U.S. Department of Transportation

United States Coast Guard

Merchant Marine Deck Examination Reference Material

GUIDANCE MANUAL FOR LOADING M.V. GRAND HAVEN

Aug 1989

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

COMDTPUB P16721.32

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 P16721.32

9 JAN 1990

COMMANDANT PUBLICATION P16721.32

Subj: Merchant Marine Deck Examination Reference Book, GUIDANCE MANUAL FOR LOADING THE MV GRAND HAVEN.

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 maybe 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					*								*													
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NON-STANDARD DISTRIBUTION:

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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:

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C:m New York (10); (Only).

INSTRUCTIONS

1. Some of the questions in the deck examination booklets require the use of vessel loading 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 vessel loading reference materials, it will be specifically stated in the stem of the question. For example, if the question in your examination booklet is, "Your vessel's existing draft is: FWD 24'-08", AFT 25'-04. Using the Guidance Manual for Loading M.V. Grand Haven, determine the new draft if 180 long tons are loaded in No.23 hatch.", you must use The Merchant Marine Deck Examination Reference Book, GUIDANCE MANUAL FOR LOADING M.V. GRAND HAVEN to answer the question.

3. 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.

4. 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
GUIDANCE MANUAL FOR LOADING M.V. GRAND HAVEN
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.

GUIDANCE MANUAL
FOR LOADING
M.V. GRAND HAVEN

JUN 1 1 1984

APPROVED
Subject to comments in
Commander 9th Coast Guard District (m)
letter of

JUN 13 1984

By Direction of Commander, Ninth
Coast Guard Di

APPROVED BY:

OWNER

USCG

ABS

		DWG NO.	REV.	SHT.
		1468-803-3	4	1

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PRINCIPAL DIMENSIONS

Length Overall, Molded	704'-0"
Length for Classification	690'-0" (LBP)
Beam, Molded	78'-0"
Depth at Side, Molded	45'-0"
Sheer, Forward	0"
Sheer, Aft	0"
Camber of Spar Deck	0"
Deadrise	0"
Tumblehome	0"
Keel Below Molded Baseline	0-5/8"
Midships Aft Frame 44	5'-0" (1/2 LBP)

ADMEASUREMENT DATA

Port of Registry	Wilmington, Delaware
Registered Dimensions	690.8' x 78.1' x 42.7'
Builder	Bay Shipbuilding Corporation Sturgeon Bay, Wi. 54235 USA
Builder's Hull Number	711
Year Built	1974
Official Number	556460
Gross Tonnage	14499
Net Tonnage	10348

LOADLINE DATA

Top of Deck Line Above Molded Line	0-3/4"
Assigned Freeboard	15'-2 3/4"
Summer Molded Draft	29'-10"
Midsummer Keel Draft	30'-7 5/8"
Summer Keel Draft	29'-10 5/8"
Intermediate Keel Draft	28'-9 1/8"
Winter Keel Draft	28'-7 5/8"

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LIGHTSHIP DATA

Ship complete in every respect, with liquids in machinery and piping but with all tanks and bunkers empty and no cargo, fuel, fresh water, stores, or crew and effects on board. Lightship weight is 6344 long tons with center 52.58 feet aft of midships based on Deadweight Survey May 5, 1974.

LONGITUDINAL STRENGTH DATA

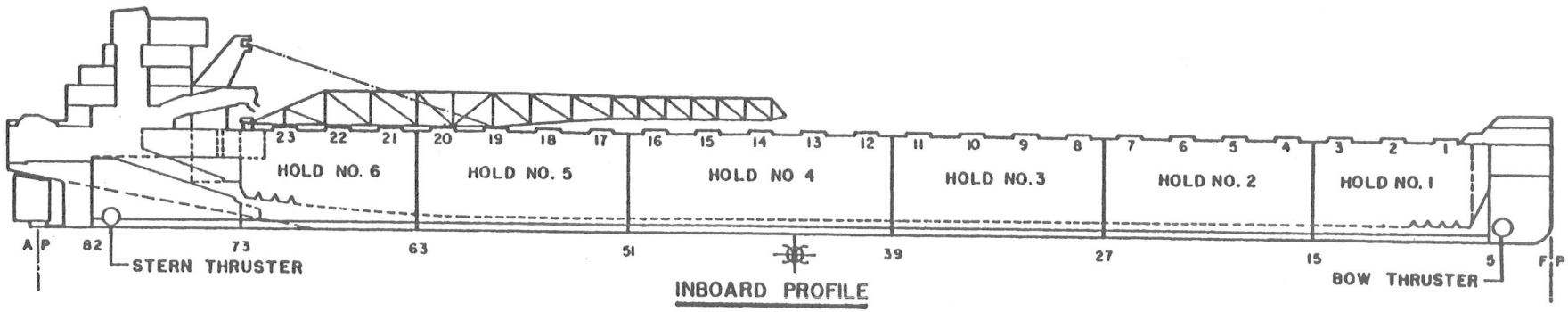
Section Modulus	34,821 IN^2FT
Moment Of Inertia	864,304 IN^2FT^2
Allowable Still Water Bending Moment	205,541 FT-LT
Allowable Still Water Bending Stress	5.90 LT/IN^2

