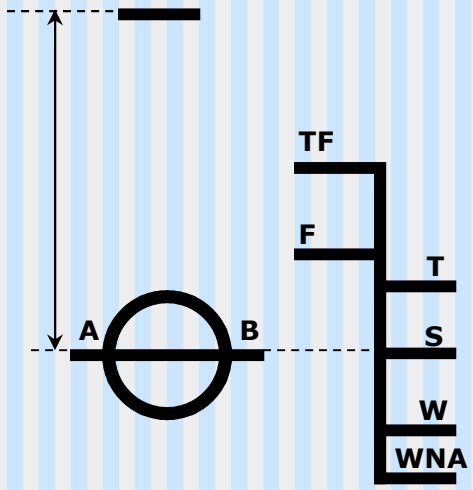
United States Coast Guard
U.S. Department of Homeland Security

OVERVIEW OF LOAD LINES



Prepared by Thomas Jordan
USCG Naval Architecture Division
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Load Line Assignment

What is a "Load line"

…and what is its purpose?

Purpose of Load Lines

A SAFETY REGIME TO SAFEGUARD THE SEAWORTHINESS OF THE INTACT (UNDAMAGED) VESSEL

By protecting its weathertight & watertight integrity

Purpose of Load Lines

How is this accomplished?

Two Parts of LL Assignment

Freeboard Assignment

- Reserve buoyancy
- Improves seakeeping
- Reduces water on deck

Conditions of Assignment

- Stability
- Strength of hull
- Watertight features
- Weathertight features
- Protection of crew

Hull Markings
(to verify not overloaded)

Periodic Inspections
(to verify working condition)

Strategic Elements of LL Assignment

What are the strategic elements of LL?

Strategic Elements of LL Assignment

- *Ensure robustly-constructed hull & deckhouses*
  - *That can withstand severe sea conditions,*
- *Safety features that are built into vessel*
- *Limit fully-loaded vessel to a safe draft*
  - *Indicated by Plimsoll circle & associated LL marks on hull*
- *Approve stability information for master*
  - *To allow calculation of vessel's center of gravity, draft & trim under various fuel & loading conditions*
  - *To ensure within safe limits for duration of voyage*

Strategic Elements of LL Assignment

- *Prevent seawater from getting into vessel interior*
  - *Weathertightness above freeboard deck*
  - *Watertightness below freeboard deck*
  - *Shut-off valves on thru-hull piping penetrations*
- *Freeboard*
  - *Minimum midship height above waterline*
  - *Minimum bow height above waterline*
- *Protection of crew working on deck*

Strategic Elements of LL Assignment

- *Plan review & construction surveys*
  - *By LL-assigning authority (class society)*
  - *Verify that vessel design has LL features*
  - *Verify construction workmanship in shipyard:*
    - *Vessel is constructed iaw approved plans, with proper [steel] material, properly-certified welders, etc.*
  - *Final survey to verify that LL marks are properly located*
  - *LL certificate issued on delivery*
- *Periodic in-service surveys*
  - *Verify that LL safety features are in good working condition*
  - *No modifications to vessel that compromise its seaworthiness*
  - *Drydocking & inspection of UW hull (plating & penetrations)*

Load Line Safety Features

What are the LL safety features?

Load Line Safety Features

- *Door sills & coamings on vents, air pipes & hatches*
  - *To keep out water-on-deck when open*
- *Weathertight closures for openings into deckhouses & penetrations thru the freeboard deck*
  - *Doors, bulkhead vents, air pipes & tank vents*
- *Weathertight hatch covers*
  - *Steel (or equivalent), gasketed & clamped*
  - *Designed for specific hydrostatic loads (205 psf—358 psf)*
- *Deadlight (storm) covers*
  - *For exposed windows & portholes on lower deckhouse tiers*

Load Line Safety Features

- *Freeing ports in bulwarks*
  - *To allow rapid overboard drainage of water-on-deck*
- *Watertight closures for openings in hull*
  - *Cargo doors, loading ports, etc, that are below freeboard deck*
- *Control valves for thru-hull piping penetrations*
  - *Shut-offs on inlets & discharges (in event of pipe failure)*
  - *Check valves on scuppers & drain lines (to prevent backflow)*
- *Guard rails*
  - *Around deck edges*
  - *Along exposed on-deck walkways to bow, stern, quarters & other areas necessary for safe operation of vessel*

Load Line Stability

What about stability?

