	-0.5	+3.5
+0.4	+2.3	-0.1	+3.2
+0.6	+2.1	+0.2	+2.8
+0.9	+1.9	+0.6	+2.5
+1.2	+1.6	+0.9	+2.2
+1.5	+1.4	+1.3	+1.9
+1.8	+1.1	+1.6	+1.5
+2.0	+0.9	+2.0	+1.2
+2.3	+0.7	+2.3	+0.9
+2.6	+0.4	+2.7	+0.6
+2.9	+0.2	+3.0	+0.3
+3.2	0	+3.4	-0.1
+3.4	-0.3	+3.7	-0.4
+3.7	-0.5	+4.1	-0.7
+4.0	-0.8	+4.4	-1.0
+4.3	-1.0	+4.8	-1.4
+4.6	-1.2	+5.1	-1.7
+4.8	-1.5	+5.5	-2.0
+5.1	-1.7	+5.9	-2.3
+5.4	-1.9	+6.2	-2.7
+5.7	-2.2	+6.6	-3.0
+6.0	-2.4	+6.9	-3.3
+6.2	-2.7	+7.3	-3.6
+6.5	-2.9	+7.6	-4.0
+6.8	-3.1	+8.0	-4.3
+7.1	-3.4	+8.3	-4.6
+7.4	-3.6	+8.7	-4.9
+7.6	-3.8	+9.0	-5.3
+7.9	-4.1	+9.4	-5.6
+8.2	-4.3	+9.7	-5.9
+8.5	-4.6	+10.1	-6.2
+8.5	-4.8	+10.4	-6.6
+9.0	-5.0	+10.8	-6.9
+9.0	-5.3	+11.1	-7.2

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.

SCALE 1"=50'

SHEET 2

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	20000	31.3	69	1900	268	281	29
28	19000	31.2	68	1850	267	280	28
27	18000	31.1	67	1800	266	279	27
26	17000	31.05	66	1750	265	278	26
25	16000	31.1	65	1700	264	277	25
24	15000	31.2	64	1650	263	276	24
23	14000	31.3	63	1600	262	275	23
22	13000	31.4	62	1550	261	274	22
21	12000	31.5	61	1500	260	273	21
20	11000	31.6	60	1450	259	272	20
19	10000	31.8	59	1400	258	271	19
18	9000	32.0		1350	257	270	18
17	8000	32.5		1300	256	269	17
16		33.0			255	268	16
15		33.5			254	267	15
14		34.0			253	266	14
13		34.5			252	265	13
12		35.0			251	264	12
		35.5			250	263	
		36.0			249	262	
		37.0			248	261	
		38.0			247	260	

TABLE FOR FREE SURFACE CORRECTION AND TANK CAPACITIES

C4-S-1a

TANK		FRAMES	TANK CAPACITY 97% F.O. TONS	TANK CAPACITY 100% S.W. TONS	FREE SURFACE CORRECTION COL A i SLACK	FREE SURFACE CORRECTION COL B i 97%	V.C.G.	L.C.G. F.P.
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 100% F.W TONS	TANK CAPACITY 100% S.W. TONS	F.S. CORR. COL C i SLACK	V.C.G.	L.C.G. F.P.
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