GENERAL ARRANGEMENT

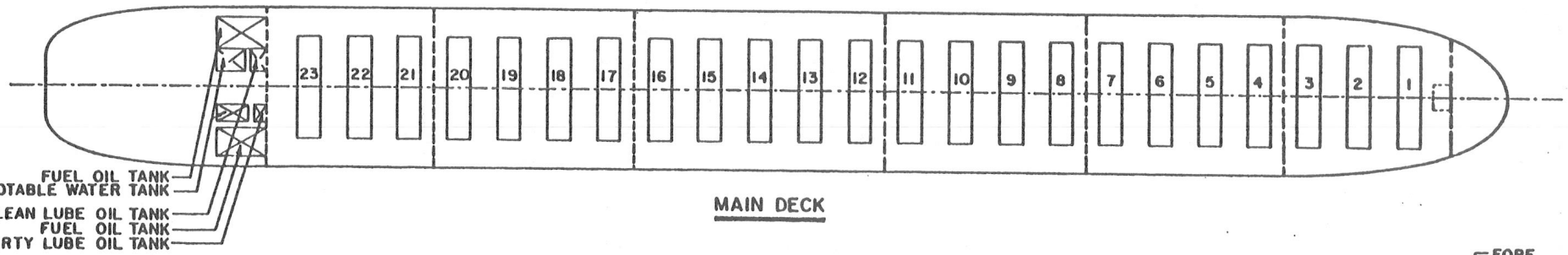
DWG. NO. 1468-803-3

REV. 0

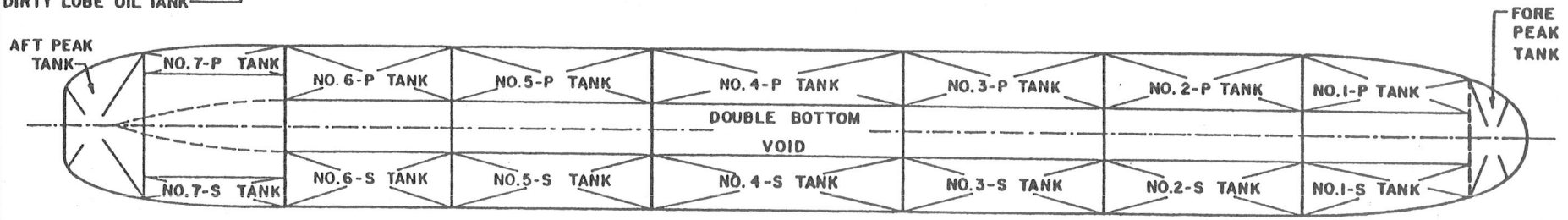
SHT 4



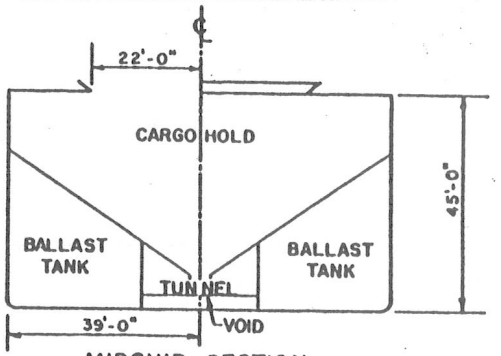
INBOARD PROFILE



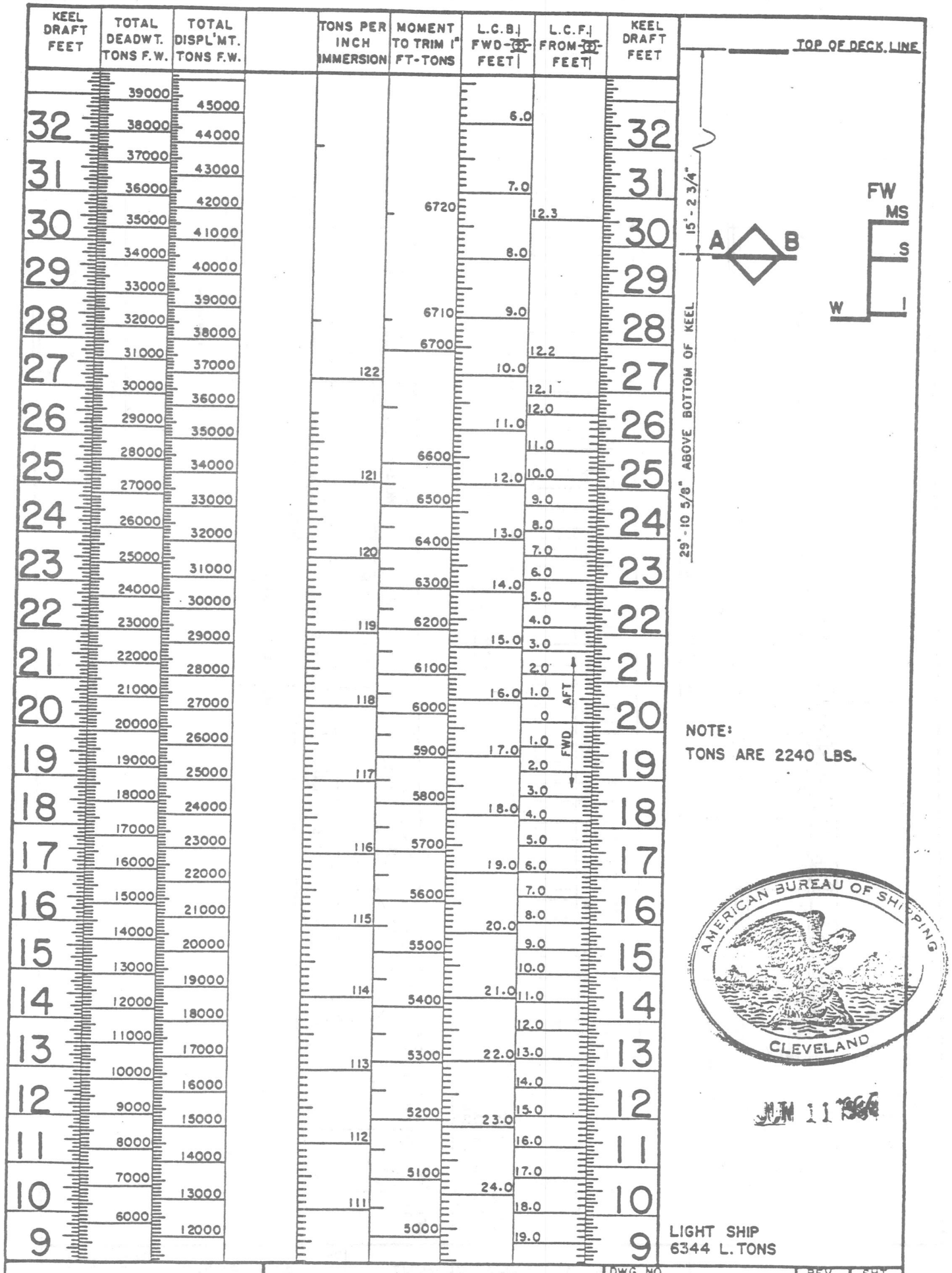
MAIN DECK



BALLAST TANKS



MIDSHIP SECTION


KEEL DRAFT FEET
TOTAL DEADWT. TONS F.W.
TOTAL DISPL'MT. TONS F.W.
TONS PER INCH IMMERSION
MOMENT TO TRIM 1" FT-TONS
L.C.B. FWD-(+)- FEET
L.C.F. FROM-(+)- FEET
KEEL DRAFT FEET
TOP OF DECK LINE
15'-2 3/4"
29'-10 5/8" ABOVE BOTTOM OF KEEL
A
B
FW
MS
S
W
I
AFT
FWD
NOTE:
TONS ARE 2240 LBS.
AMERICAN BUREAU OF SHIPPING
CLEVELAND
LIGHT SHIP
6344 L. TONS
HYDROSTATIC PROPERTIES
DWG NO. 1468-803-3
REV. 0
SHT. 5

TANK	LOCATION FRAMES	100% FULL CAPACITY CU. FT.	100% FULL CAPACITY L. TONS	100% FULL CAPACITY GALLONS	FULL CAPACITY LCG FROM MIDSHIP +AFT -FWD	
BALLAST WATER:						
FOREPEAK	BOW-5	28097	783		-327.80	
#1 TANK PORT	5-15	41276	1150		-272.80	
#1 TANK STBD	5-15	41276	1150		-272.80	
#2 TANK PORT	15-27	59130	1647		-189.00	
#2 TANK STBD	15-27	59130	1647		-189.00	
#3 TANK PORT	27-39	59130	1647		-93.00	
#3 TANK STBD	27-39	59130	1647		-93.00	
#4 TANK PORT	39-51	73912	2059		15.00	
#4 TANK STBD	39-51	73912	2059		15.00	
#5 TANK PORT	51-63	59130	1647		123.00	
#5 TANK STBD	51-63	59130	1647		123.00	
#6 TANK PORT	63-73	56379	1570		212.80	
#6 TANK STBD	63-73	56379	1570		212.80	
#7 TANK PORT	73-82	17520	488		283.80	
#7 TANK STBD	73-82	17520	488		283.80	
AFT PEAK	82-TRANS.	17414	485		332.42	
FRESH WATER: PORT	74-76	1545		11556	268.00	
STBD	74-76	1766		13206	267.00	
FUEL OIL: PORT	73-76	6381		47732	268.00	
STBD	73-76	6381		47732	267.00	
DAY TANK	75-76	46		347	270.10	
LUBE OIL: CLEAN	73-74	1070		8002	255.00	
DIRTY	73-74	629		4705	254.00	
EMERGENCY GEN. TANK	77-78	36		272	284.50	
S/S GEN. L.O. TANK	78-79	32		240	297.50	
REDUCTION GEAR L.O. TK	79-80	32		240	300.50	
PROPELLER LOWER OIL TK	81-82	73		547	312.50	

	TANK CAPACITIES	DWG NO. 1468-803-3	REV. 4	SHT. 6

HOLD	LOCATION FRAMES	35° REPOSE		20° REPOSE		0° REPOSE		
		FT^3	—	FT^3	COAL SHORT TONS	FT^3		
1	5-15	130786		139952	3499	149009		
2	15-27	166255		178700	4468	189934		
3	27-39	166255		178700	4468	189934		
4	39-51	207819		223375	5585	237431		
5	51-63	166032		178443	4461	189787		
6	63-73	112058		118854	2971	127197		
TOTAL		949205		1018024	25452	1083292		

STOWAGE FACTORS:

1 LONG TON IRON ORE PELLETS	17 CUBIC FEET (NOTE 1)
1 LONG TON RED ORE	12 CUBIC FEET
1 LONG TON LIMESTONE	25 CUBIC FEET
1 SHORT TON COAL	40 CUBIC FEET

NOTE 1 - NORMAL REPOSE ANGLE OF IRON ORE PELLETS IS 30°.

