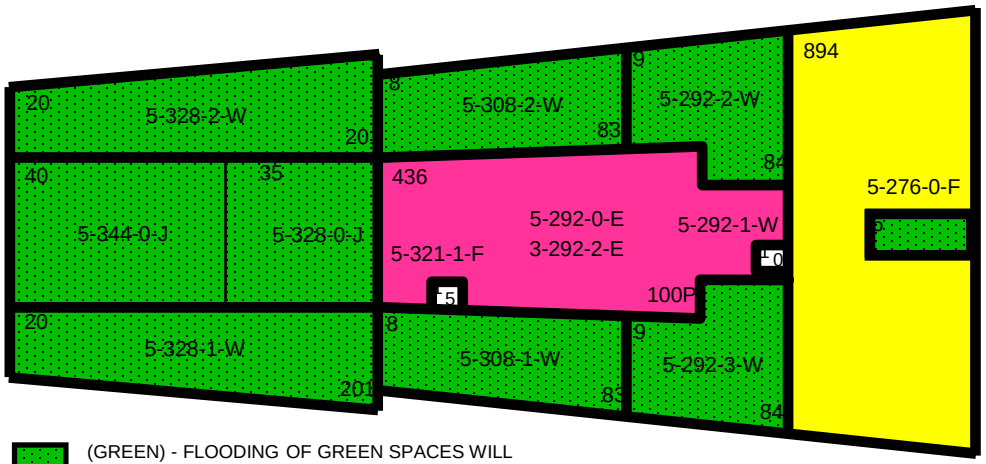
4.7 Principles of Controlling Flooding



(GREEN) - FLOODING OF GREEN SPACES WILL IMPROVE STABILITY, EVEN THOUGH FREE SURFACE EXISTS.

(YELLOW) - FLOODING OF YELLOW SPACES WILL IMPROVE STABILITY IF NO FREE SURFACE EXISTS. IF SPACE IS NOT 100% FULL STABILITY WILL BE IMPAIRED.

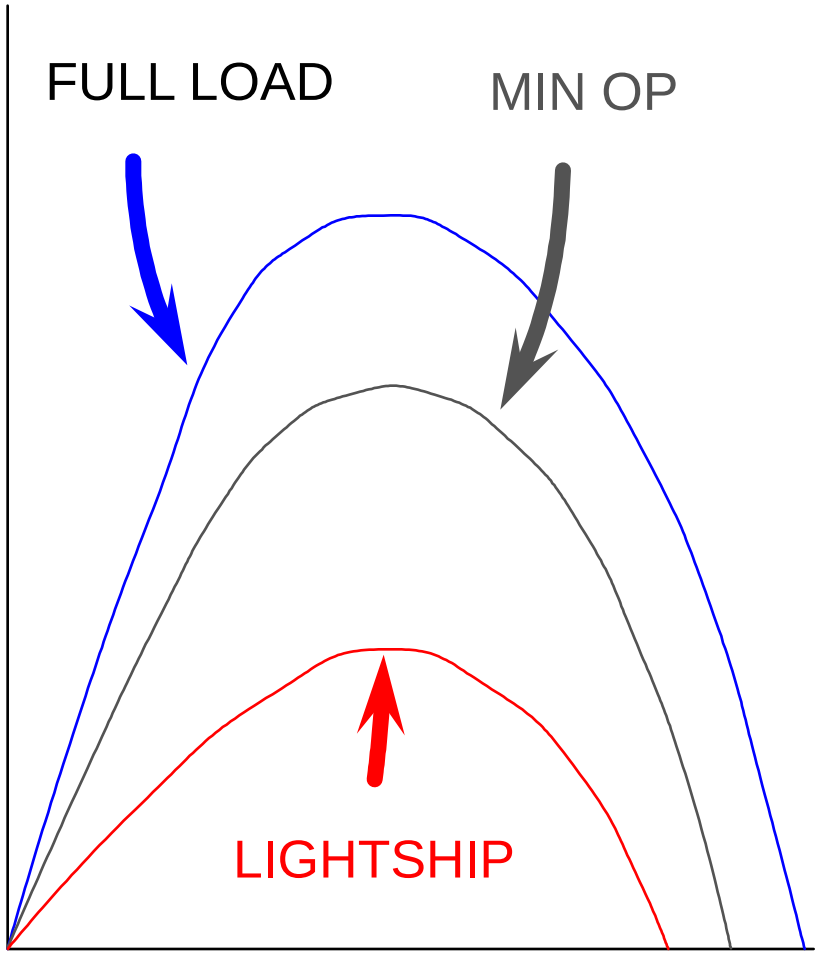
(PINK) - FLOODING OF PINK SPACES WILL DECREASE STABILITY BECAUSE OF ADDED HIGH WEIGHT, FREE SURFACE EFFECT OR BOTH.

(WHITE) - FLOODING OF WHITE SPACES HAS NO APPRECIABLE EFFECT ON STABILITY.