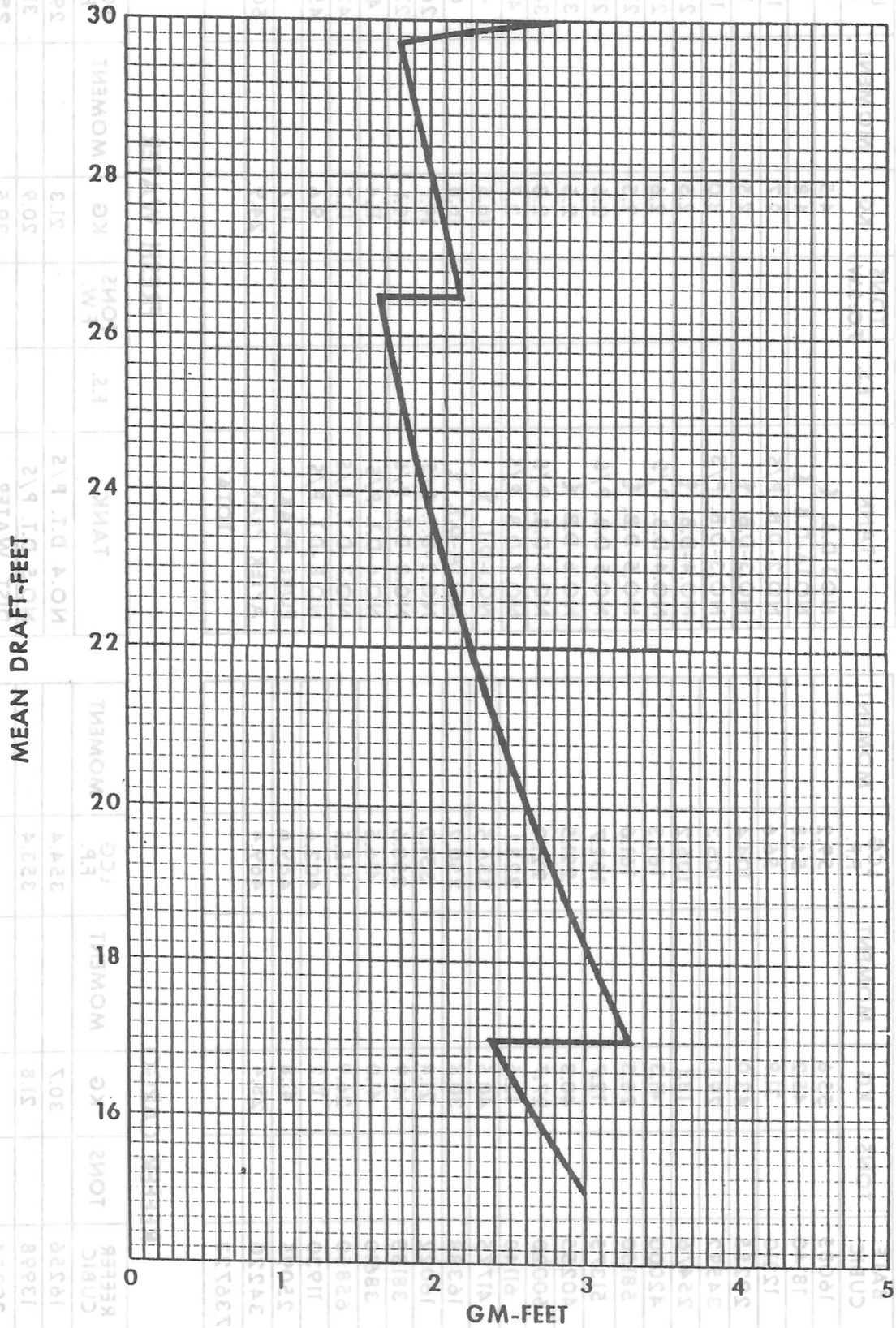
ADD QUANTITY IN COLUMN A FOR TANKS SLACK
ADD QUANTITY IN COLUMN B FOR TANKS 97% FULL
ADD QUANTITY IN COLUMN C FOR F.W. TANKS
IF ANY TANK IS EMPTY, OR PRESSED UP WITH WATER, USE ZERO FOR THAT TANK.

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-S-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					

FUEL OIL OR BALLAST

TANK	F.S.	TONS F.O.-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						

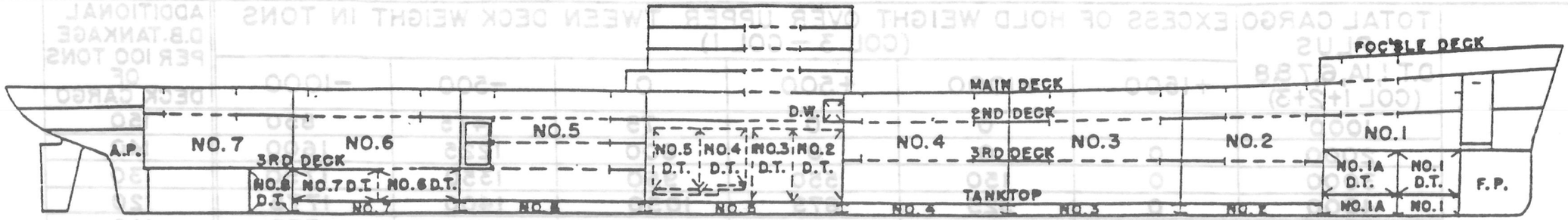
REEFER CARGO

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					

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		255B	
TOTAL						

VOYAGE NO.