Load Line Stability

- *Vessel master must be furnished with approved stability & loading information in order to:*
  - *Calculate vessel's draft, displacement and centers of gravity under various fuel & loading conditions…*
  - *…to ensure it is within safe limits for the duration of voyage.*
- *Stability "Inclining test"*
  - *Determines "light ship" (empty) displacement, VCG & LCG*
  - *Subsequent "deadweight survey" may be required to evaluate how much displacement & LCG has changed since inclining*
  - *Vessel must be re-inclined if there are significant changes to its light ship characteristics*

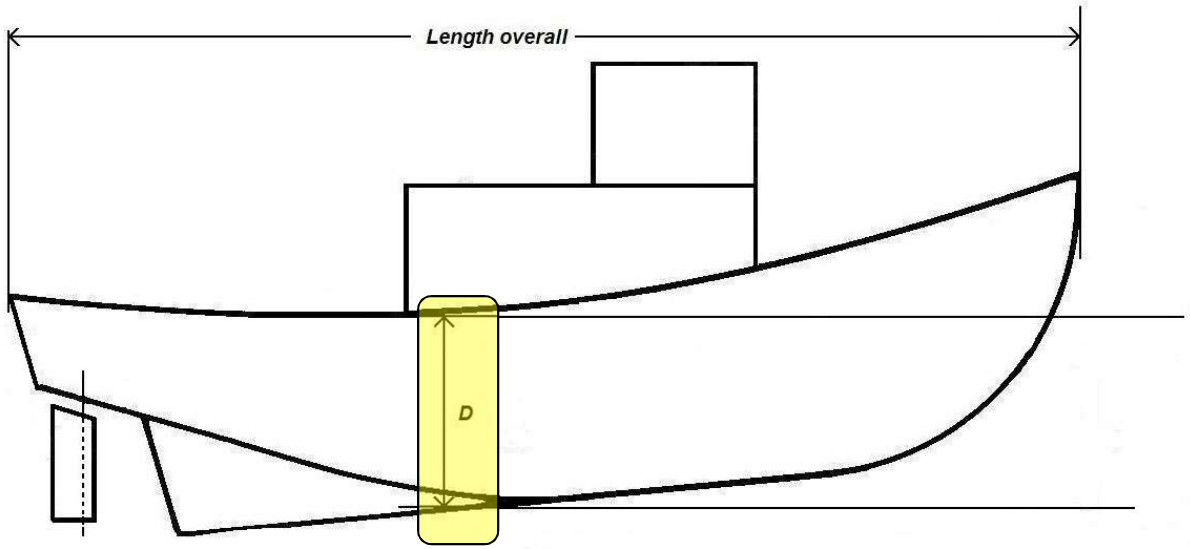
Load Line Stability

- *"Trim & Stability Book" (or computer)*
  - *Light ship characteristics (Displacement, VCG & LCG)*
  - *Hydrostatic characteristics (Draft vs displacement, LCF, etc)*
  - *"Required GM" curve (stability limits for VCG at various drafts)*
  - *Tables of variable & consumable weights & CGs*
    - *Tanks (fuel, potable water, ballast, stick water)*
    - *Cargo loads (fish, bait, tendering supplies)*
    - *Equipment & outfitting (nets, crab pots, etc)*
    - *Other (crew & effects, provisions, etc)*
  - *Pre-calculated voyage loading conditions*
    - *Departure (100% fuel, bait, provisions, pots, no fish cargo, etc)*
    - *Intermediate (50% fuel, bait provisions, fish cargo, etc)*
    - *Arrival (10% fuel, 100% fish cargo, 10% provisions, no bait, etc,)*
  - *Worksheets for master to perform alternate loading calculations*

Freeboard Assignment

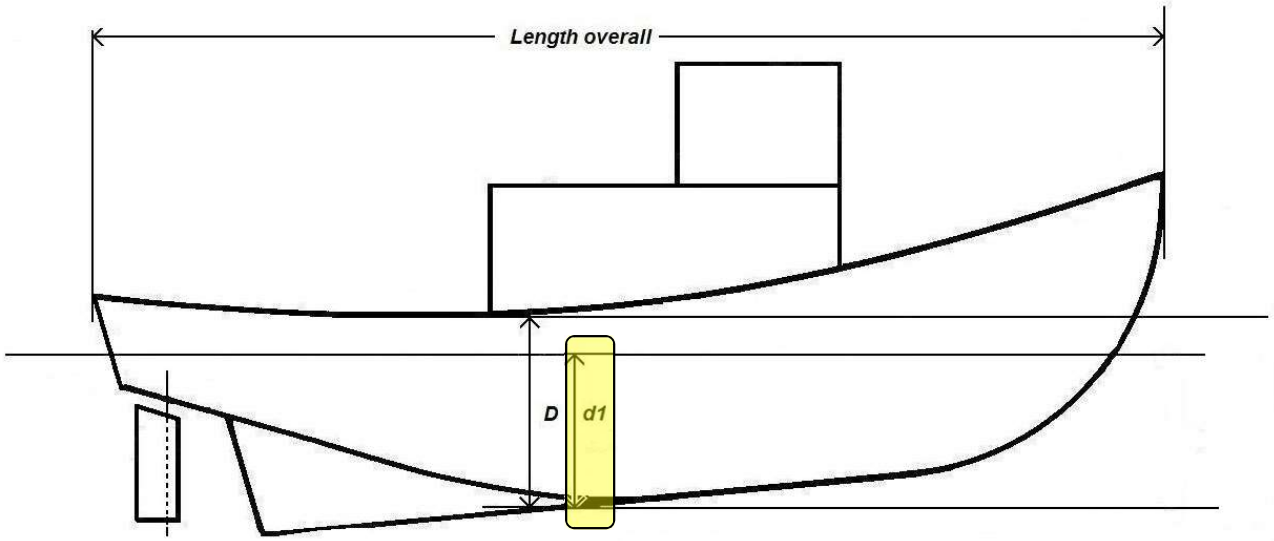
How is LL length determined?