CAPACITY-TONS SW

COMPARTMENT NUMBER

INCLINING MOMENTS FT-T



References

a) NSTM 079 Volume 1

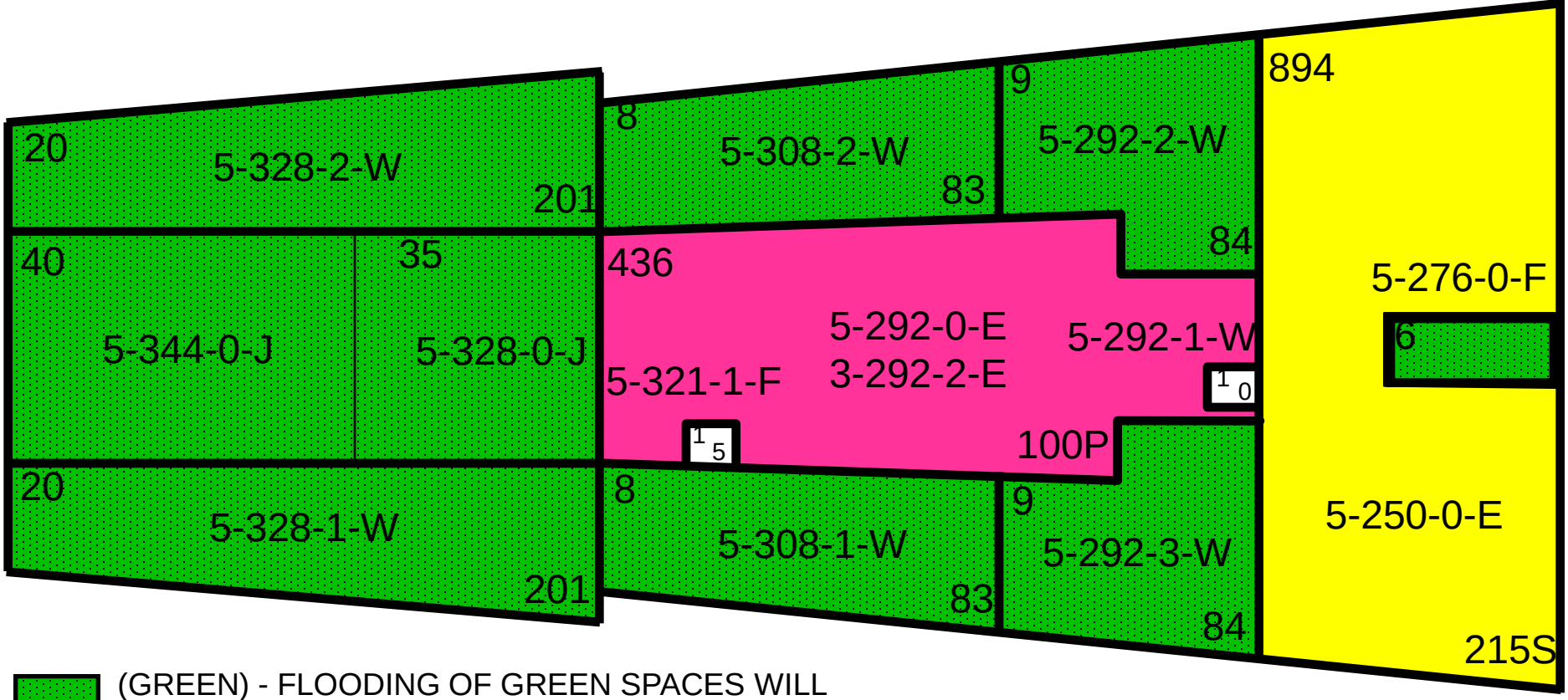
b) NTTP 3-20.31

c) Damage Control Book, section II (a)

d) OPNAV P-03C-01-89, Cold Weather Handbook for Surface Ships

Enabling Objectives

- Flooding Effects / Liquid Loading Diagrams
- Damage Control Book Specifics
- Weight / Moment Compensation
- Case Studies
- Stability Report
- Procedures to Control Flooding



(GREEN) - FLOODING OF GREEN SPACES WILL IMPROVE STABILITY, EVEN THOUGH FREE SURFACE EXISTS.

(YELLOW) - FLOODING OF YELLOW SPACES WILL IMPROVE STABILITY IF NO FREE SURFACE EXISTS. IF SPACE IS NOT 100% FULL STABILITY WILL BE IMPAIRED.