	CARGO CAPACITY	DWG NO. 1468-803-3	REV. 4	SHT. 7

AVERAGE TEST WEIGHT OF THE PRINCIPAL GRAINS LOADED AT UNITED STATES PORTS

The test weight of a particular grain is the actual weight in pounds of a U.S. (Winchester) bushel which is a unit of volume (dry measure) equaling 2,150.42 cubic inches or 1.2445 cubic feet.

	LBS. PER BUSHEL		LBS. PER BUSHEL
BARLEY	50	SORGHUM (MILO)	57
CORN	55	SOYBEANS	56
LINSEED	50	SUNFLOWER SEED	28
MILLET	57	WHEAT, AMBER DURUM	61
OATS	40	WHEAT, HARD WINTER	62
PEANUTS	51	WHEAT, NORTHERN SPRING	60
RICE	60	WHEAT, SOFT RED	59
RYE	58	WHEAT, WHITE	61
SAFFLOWER SEED	41		

NOTE: THE ABOVE TEST WEIGHTS ARE AVERAGE FIGURES BASED ON INFORMATION OBTAINED FROM GRAIN LOADING PORTS. THE SPECIFIC TEST WEIGHTS OF PARTICULAR GRAIN CARGOES MAY VARY FROM THE FIGURES SHOWN. DATA ON TEST WEIGHTS IS USUALLY AVAILABLE FROM GRAIN INSPECTION OFFICES AT SHIPPING ELEVATORS.

CARGO STOWAGE FACTORS

1 U.S. Bushel = 1.2445 Cu. Ft.

$$\frac{\text{2240 lbs.}}{\text{Test Weight per bushel (lbs.)}} \times 1.2245 \text{ Cu. Ft.} = \text{Cu. Ft. Per Long Tons}$$

TEST WEIGHT	CU. FT. PER LONG TON	TEST WEIGHT	CU. FT. PER LONG TON	TEST WEIGHT	CU. FT. PER LONG TON
32	87.11	44	63.35	56	49.78
33	84.47	45	61.95	57	48.91
34	81.99	46	60.60	58	48.06
35	79.65	47	59.31	59	47.25
36	77.43	48	58.08	60	46.46
37	75.34	49	56.89	61	45.70
38	73.36	50	55.75	62	44.96
39	71.48	51	54.66	63	44.25
40	69.69	52	53.61	64	43.56
41	67.99	53	52.60	65	42.89
42	66.37	54	51.62	66	42.24
43	64.83	55	50.68	67	41.61

When test weights are for Canadian Imperial Bushels, multiply the above stowage factors by 1.0315. (1 Canadian Imperial Bushel equals 1.2837 Cu. Ft.)

Data taken from "General Information for Grain Loading", 1976, published by the National Cargo Bureau, Inc., New York, New York

PURPOSE OF MANUAL

The purpose of this manual is to provide the ship's officers with sufficient information to safely load the ship with ballast or cargo, with respect to the ship's longitudinal bending strength. Stability has been considered and subject to the conditions stated in the STABILITY LETTER posted in the pilot house, stability will be adequate if the vessel is loaded or ballasted in accordance with this manual.

HULL BENDING

An understanding of the effects of internal loading and external forces on the ship's structure is helpful to the operator in understanding the reasons for distribution of cargo and ballast.

The hull may be compared to a long girder which is loaded by the weight of the hull structure, machinery, cargo, ballast, fuel, stores, etc. The support for this girder is provided by buoyancy of the displaced water. The uneven distribution of weight, with respect to buoyancy, along the hull results in hull bending.

The bending of the hull girder varies with sea state, vessel speed, and heading. When operating in waves, the support for the vessel varies from the still water condition according to size of waves and location of wave trough and crests relative to the ship. When the trough of a long wave is amidships, and wave crests near the ship's ends, the weight of the ship and cargo generally exceeds buoyancy throughout the middle of the ship's length and sagging occurs (compression in deck plating and tension in bottom plating). The stresses are reversed when the wave crest is amidships, and hogging occurs.

Proper distribution of the cargo or ballast along the length of the hold will assure that satisfactory stress levels will not be exceeded, in the hogging and sagging conditions, when operating in waves.

Experience has shown that there is a "safe still water bending stress" which will allow sufficient strength margin to handle the additional stresses caused by wave action, springing, local loads, machinery vibration, etc. This stress level is determined from the size, shape, and strength of the hull. The strength of the hull is fixed by the structure according to rules of the American Bureau of Shipping and the United States Coast Guard.

JUN 11 19

For this vessel, the "safe still water bending stress" is 5.90 long tons per square inch. The still water bending stress will be within the safe level if the vessel is loaded as this manual suggests and with the resultant deflection accepted. Loading to values not shown in this manual so as to change the deflection may cause the safe still water bending stress to be unacceptable.

(Cont'd)

HULL BENDING (Cont'd)

This manual shows the recommended load distribution for cargo and ballast so as to restrict the still water stresses to satisfactory levels. The following table lists the still water bending stress for loading conditions typical to those shown in this manual.

Conditions	Consumables**	Stress, Long Tons Per Sq. In.	%of Allowable At-Sea Still Water Bending Stress
Ballast:			
Light	AV	1.74	29
Medium	AV	4.39	74
Maneuvering	AV	1.76	30
Heavy	AV	1.15	19
Prop. Out*	MAX	9.34	158
"C"	AV	3.56	60
Ship Ready for Sea*	AV	5.94	101
Ore:			
30'-7 5/8" MS	MAX	4.48	76
	AV	4.60	78
	MIN	4.76	81
29'-0"	AV	4.27	72
27'-0"	AV	3.29	56
23'-0"	AV	1.43	24
Stone:			
30'-7 5/8" MS	AV	5.17	88
	MIN	5.41	92
29'-0"	AV	4.24	72
27'-0"	AV	3.40	58
23'-0"	AV	1.65	28
Coal:			
Full Cubic	AV	.98	17

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*Not an "at-sea" condition.

**MAX = Consumables at 100% of capacity (A.P. Tank at 30 L.T., #7 Tank Empty)
AV = Consumables as shown on Sheet No. 12.
MIN = Consumables at 10% capacity (0 L.T. in A.P. Tank)

Changing the consumables to either maximum or minimum from the amounts on sheet 12 will not cause the safe still water bending stress to be exceeded in all "at-sea" conditions.

HULL BENDING (Cont'd)

Conditions	Consumables**	Stress, Long Tons Per Sq. In.	%of Allowable At-Sea Still Water Bending Stress
Cubic Grain With Specified Ballast (sht 25):			
Stowage Factor CU FT/LT			
99.6	AV	2.16	37
85.0	AV	2.23	38
70.0	AV	2.38	40
65.0	AV	2.48	42
60.0	AV	2.73	46
55.0	AV	1.98	33
50.0	AV	1.13	19
45.0	AV	1.05	18

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AMERICAN BUREAU OF SHIPPING
CLEVELAND

OPERATION IN ICE

Provided the seasonal draft mark is not immersed, in any "at-sea" condition, up to 976 long tons total (488 each P & S, full sounding) may be carried in ballast tank 7. This water is available for cooling the machinery.