Load Line Length



D = Least molded depth ***(shortest vertical height from keel to deck edge)***

Load Line Length



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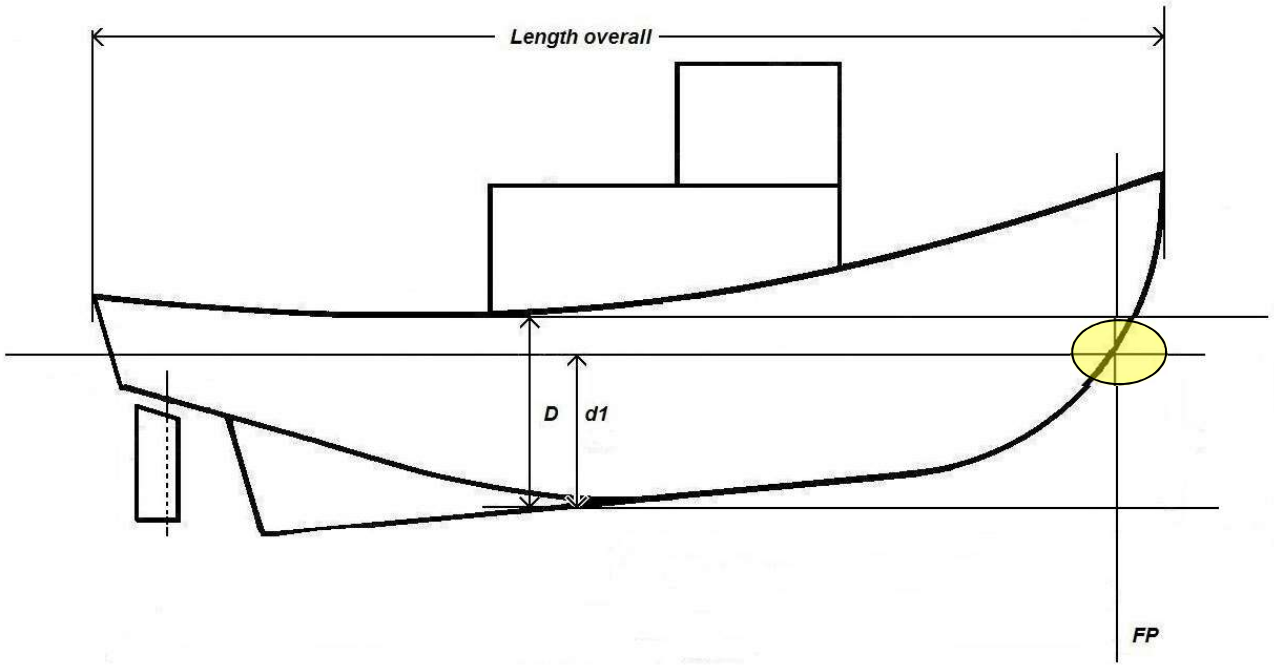

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FP = Forward perpendicular ***(where d1 waterline crosses stem)***