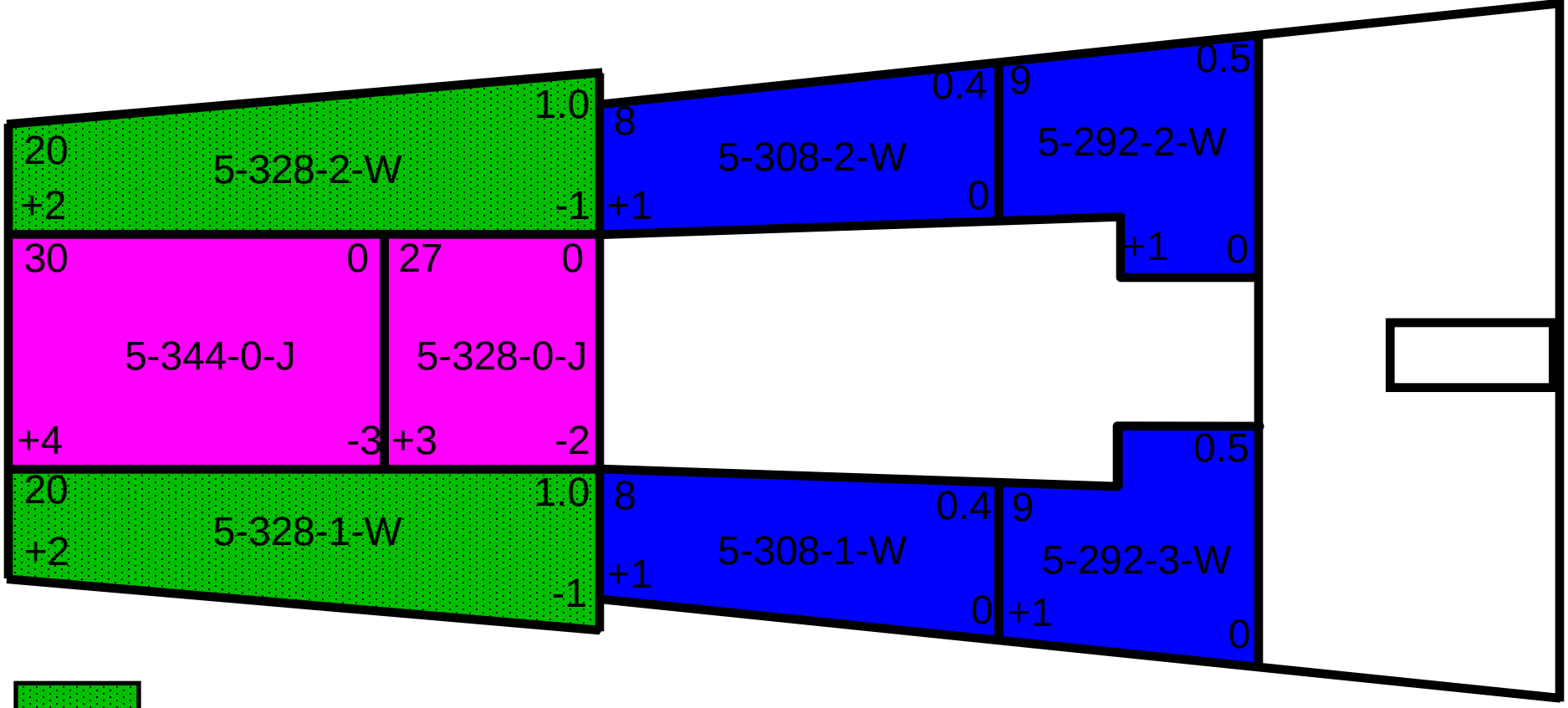
(PINK) - FLOODING OF PINK SPACES WILL DECREASE STABILITY BECAUSE OF ADDED HIGH WEIGHT, FREE SURFACE EFFECT OR BOTH.

(WHITE) - FLOODING OF WHITE SPACES HAS NO APPPRECIABLE EFFECT ON STABILITY.

CAPACITY-TONS SW

COMPARTMENT NUMBER

INCLINING MOMENTS FT-T



CLEAN BALLAST

POTABLE WATER

JP-5

CAPACITY-TONS LIST

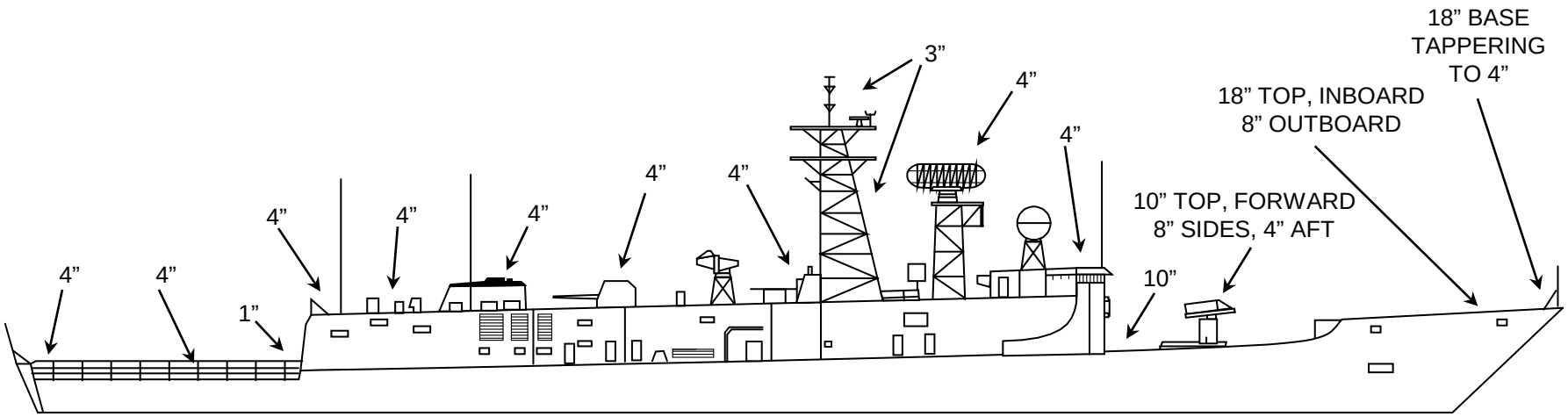
COMPARTMENT NUMBER

CHANGE IN DRAFT AFT - INCHES

CHANGE IN DRAFT FWD - INCHES

Intact Stability with Ice

- Conditions Conducive to Icing
- Ship Ballasting Plan for Topside Icing
- Outboard Profile View showing ice accumulations