ITEM	TONS	KG	MOMENT	L.C.G. F.P.	MOMENT	F.S.
LIGHTSHIP	7675	31.5	241763	276.5	2122138	
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, 1A, 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 ℄	
" 1 2ND. "		" 2 "		" 1A "	
" 2 " "		" 3 "		" 2 TANKTOP	
" 3 " "		" 4 "		" 3 "	
" 4 " "		" 5 26'-6" FLAT DRY & REEFER		" 4 "	
" 5 " "		" 5 3RD. DK. "		" 5 "	
" 6 " "		" 6 "		" 6 DEEP TANK P/S	
" 7 " "		" 7 "		" 7 "	
				" 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	

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

JAN 28 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

TABLE OF CONTENTS

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 FORMS

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	18,944	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		CAPACITY CUBIC FT	TONS 100% FULL	VCG ABV. MLD BL	LCG FROM @
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

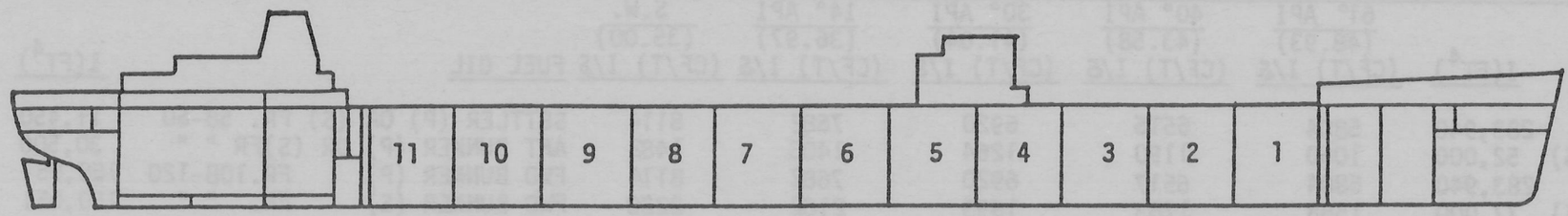
NO.	I(FT^4)	61° API (48.93) (CF/T) I/δ	40° API (43.58) (CF/T) I/δ	30° API (41.04) (CF/T) I/δ	14° API (36.97) (CF/T) I/δ	S.W. (35.00) (CF/T) I/δ
1 CL	283,940	5804	6515	6920	7682	8114
1 (P) OR (S)	52,000	1060	1190	1264	1403	1482
2 CL	283,940	5804	6517	6920	7682	8114
2 (P) OR (S)	77,000	1588	1783	1893	2102	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