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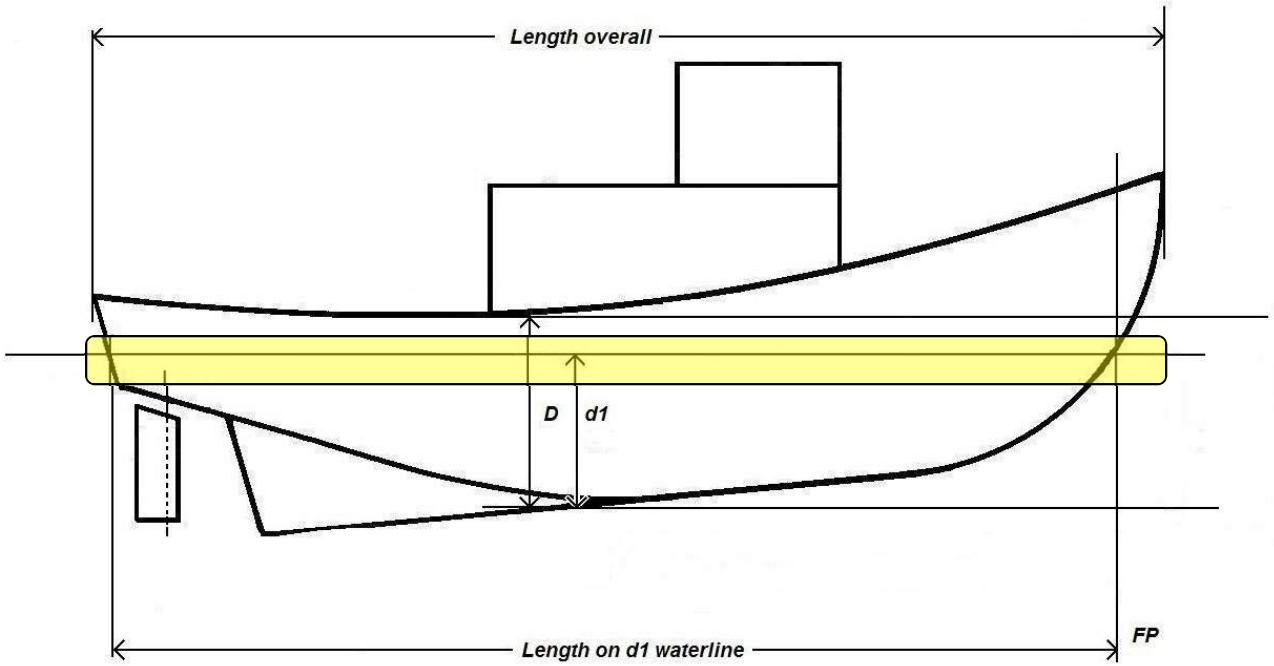

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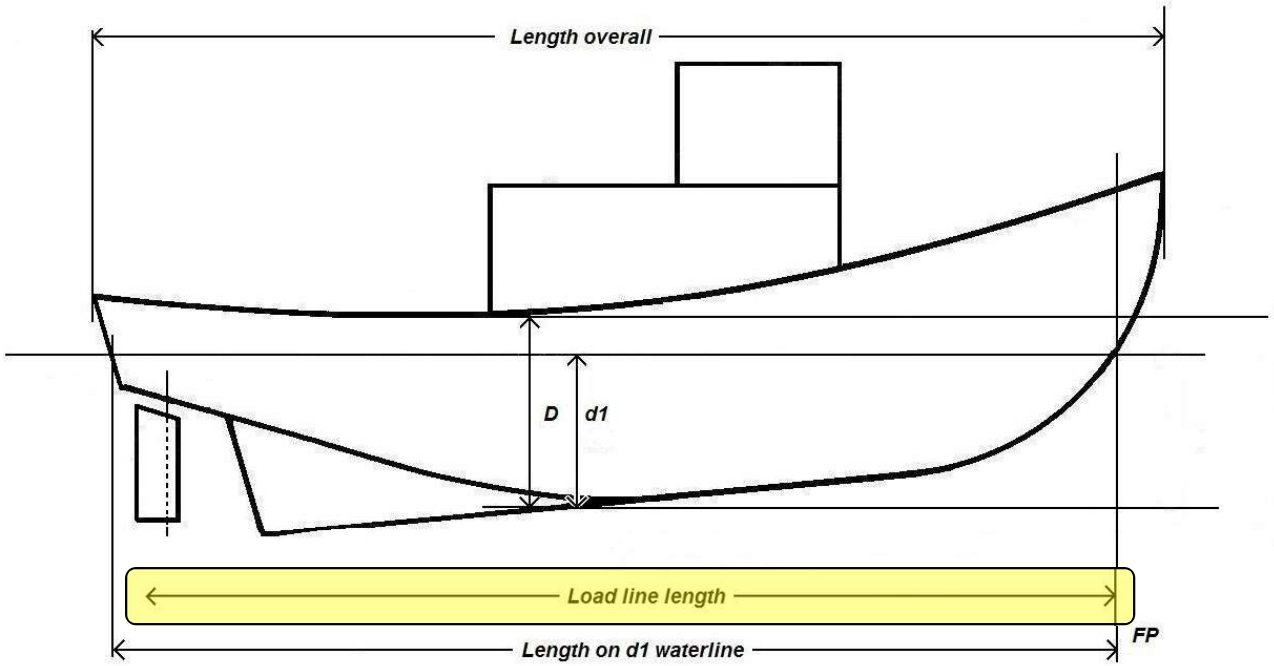
LL Overview

Load Line Length



D = Least molded depth ***(shortest vertical height from keel to deck edge)***
d1 = Waterline at 0.85D ***(measured up from keel)***
FP = Forward perpendicular ***(where d1 waterline crosses stem)***
LL length = Length between FP & rudder axis, or 96% of d1 waterline length
(whichever is longer)

Purpose of Freeboard Assignment

Why freeboard?