Notice 12’’ of ice accumulation on hull…

- ICING VIDEO

WEIGHT AND MOMENT COMPENSATION PROGRAM

- **Status I:** No displacement or Stability problems
- **Status II:** Deficient in both margins
- **Status III:** Deficient in KG margin
- **Status IV:** Deficient in displacement margin

“Intentionally Left Blank”

“Intentionally Left Blank”

LIMITATIONS

- Follow Liquid Loading Instructions
- No Abnormal Topside Weights
- Don’t Submerge Limiting Draft Marks
- Maintain Watertight Integrity

LIMITATIONS

- Follow Liquid Loading Instructions
- No Abnormal Topside Weights
- Don’t Submerge Limiting Draft Marks
- Maintain Watertight Integrity

LIMITATIONS

- Follow Liquid Loading Instructions
- No Abnormal Topside Weights
- Don’t Submerge Limiting Draft Marks
- Maintain Watertight Integrity

DID NOT FOLLOW LIQUID LOADING INSTRUCTIONS PRIOR TO ONLOAD…


VERTICAL
CLEARANCE
15 FT. 5 IN.


VERTICAL
CLEARANCE


VERTICAL
CLEARANCE
15 FT 5 IN


VERTICAL
CLEARANCE
15 FT 5 IN


VERTICAL
CLEARANCE
15 FT 5 IN

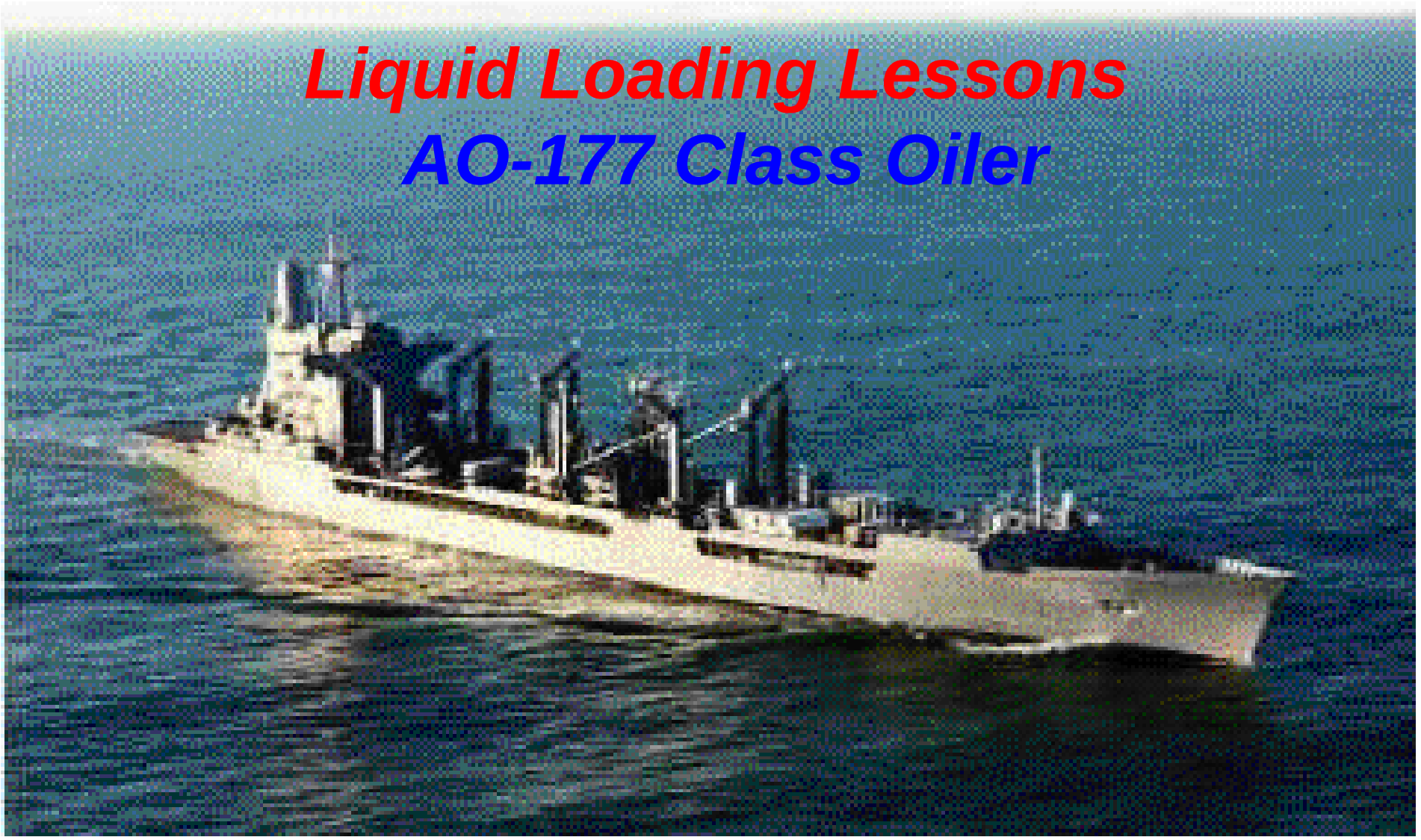

VERTICAL
CLEARANCE
15 FT 5 IN


VERTICAL
CLEARANCE


VERTICAL
CLEARANCE

Liquid Loading Lessons

AO-177 Class Oiler



Liquid Loading Lessons
AO-177 Class Oiler

- Standard Unwritten "Tradition" of trimming 4–8 feet bow–down prior to UNREP
- During UNREP ballasted bow–down by eight feet.
- During SAR ops, fwd weather deck was continuously covered with two feet of water

Liquid Loading Lessons
AO-177 Class Oiler

- During SAR ops:
  Draft fwd = >38 feet
  Draft aft = 30 feet
- DC Book States:
  1. "Trim > one foot by the bow may decrease Stability."
  2. "Limiting draft of 35 feet shall not be exceeded at bow or stern."

Liquid Loading Lessons
AO-177 Class Oiler

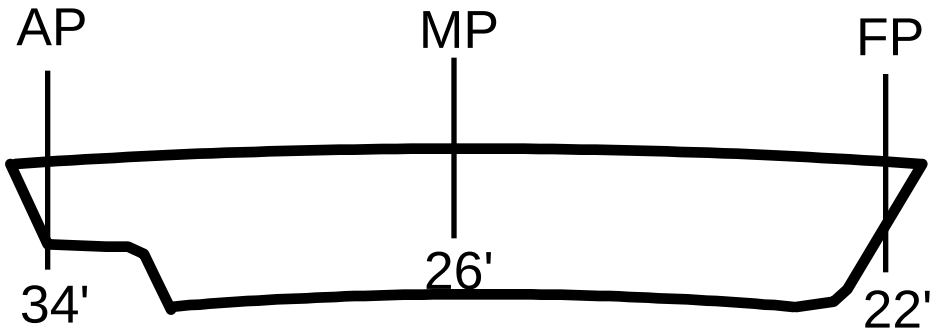
- Ship's Policy: No formal trim reports to CO after ballasting or deballasting
- Ship not retrimmed until 10 hours after UNREP secured

DAMAGE: $200K when main deck caved in due to weight of topside water

Liquid Loading Lessons
AOR-1 Class