If it is desired to add ballast in tank number 7 while maintaining the loading manual drafts, compensation must be made by changing the cargo distribution in holds 6 and 4. For every 100 long tons ballast added in tank 7 reduce the cargo in hold 6 by 140 long tons and increase the cargo in hold 4 by 40 long tons.

If it is not necessary to maintain the loading manual drafts no compensation need be made in the cargo distribution.

This addition of ballast water will not cause the allowable still water bending moment to be exceeded.

BALLASTING INSTRUCTIONS

The recommended ballasting conditions are shown on sheets 17 and 18. The weights shown are the combined totals for both sides of the ship in long tons. The soundings are in feet and inches and are corrected for vessel trim and height of striking plate above baseline. The drafts shown at the bottom of each column are based on average shipboard conditions. They will be affected by the weight of variable items of load on board such as fuel and fresh water.

In general, the "at-sea" conditions concentrate ballast less at the ends and more near midships.

Stress curves covering the range of these conditions are shown on sheet 19. Changing the amount of consumables to either maximum or minimum from the amounts on sheet 12 without changing ballast will not cause the safe still water bending stress to be exceeded in the "at-sea" conditions.

The Prop. Out* condition is intended for use when work is required on the propeller. This ballast condition should be used in protected waters only.

When pumping from one ballast condition to another, all affected tanks shall be pumped simultaneously and evenly until the required individual tank sounding is reached. Small adjustments to individual tank soundings may be necessary to account for changes in sounding due to changes in vessel trim while pumping.

* Not an "at-sea" conditions

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LOADING INSTRUCTIONS

The Loading Curves on sheets 20, 21, 23 indicate the recommended amount of cargo to be loaded through each hatch (in long tons per hatch) to arrive at a desired mean keel draft between 22'-6" and 30'- 7 5/8" with approximately 3 inches trim by the stern. For this range of drafts the safe still water bending stress will not be exceeded if the recommended loading is followed.

The amount of cargo to be loaded through any one hatch is dependent upon the following factors:

1. Density of the cargo.
2. Type of loading equipment.
3. Sequence of loading.
4. Amount of cargo spread, which is affected by:
   a. The cargo's natural angle of repose.
   b. Location of bulkheads relative to the hatch.
   b. Amount of cargo already loaded in an adjacent hatch.

Therefore, the values in the Loading Curves will be valid only for the cargo, loading equipment, and sequence of loading stated. On the sheet following each Loading Curve (sheet 22) is a sheet which shows the sequence of loading that cargo. Also indicated is the still water bending stress along the length of the hull.

Since practical considerations will make it nearly impossible to load exactly to the values of the curves, they should be considered as target values from which variations will have little effect on the bending stress if reasonable compensation is made in nearby hatches.

To use the Loading Curves, first determine the midships draft. Second, on the Loading Curve at this draft draw a line parallel to the even foot draft lines. Third, where this draft line intersects each "long tons per hatch" curve determine the long tons per hatch. Blank forms are provided at the end of the manual for entering these values.

The Loading Officer must use his judgment, based on his experience with and confidence in the loading equipment and procedure, to estimate the amount of cargo to be reserved for final adjustment of draft, heel, and trim. The amount so reserved must be deducted from the values indicated.

JUN 11 19

The Loading Curves are based on the assumption that there is approximately 68 long tons of mud and residual ballast in the tanks; 57 long tons of thruster lost buoyancy; 17 long tons of miscellaneous deadweight consisting of crew, stores, small tanks, etc., and the following amount of consumables on board:

Diesel Oil	148 L. Tons (50% Full)
Lube Oil	22 L. Tons (50% Full)
Fresh Water	46 L. Tons (50% Full)
Aft Peak Water	15 L. Tons (3% Full)

for a total of 373 long tons.

(Cont'd)

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LOADING INSTRUCTIONS (Cont'd)

For each 100 long tons increase in consumables decrease the cargo in hold 6 by 130 long tons and increase the cargo in hold 4 by 30 long tons. Reverse this process for a decrease in consumables.

As a check on the values read off the Loading Curves, add the 373 long tons of consumables to the total cargo. This value should equal the total deadweight on sheet 5 for the midship keel draft selected.

Iron Ore and Pellets - Single Belt Loader (sheets 20 and 22)

For these curves (sheet 20) to be valid, the loading sequence within each hold must be followed as shown on sheet 22.

Hold	Hatch Sequence
6	23, 22, 21
5	20, 19, 18, 17
4	15, 13, 16 or 14 or 12
3	9, 11, 10 or 8
2	7, 5, 6 or 4
1	3, 1, 2

The sequence of holds can be varied. You need not complete a hold before starting another as long as the sequence within the hold is followed.

Coal

No loading curves for coal are shown since all available cubic is used; i.e., all hatches are plugged full. Thus the sequence of loading makes no difference and is left to the discretion of the loading officer.

Up to 976 L.T. of ballast may be carried in ballast tank number 7 (full sounding each tank) for trim while carrying coal. A stress curve is provided on sheet 26.

Grain

No loading curves for grain are shown since all available cubic is used; i.e., all hatches are plugged full. Thus a reasonable sequence of loading should be used and is left to the discretion of the Loading Officer.

Ballast curves are provided on sheet 25. These curves specify the ballast needed to maintain drafts of about 22'-6" aft and 17'-0" forward for stowage factors from 46 to 100 Cu. Ft. per long ton. For stowage factors below 46, ballast tank #7 is used to maintain even keel. The tankage values specified by the ballast curves are not required to limit bending stress, however, it is recommended that ballast be pumped in conjunction with loading. Stress curves for some grain cargoes are provided on sheet 26.

INSTRUCTIONS FOR USE OF TRIM DIAGRAM

The trim diagram, sheet 16, can be used to determine changes to the forward and aft drafts for loading or unloading a known weight at a given location along the length of the hull.

The use is best illustrated by an example: With an existing draft of 23 feet aft and 17 feet forward (mean draft is 20 feet), what will be the new draft if 150 long tons is added in hatch #2?

1. Draw vertical line from center of hatch #2 to CHANGE IN FWD DRAFT line for 20 feet mean draft.

2. Project horizontally from this intersection to CHANGE IN FWD DRAFT scale to read +3.1".

3. Continue vertical line to CHANGE IN AFT DRAFT line for 20 feet mean draft.

4. Project horizontally from this intersection to CHANGE IN AFT DRAFT scale to read -1.4".

5. Since these changes are for loading 100 tons and our example is for 150 tons, modify draft changes by the ratio $\frac{150}{100}$

$$\text{Fwd draft change is } \frac{150}{100} \times (+3.1") = \underline{+4.65"}$$

$$\text{NEW FWD DRAFT is } 17'\text{-}0" + 4\ 5/8" = \underline{17'\text{-}4\ 5/8"}$$

$$\text{Aft draft change is } \frac{150}{100} \times (-1.4") = \underline{-2.10"}$$