Purpose of Freeboard Assignment

LL restricts the maximum loaded draft of the vessel by requiring a minimum freeboard above the waterline…

…This keeps a portion of the hull volume above water as reserve buoyancy…

…which improves seakeeping and reduces boarding seas (water on deck) during heavy weather.

Freeboard Assignment

How is LL freeboard determined?

Freeboard Assignment

- *Freeboard tables, based on vessel's length*
  - *150 ft vessel: 15.5 inches*
  - *250 ft vessel: 32.4 inches*
- *Adjusted for certain dimensional characteristics*
  - *Increased for flush-deck vessels less than 328 ft*
  - *Credits/penalties for superstructure, block coefficient, sheer…*
  - *Penalty for inadequate bow height (above waterline)*
- *Result = Freeboard assignment (Summer freeboard)*
- *Verification that LL draft is acceptable*
  - *Stability*
  - *Hull strength*

Freeboard Assignment

How are the LL marks determined?

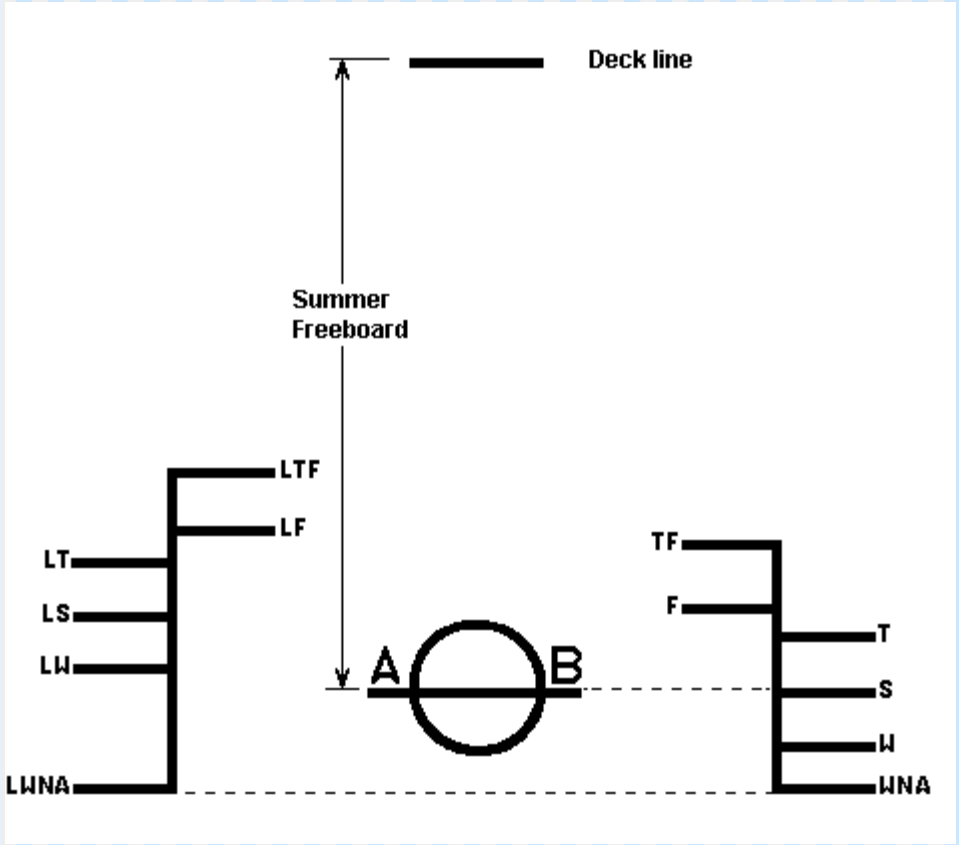
Load Line Marks

- *Freeboard Deck*
  - *Designated deck that forms upper boundary of hull volume*
  - *Usually the uppermost continuous deck exposed to weather*
- *Deck line mark*
  - *Freeboard deck edge*
  - *Base point from which freeboard assignment is measured*
- *"Plimsoll" mark*
  - *Named for Samuel Plimsoll, Parliament, 1876*
  - *Located at midship of LL length*
  - *Horizontal line located at freeboard below deck line mark*
  - *Initials of LL-assigning authority (class society)*

Load Line Marks

- *Additional marks: Density, zones & seasons*
  - *Marks located on "ladder" forward of Plimsoll mark*
  - *Marks for loading cargo in fresh water (river) ports:*
    - *Fresh water (F)*
    - *Tropical Fresh water (TF)*
  - *Marks for salt water voyages in designated seasons:*
    - *Summer (S)*
    - *Tropical (T)*
    - *Winter (W), and*
    - *Winter North Atlantic (WNA) for vessels less than 328 ft*
  - *Also separate marks (aft of Plimsoll) for log & lumber carriers*