Liquid Loading Lessons
AOR-1 Class

- Ammunition download and refueling of CV
- Ballasting of AOR–1 not conducted soon enough – excessive rolling
- Drafts after download / refueling:
  Fwd: 22 ft
  Mid: 26 ft
  Aft: 34 ft



Liquid Loading Lessons
AOR-1 Class

- Ship's hull in severe hogging and trim condition
- DC Book permits: "...no more than 3.7 ft difference between the bow and stern."
- Ship's policy was not to ballast cargo tanks unless a "serious" (undefined) condition existed.

DAMAGE: $600K of ordnance lost over the side because of excessive rolling.

Liquid Loading Lessons
AD-41

- Destroyer Tender completing ROH scheduled to conduct sea trials
- Full speed / full rudder turn required to test steering gear
- Anticipated return to shipyard following sea trials

Liquid Loading Lessons
AD-41

- LIQUID LOAD:

Diesel Fuel	23 %
Potable Water	86 %
Feed Water	98 %

- DRAFTS:

Fwd:	15' 3"
Aft:	23' 2"
Trim:	7' 11" by stern

Liquid Loading Lessons
AD-41

- DISPLACEMENT:

Lightship	13,400 LT
At incident	**16,300 LT**
Min OP Cond	18,400 LT

Liquid Loading Lessons
AD-41

- Ship speed: 20+ KTS
- Wind: NW 30–35 KTS,
  Gusts to 40 KTS
- Waves: 3–6 FT
- Anticipated heel < 20 degrees at full rudder

Liquid Loading Lessons
AD-41

- OOD requested permission to notify crew of impending rolls
- CO: "Let's see what shakes loose."
- Heeled 15 - 20 degrees, paused then rolled to 30 -35 degrees
- Righted slowly to 5 - 8 degree list

Liquid Loading Lessons
AD-41

- 27 Personnel injuries – 4 MEDEVAC
- Cabinets and Safes
- Medical tables
- Weights/ compressed air cylinders
- Piping systems

Lesson Topics

- ~~Damage Control Book~~
- ~~Flooding Effects / Liquid Loading Diagrams~~
- ~~Weight / Moment Compensation~~
- ~~Case Studies~~
- Stability Report
- Procedures to Control Flooding

Prior to damage, sit down with CO and discuss:

- Ship's danger angle
- Floodable Length
- Negative GM
- Dynamic Stability

(Iron out what information CO wants after damage)

NSTM 079V1, Rev 1 Page 16-6.