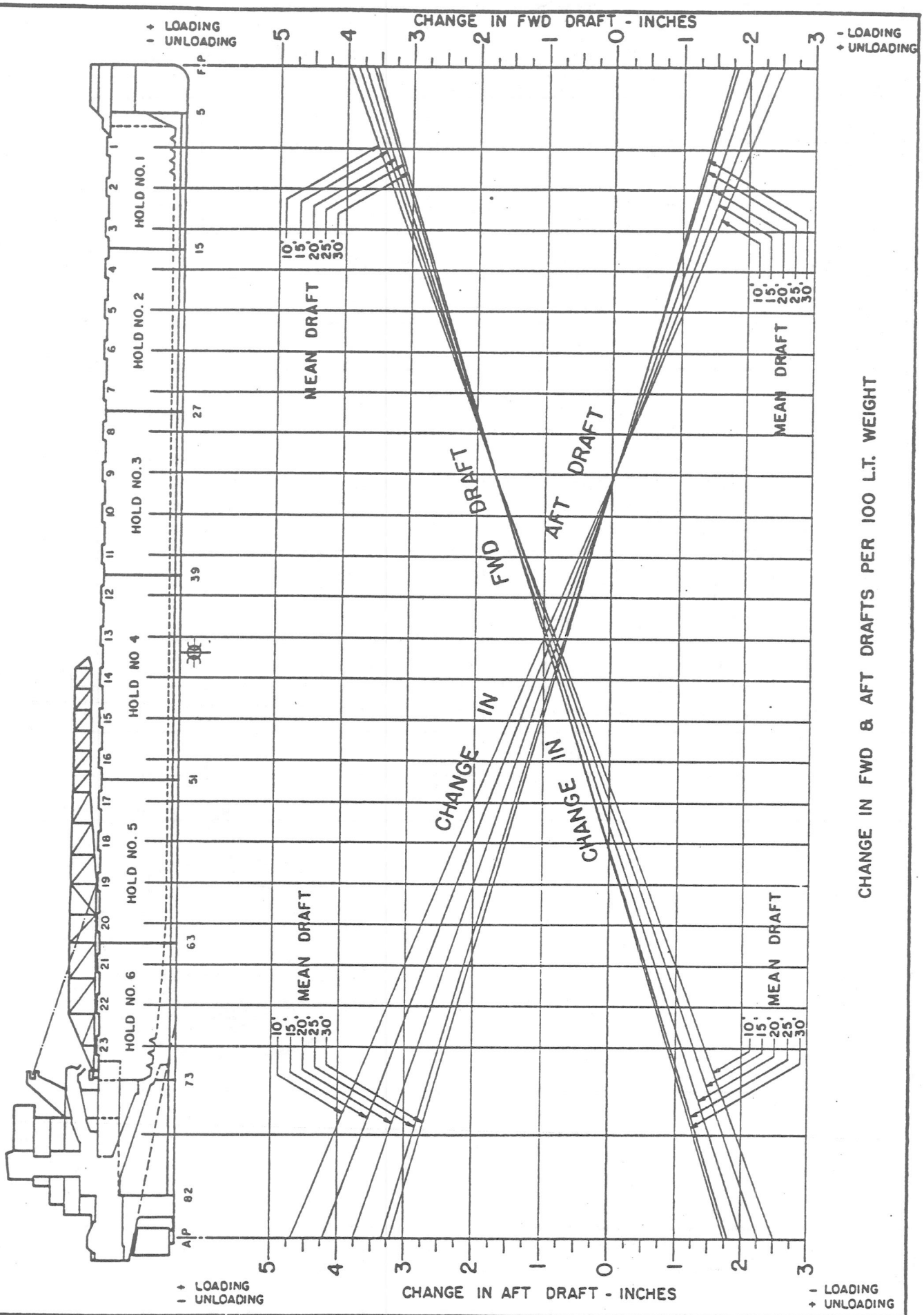
$$\text{NEW AFT DRAFT is } 23'\text{-}0" - 2\ 1/8" = \underline{22'\text{-}9\ 7/8"}$$

As the hull sinkage and trim characteristics vary with draft, five values of mean draft (average of forward and aft drafts) are shown for determining the change in draft. After loading or unloading a given amount, the new mean draft should be used for the next calculations. The position for mean drafts other than those shown may be estimated (interpolated).

Note that the sign (plus or minus) shows if the change in draft is to be added to or subtracted from the present draft, depending upon if the weight is being loaded or unloaded and the location along the hull.

Note that weight loaded or unloaded at approximately hatch #9 will not change the aft draft. Likewise, weight loaded or unloaded at hatch #17 will not change the forward draft. These points are the "holding hatches". Weight loaded or unoaded at hatch #13 will cause equal changes in forward and aft drafts.

The trim diagram can be used for determining changes in draft for adding or subtracting cargo, fuel, ballast, stores, etc. The accuracy will depend upon the estimated location along the hull length of the center of gravity of the item being considered and the estimated weight of the item.



TRIM DIAGRAM

DWG. NO.	REV.	SHT.
1468-803-3	0	16

TANK		LIGHT BALLAST	MEDIUM BALLAST	HEAVY BALLAST	MANEU-VERING	BOW THRUSTER OUT	PROP. OUT*		TANK
FORE PEAK	TONS							TONS	FORE PEAK
	SNDG							SNDG	
1	TONS			2300	936		2300	TONS	1
	SNDG			FULL	9'-10"		FULL	SNDG	
2	TONS		629	3294	2800			TONS	2
	SNDG		5'-3"	FULL	21'-5"			SNDG	
3	TONS		2800	3294	2800			TONS	3
	SNDG		21'-10"	FULL	21'-5"			SNDG	
4	TONS	2698	3500	4118	3500			TONS	4
	SNDG	16'-9"	22'-0"	FULL	21'-6"			SNDG	
5	TONS	2800	2800	3294	2800			TONS	5
	SNDG	22'-3"	21'-10"	FULL	21'-5"			SNDG	
6	TONS	269	144	3140	1258			TONS	6
	SNDG	4'-0"	2'-5"	FULL	11'-9"			SNDG	
7	TONS	0	0	0	0		0	TONS	7
	SNDG							SNDG	
	TONS							TONS	
	SNDG							SNDG	
	TONS							TONS	
	SNDG							SNDG	
	TONS							TONS	
	SNDG							SNDG	
AFT PEAK	TONS	15	15	15	15		30	TONS	AFT PEAK
	SNDG	12'-6"	12'-6"	12'-6"	12'-6"		18'-10"	SNDG	
TOTAL	TONS	5782	9888	19455	14109		2330	TONS	TOTAL
DRAFT	FWD	1'-0"	7'-0"	17'-0"	13'-0"		6'-9"	FWD	DRAFT
	AFT	19'-0"	19'-0"	22'-6"	19'-0"		8'-1"	AFT	

SAME AS LIGHT BALLAST

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	BALLAST CONDITIONS	DWG NO. 1468-803-3	REV. 0	SHT. 17

TANK			A BALLAST	B BALLAST	C BALLAST			TANK
FORE PEAK	TONS							FORE PEAK
	SNDG							
1	TONS		1100		2300			1
	SNDG		11'-6"		FULL			
2	TONS		2800	2310	3294			2
	SNDG		21'-7"	17'-3"	FULL			
3	TONS		2800	2800	3294			3
	SNDG		21'-7"	22'-0"	FULL			
4	TONS		3500	3500	3689			4
	SNDG		21'-7"	22'-2"	23'-2"			
5	TONS		2800	2800	1901			5
	SNDG		21'-7"	22'-0"	13'-7"			
6	TONS		1795	1981	3140			6
	SNDG		16'-4"	18'-4"	FULL			
7	TONS		0	0	0			7
	SNDG							
	TONS							
	SNDG							
	TONS							
	SNDG							
	TONS							
	SNDG							
AFT PEAK	TONS		15	15	15			AFT PEAK
	SNDG		12'-6"	12'-6"	12'-6"			
TOTAL	TONS		14810	13406	17633			TOTAL
DRAFT	FWD		13'-0"	9'-0"	17'-0"			DRAFT
	AFT		20'-0"	22'-0"	20'-0"			

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	BALLAST CONDITIONS	DWG NO. 1468-803-3	REV. 2	SHT. 18