Load Line Marks



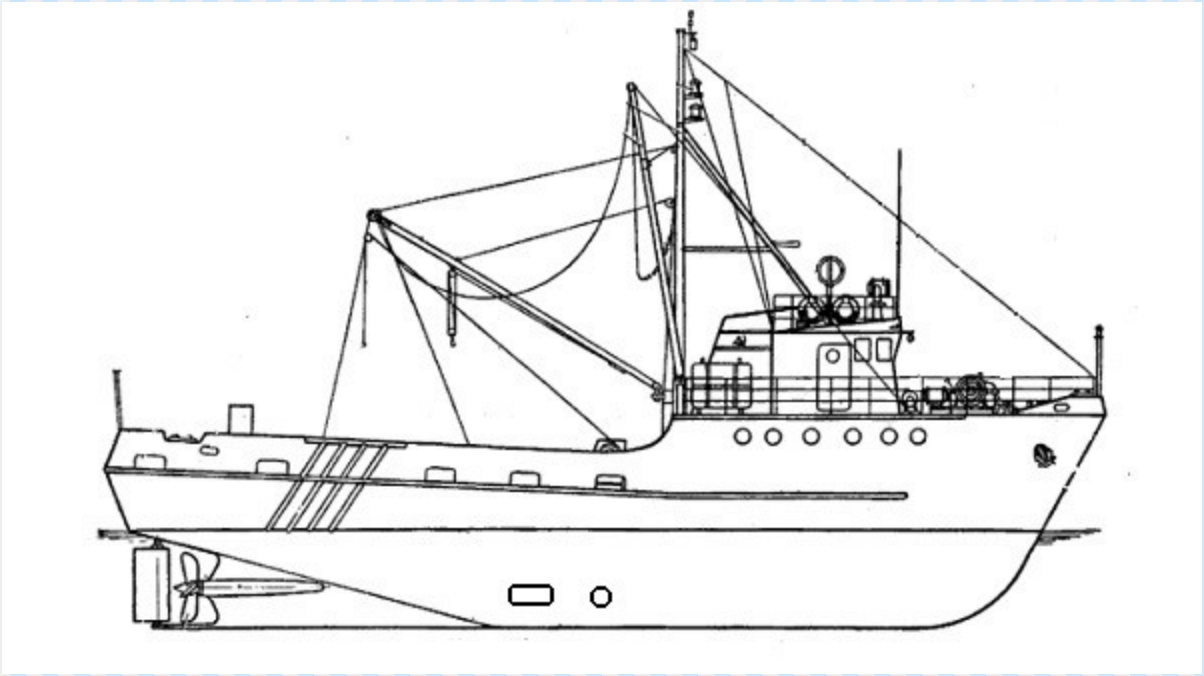
North Pacific LL zone

- *North Pacific LL waters bounded by:*
  - *Rhumb line from Cape Muzon (Dall Island, AK) to 35°N, 150°W;*
  - *Westwards along parallel 35°N to longitude 145°E;*
  - *Northwards along meridian 145°E to Hokkaido shore (Japan);*
  - *Wakkanai (north tip of Hokkaido) to south tip of Sakhalin Island;*
  - *Parallel 50°N between Sakhalin & Russian shores.*
- *North Pacific LL seasons:*
  - *Summer (S): 16 April to 15 October*
  - *Winter (W): 16 October to 15 April*
- *Freeboard increase between summer & winter marks:*
  - *1/48 of vessel's LL draft at summer (S) marks*
  - *Example: if summer LL draft = 14 feet, then winter draft decrease = 3½ inches*

Existing [non-LL] Fishing Vessels

What about existing fishing vessels that have never been load lined?