STABILITY / DAMAGE REPORT

- COMPARTMENT NAME

- CASUALTY

- LOCATION

- LEVEL OF FLOODING

- FLOODING EFFECTS CHART INFORMATION:
  Is Stability Impaired or Improved?

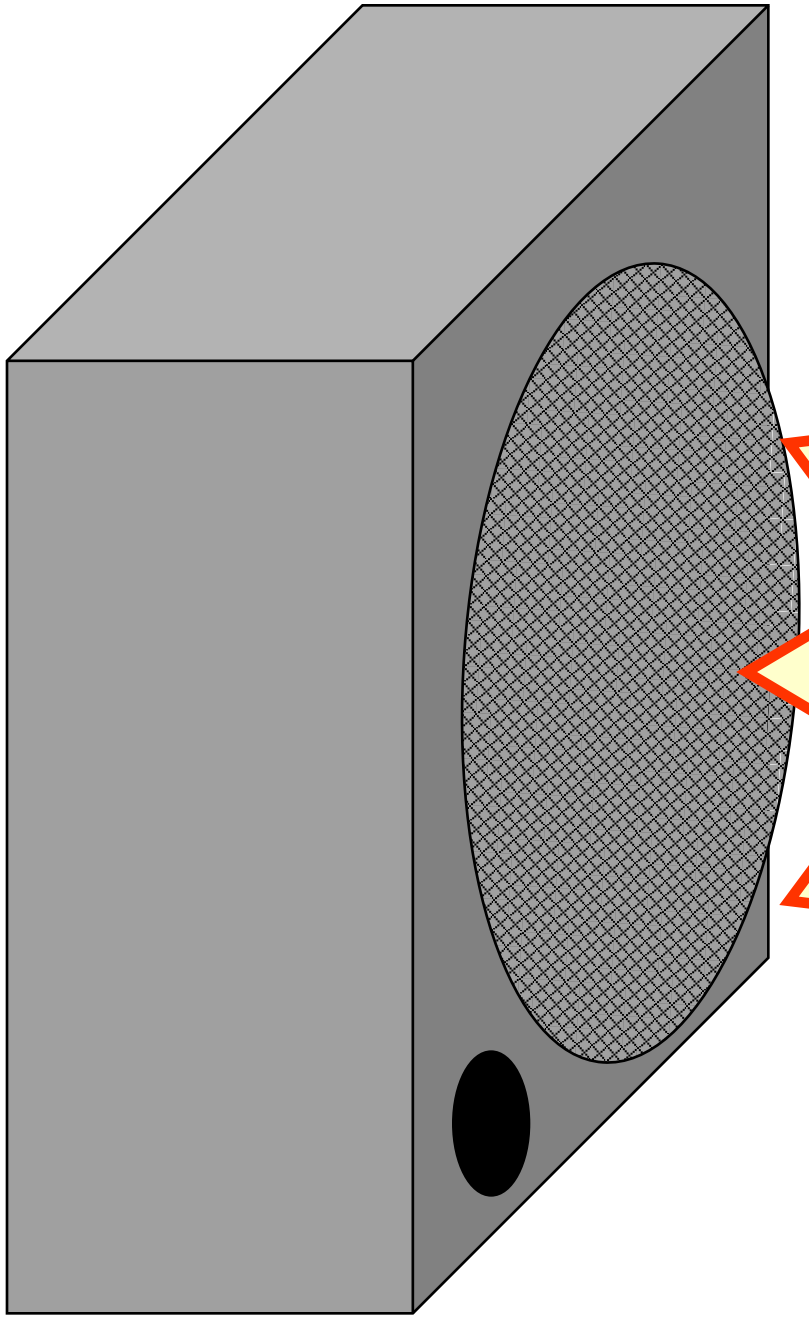
- RECOMMENDATIONS OR CURRENT ACTION

- EXPECTED LOSSES OF SHIP SERVICES:

FIRE PLUGS	AUX COOLING
DRAINAGE	CMWD
MAG SPRINKLERS	AFFF

Lesson Topics

- ~~Damage Control Book~~
- ~~Flooding Effects / Liquid Loading Diagrams~~
- ~~Weight / Moment Compensation~~
- ~~Case Studies~~
- ~~Stability Report~~
- Procedures to Control Flooding



NOW, in compt 5-250-0-E

there is a report of flooding

3 feet and rising, all hands man

your general emergency stations!

This is not a drill.

Procedures After Damage

STEP ONE -

ESTABLISH FLOODING BOUNDARIES

CANN, TEDFORD H.