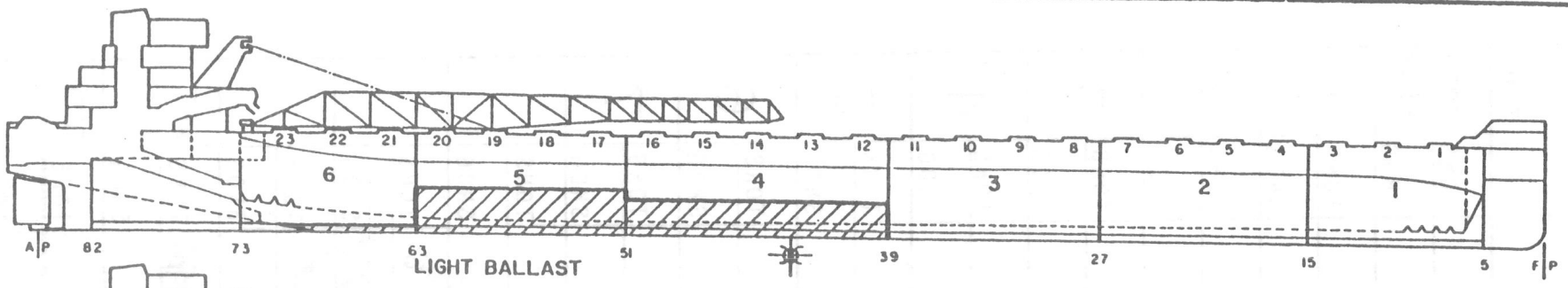
STRESS CURVES – BALLAST

DWG. NO. 1468-803-3

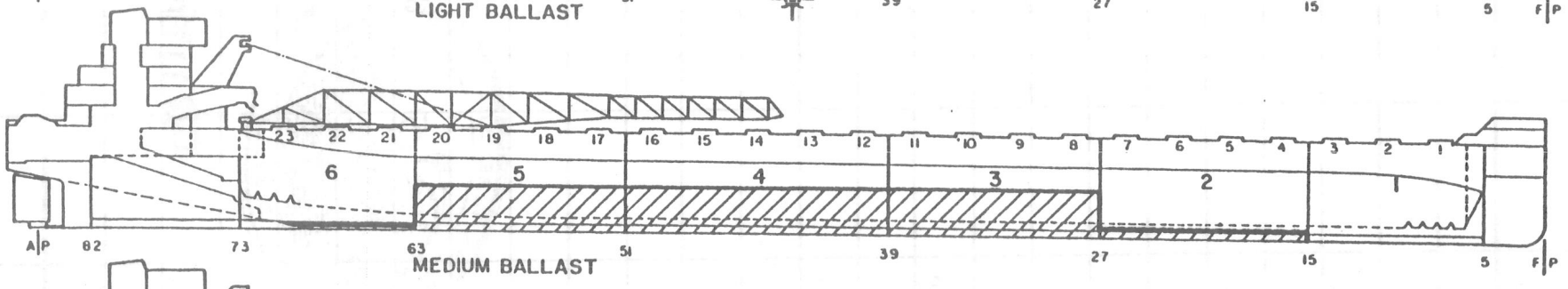
REV. 2

SHT. 19

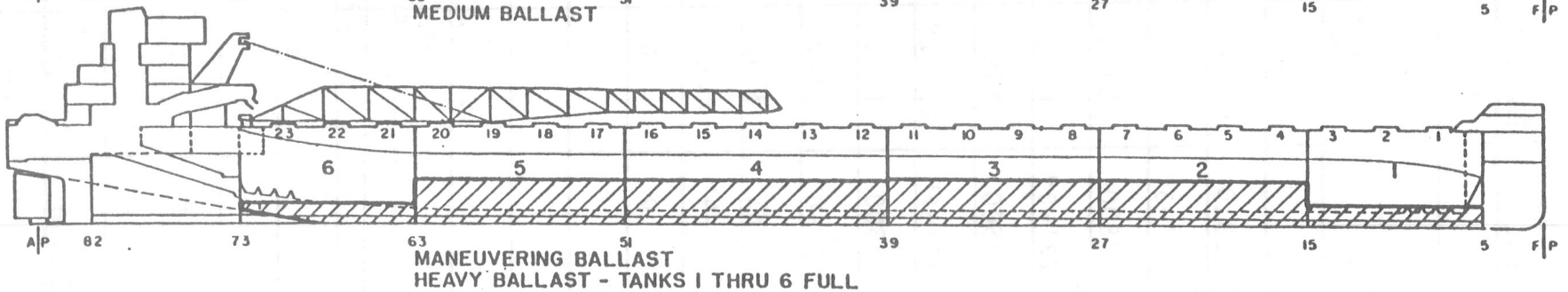
TANKAGE PROFILES



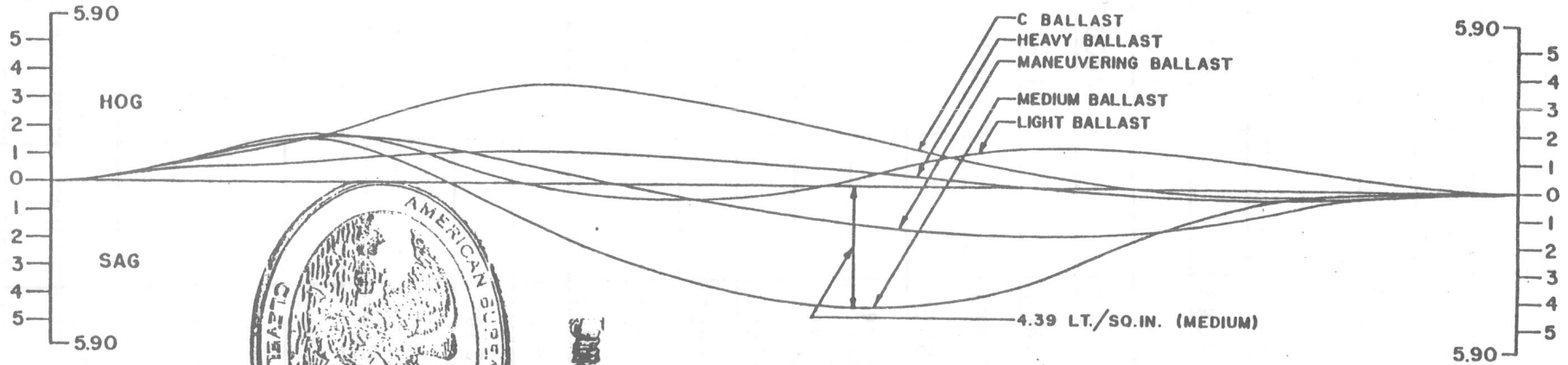
LIGHT BALLAST