Existing [non-LL] Fishing Vessels



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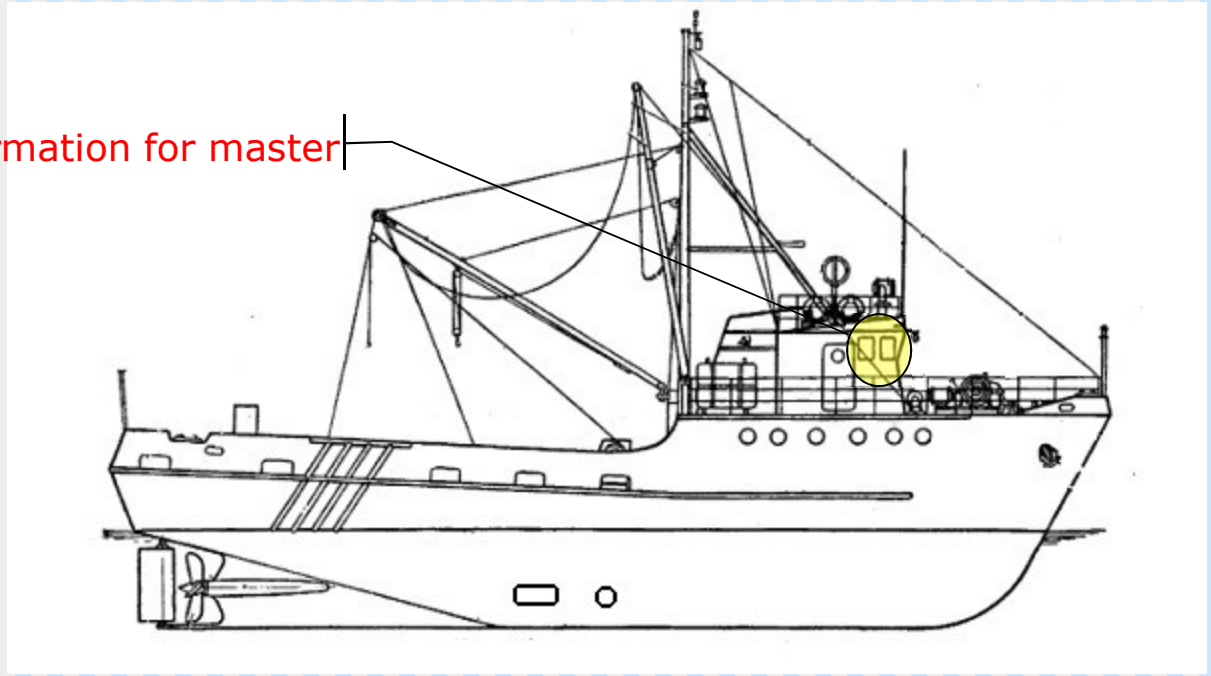
Existing [non-LL] Fishing Vessels



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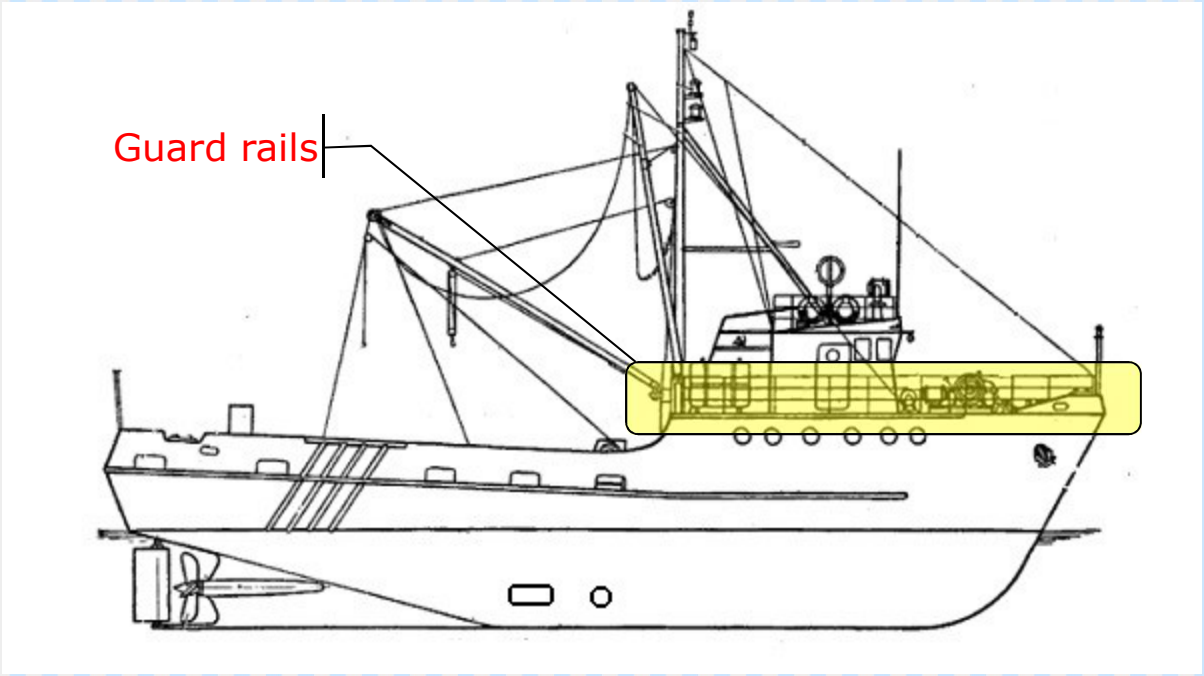