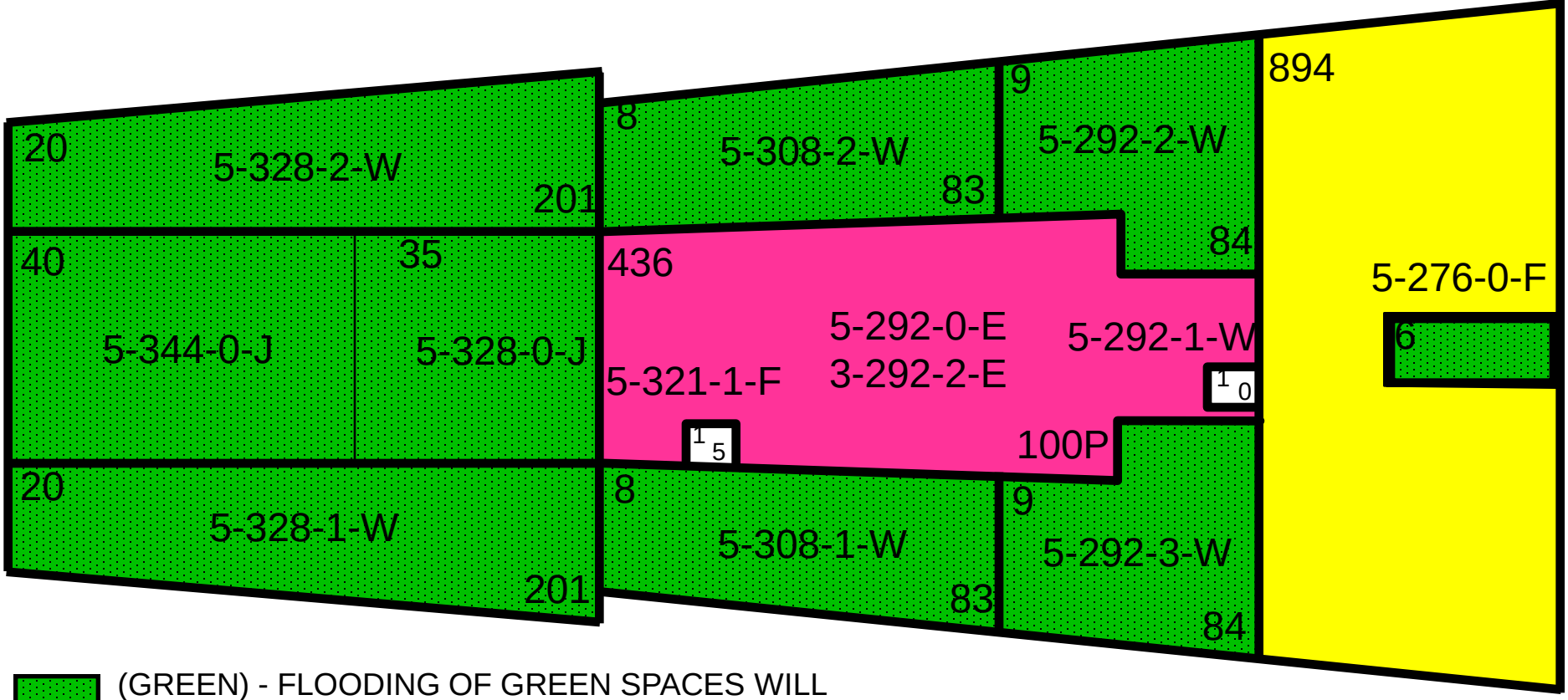
Rank and organization: Seaman, U.S. Navy. Born: 3 September 1897, Bridgeport, Conn. Accredited to: New York. G.O. No.: 366, 1918.

Citation: For courageous conduct while serving on board the U.S.S. May, 5 November 1917. Cann found a leak in a flooded compartment and closed it at the peril of his life, thereby *unquestionably saving the ship*.

Procedures After Damage

STEP TWO -

DEWATER ANY SPACE COLORED **PINK**
ON THE FLOODING EFFECTS DIAGRAM.



(GREEN) - FLOODING OF GREEN SPACES WILL IMPROVE STABILITY, EVEN THOUGH FREE SURFACE EXISTS.

(YELLOW) - FLOODING OF YELLOW SPACES WILL IMPROVE STABILITY IF NO FREE SURFACE EXISTS. IF SPACE IS NOT 100% FULL STABILITY WILL BE IMPAIRED.

(PINK) - FLOODING OF PINK SPACES WILL DECREASE STABILITY BECAUSE OF ADDED HIGH WEIGHT, FREE SURFACE EFFECT OR BOTH.

(WHITE) - FLOODING OF WHITE SPACES HAS NO APPRECIABLE EFFECT ON STABILITY.

CAPACITY-TONS SW

COMPARTMENT NUMBER

INCLINING MOMENTS FT-T

STEP THREE -

SIZE UP THE SITUATION TO DETERMINE WHETHER STABILITY IS *CRITICAL* BEFORE ANY FURTHER ACTION IS TAKEN.