MEDIUM BALLAST



MANEUVERING BALLAST
HEAVY BALLAST - TANKS I THRU 6 FULL



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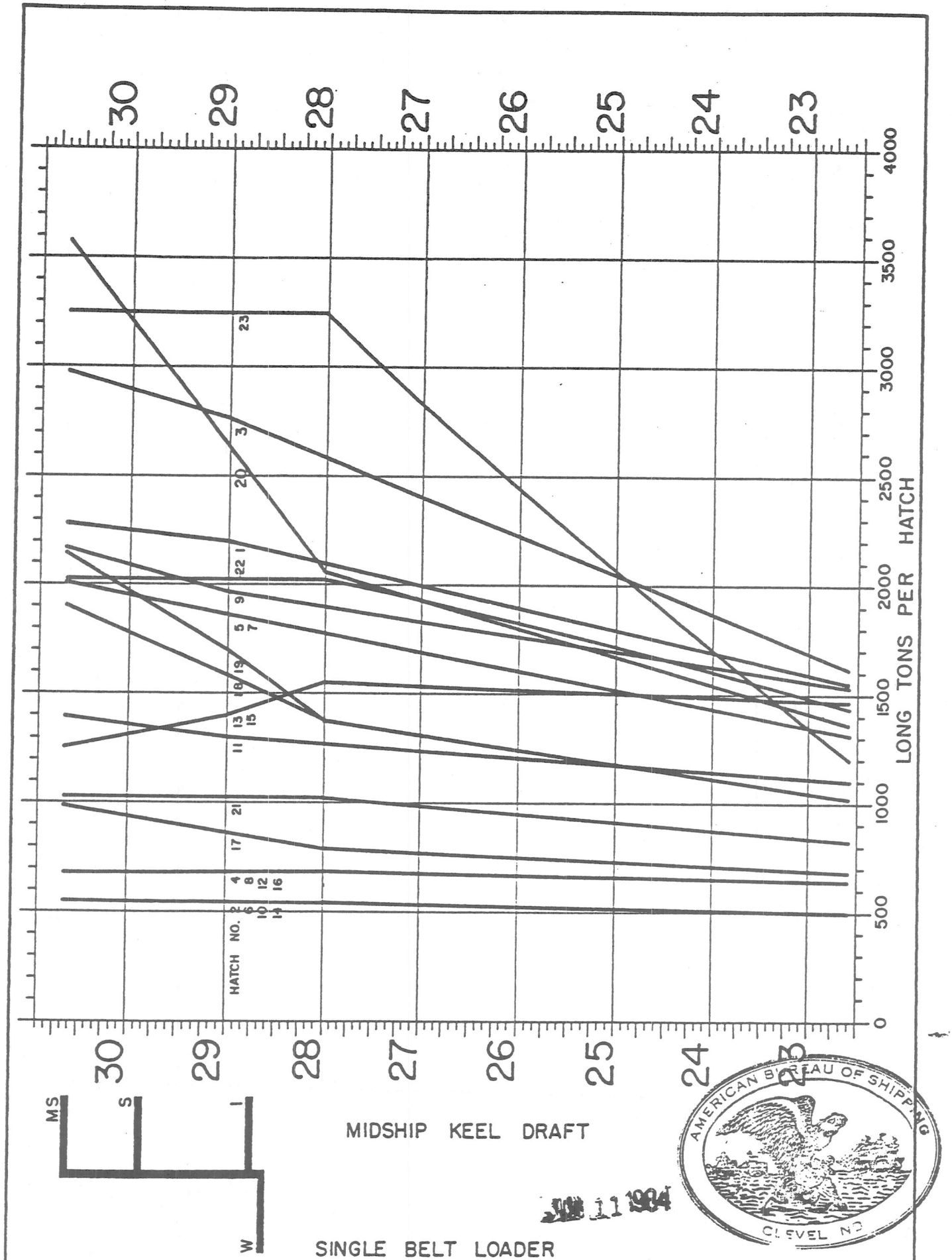
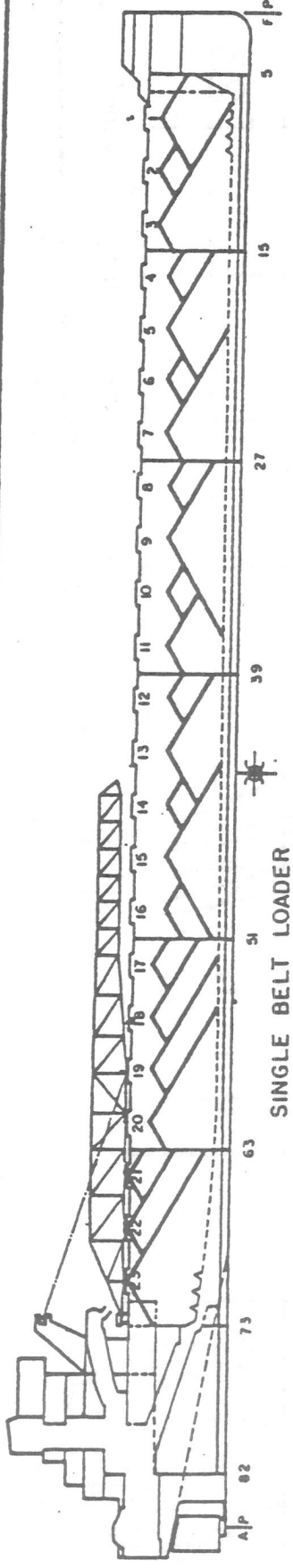
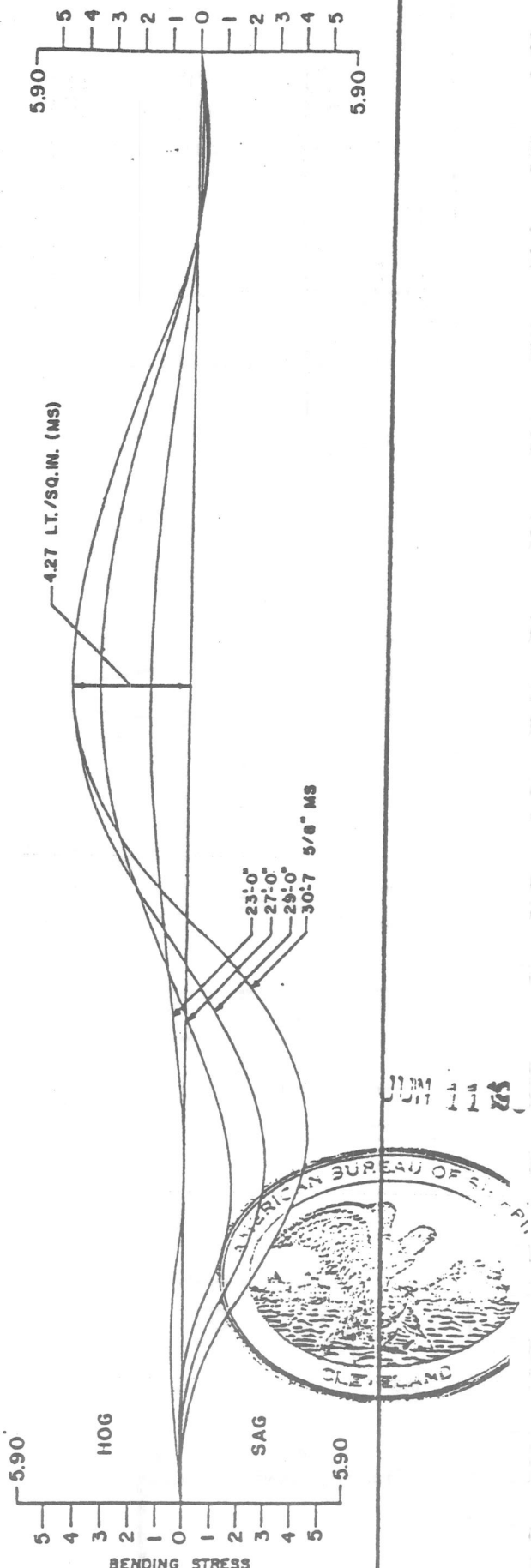