FUEL OIL		I(FT^4)	I/δ
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

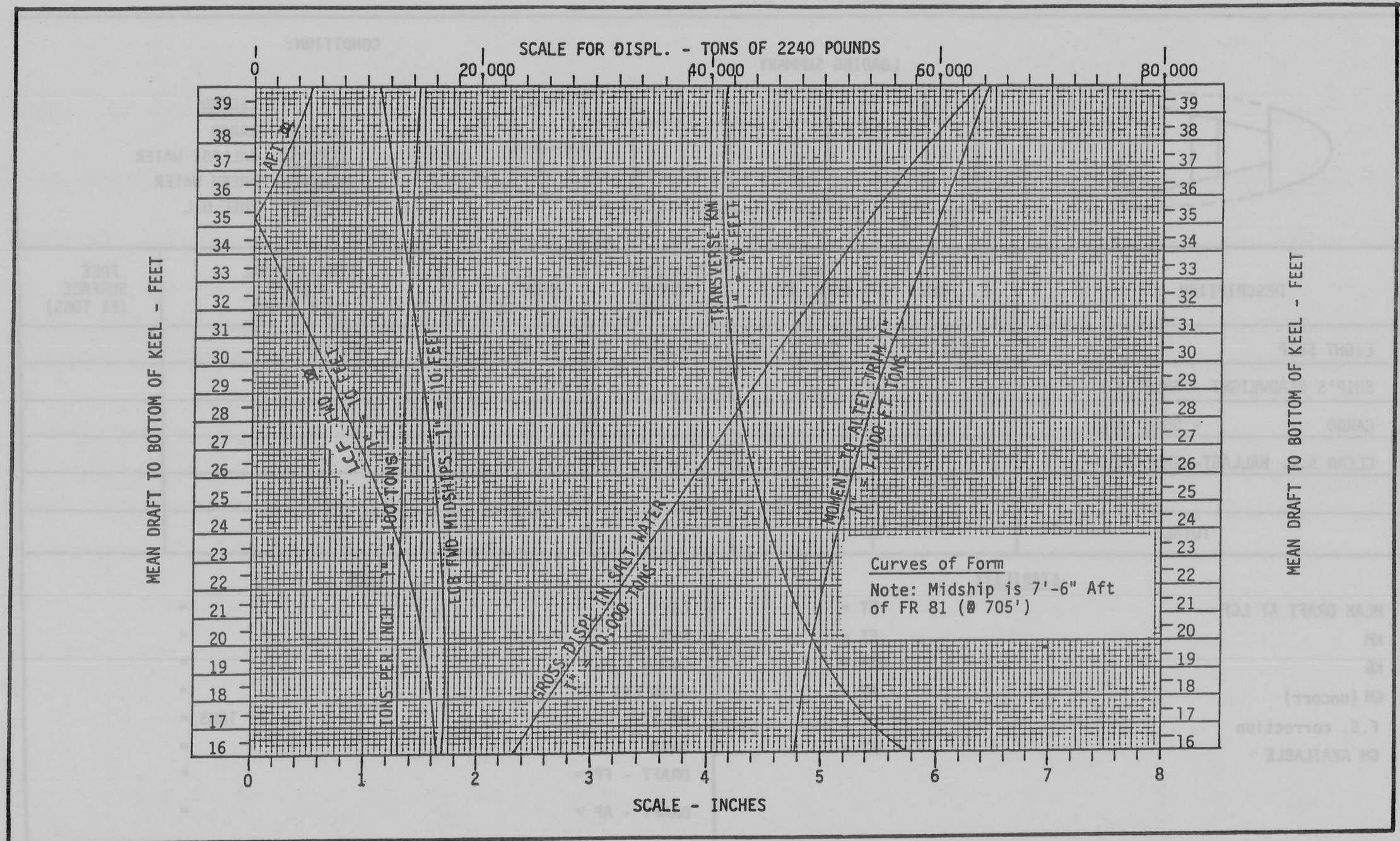
CHANGE IN DRAFTS IN INCHES FOR EACH 100 TONS ADDED

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

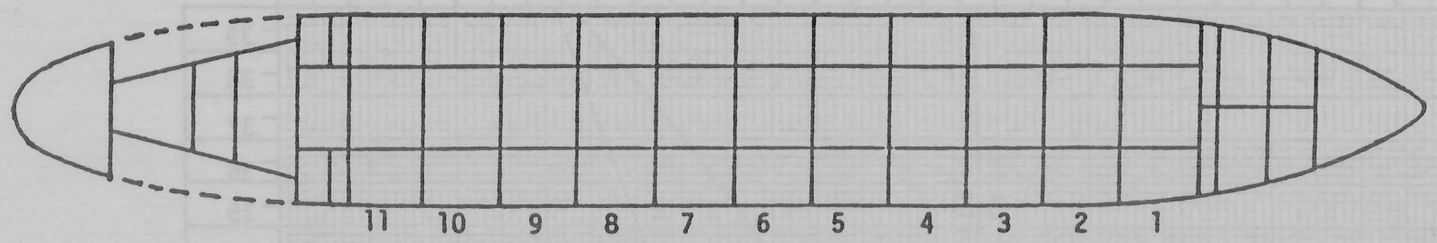
1. For discharging, reverse + and - signs in the table
2. Corrections for intermediate drafts may be interpreted from the table.


SCALE FOR DISPL. - TONS OF 2240 POUNDS
0
20,000
40,000
60,000
80,000
MEAN DRAFT TO BOTTOM OF KEEL - FEET
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
1" = 10 FEET
1" = 160 TONS
TONS PER INCH
1" = 10 FEET
LCB FWD MIDSHIPS
TRANSVERSE KM
1" = 10 FEET
MOMENT TO ALTER TRIM 1"
1" = 1,000 FT. TONS
GROSS DISPL. IN SALT WATER
1" = 10,000 TONS
Curves of Form
Note: Midship is 7'-6" Aft
of FR 81 (@ 705')
0
1
2
3
4
5
6
7
8
SCALE - INCHES

SHEET 7

CONDITION:

LOADING SUMMARY



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 (O._____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	128.50		83.63		14.01	128.50		83.63		14.01
29. LIGHT SHIP										
30. DISPLACEMENT										
31. DEADWEIGHT CORRECTION -LINE 28 WEIGHT										
32. NUMERAL (MAY NOT EXCEED 100)										