REVIEW OF CRITICAL STABILITY

1. Negative GM

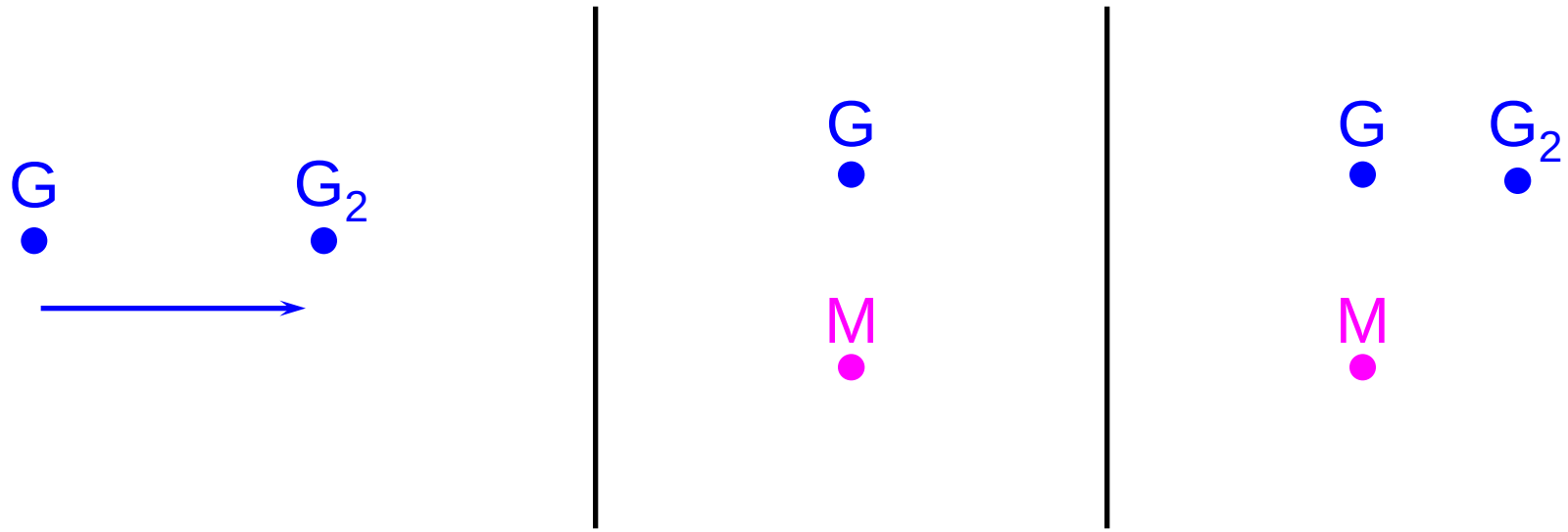
2. Listing to danger angle

3. Floodable length exceeded

4. Damage with bad weather

STEP FOUR -

ELIMINATE OR REDUCE LIST



But, its not quite that easy… **Knowing the rate of flooding is helpful in two ways:**

1. Determine if ship's dewatering capabilities can keep up with the flooding.
2. Determine time before the space is flooded solid.

"Do I send in a dewatering team…?"

Determine Rate of Flooding

Use Table 15, 079 vol 2, page 124

If not a hole, determine area of crack: 48 in x 1 in = 48 in^2

Divide area by 3.14 (or just 3): 48 / 3 = 16 in^2

Take square root of number: X^2 = 16 in^2 so X = 4 in

This number is half the diameter: Use the 8 inch hole

Estimate depth of hole/crack below waterline: 10 FT

Determine rate of flooding: **3,974 gpm**

Ship Dewatering Capacity, Section **II(c)**

Ship Class	Main Drainage	P100 @250gpm	Sub Pump @200gpm		Total Dewatering
AE	5000	5	5		7,250
AO	1000	3	3		2,350
ARS	600	3	2		1,750
CG	700	5	8		3,550
CVN	6000	7	16		10,950
DD	1250	4	6		3,450
DDG	1250	4	6		2,950
FFG	250	3	6		2,200
LHA	6600	5	14		10,650
LHD	1500	6	20		7,000
LPD	600	5	3		2,450
LSD	1000	5	5		3,250
MCM	300	3	2		1,450
MHC	300	2	2		1,200
USCG		**P100**		**Salvage Pump @180gpm**	
210’	150	3	3	2	1,780
270’	500	3	4	2	2,330
378’	600	3	4	2	2,430

Determine Time for Space FS

Previous Example was **3,974 gpm** incoming

From Plate 2 compartment "capacity" is : *894 LT*

$1\ FT^3 = 7.48\ GAL$ & $1\ LT = 35\ FT^3$

OR 1 LT per 261.8 GAL

$$\frac{1\ LT}{261.8\ \cancel{GAL}} \times \frac{\textbf{RATE OF FLOODING}\ \cancel{GAL}}{MIN} = \frac{\textbf{15.2 LT}}{\textbf{MIN}}$$

Take the capacity and divide by your answer:

$$894\ \cancel{LT} \times \frac{1\ MIN}{15.2\ \cancel{LT}} =$$

58 MINUTES TO FLOOD SOLID!!

Summary…

- Liquid Loading Diagram & Flooding Effects Diagram.
- Icing conditions and predictions/removal
- Weight Moment Compensation Program
- DC Book Limitations *(4 Limitations)*
- Procedures after damage *(4 Steps)*
  - Critical Stability *(4 Thumb rules)*

Quiz…

•What is the FIRST step in procedures AFTER damage?

ESTABLISH FLOODING BOUNDARIES

Why is a permanent LIST always bad for stability?

- *Righting Arms GZ will always be reduced due to G being off centerline.*

Instructor will now…

- Assign Homework for lesson 4.7 (Stability Problems #12, #13)
- **Read Student Guide, start reviewing EXAM Formula Sheet!!**