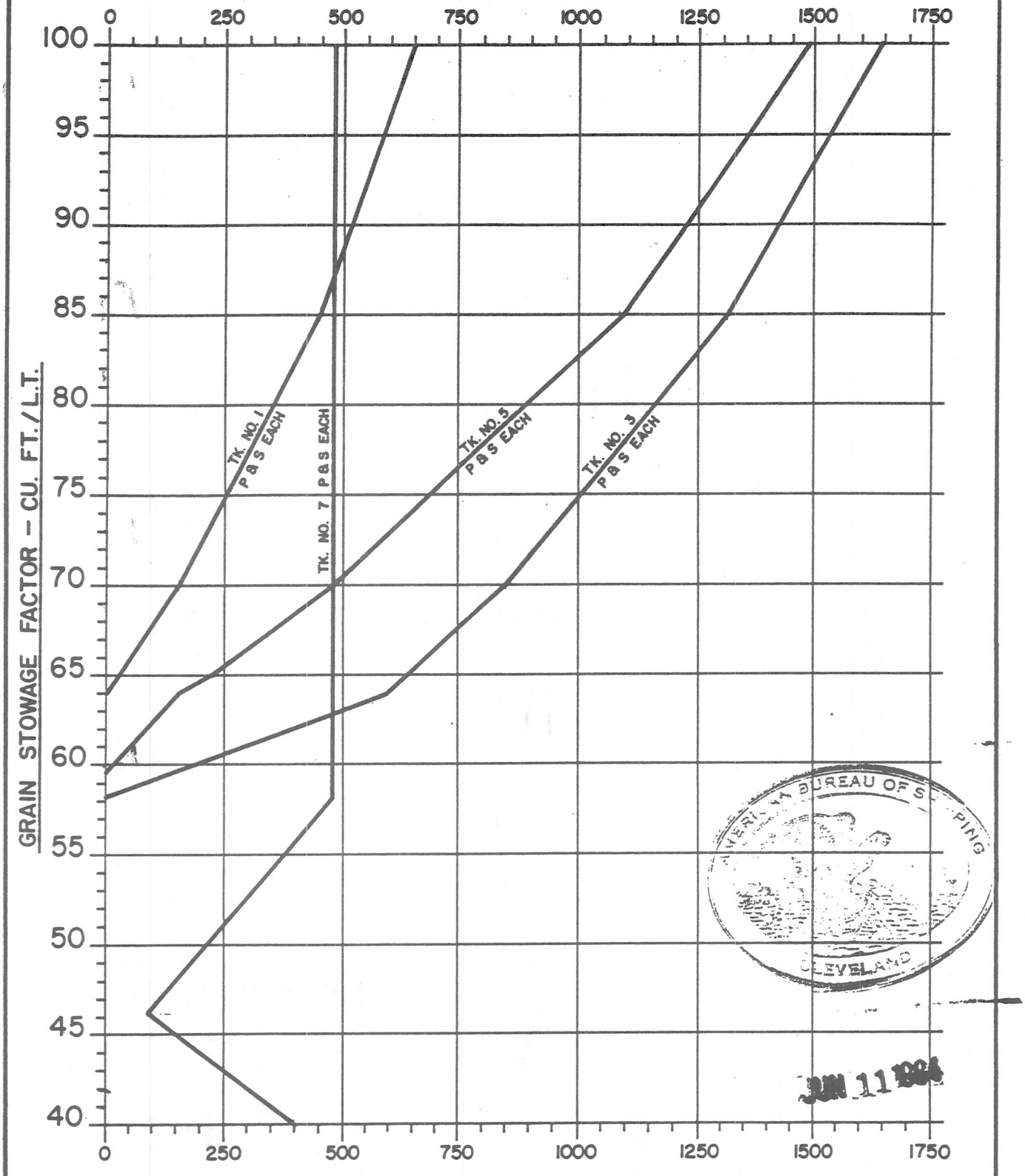
	LOADING CURVES - IRON ORE	DWG. NO. 1468-803-3	REV. 2	SHT. 20





LOADING SEQUENCE

	STRESS CURVES - IRON ORE	DWG. NO. 1468-803-3	REV. 3	SHT. 22



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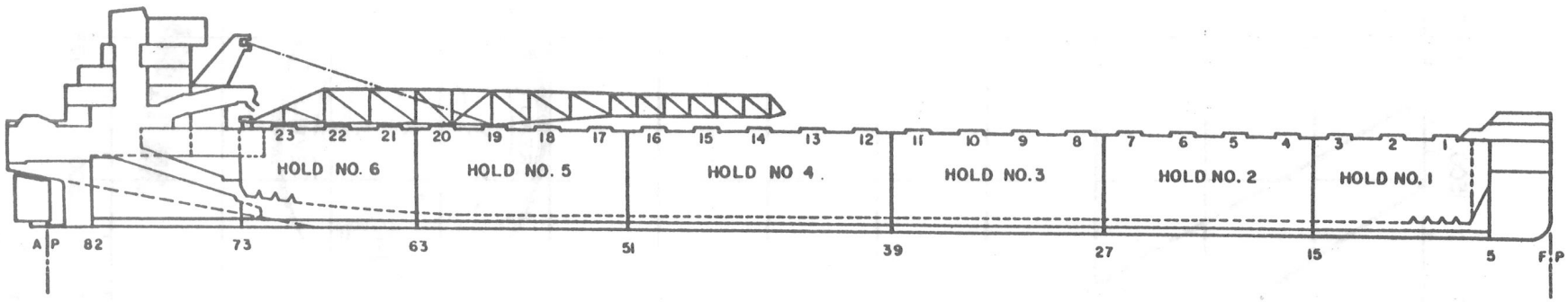
	BALLAST CURVES – GRAIN	DWG. NO. 1468-803-3	REV. 4	SHT. 25

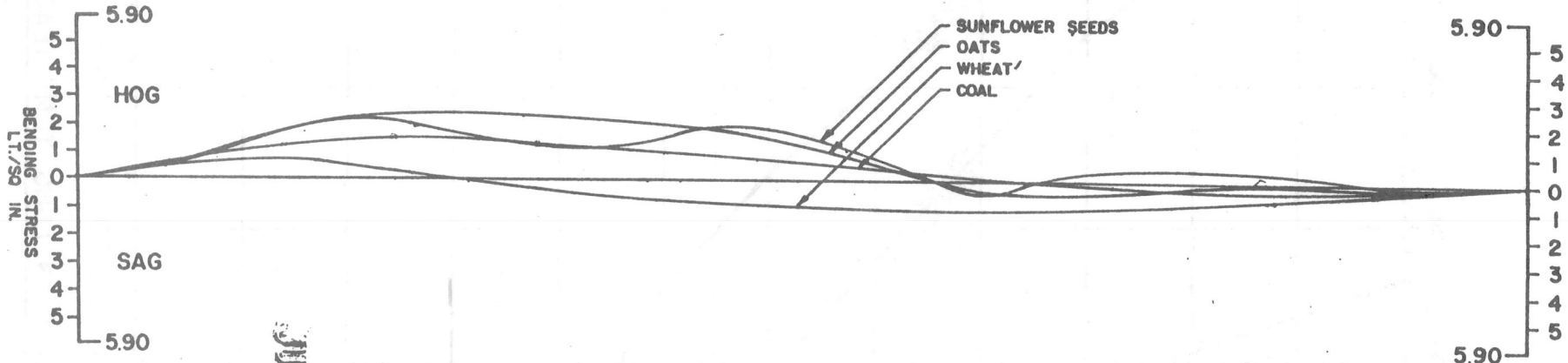
STRESS CURVES - CUBIC CARGO

DWG. NO. 1468-803-3

REV. 4

SHT. 26





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CARGO (STOWAGE FACTOR)	CARGO DEADWEIGHT	BALLAST WEIGHT	DRAFT AFT	DRAFT FWD
COAL	25450 SHORT TONS	976 LONG TONS	24'-2"	21'-3"
OATS (70.0)	15476 LONG TONS	3963 LONG TONS	22'-6"	17'-0"
SUNFLOWER SEEDS (99.6)	10876 LONG TONS	8563 LONG TONS	22'-6"	17'-0"
WHEAT (45.0)	24073 LONG TONS	285 LONG TONS	23'-3"	23'-3"