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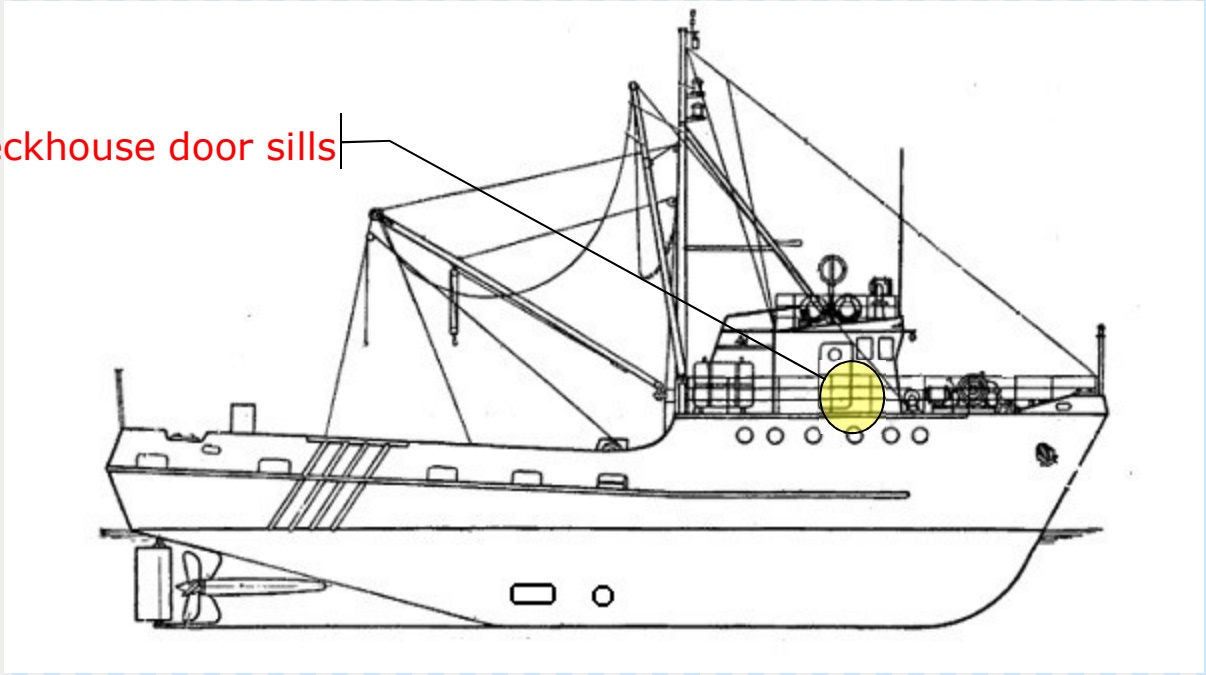

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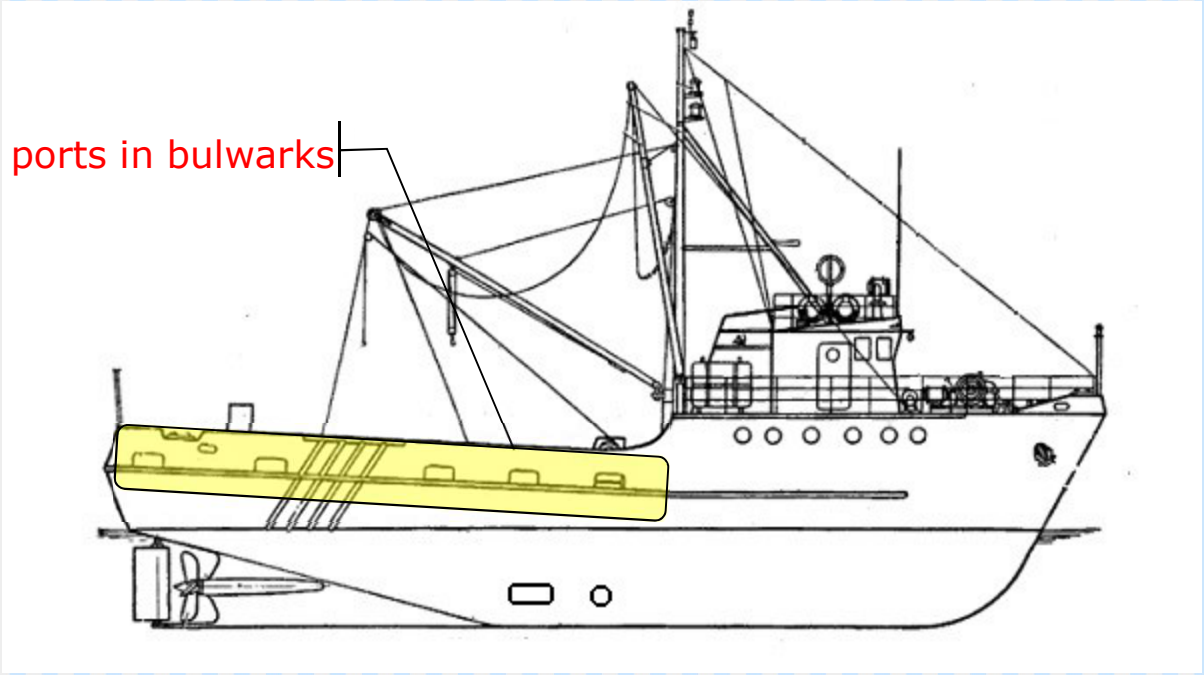

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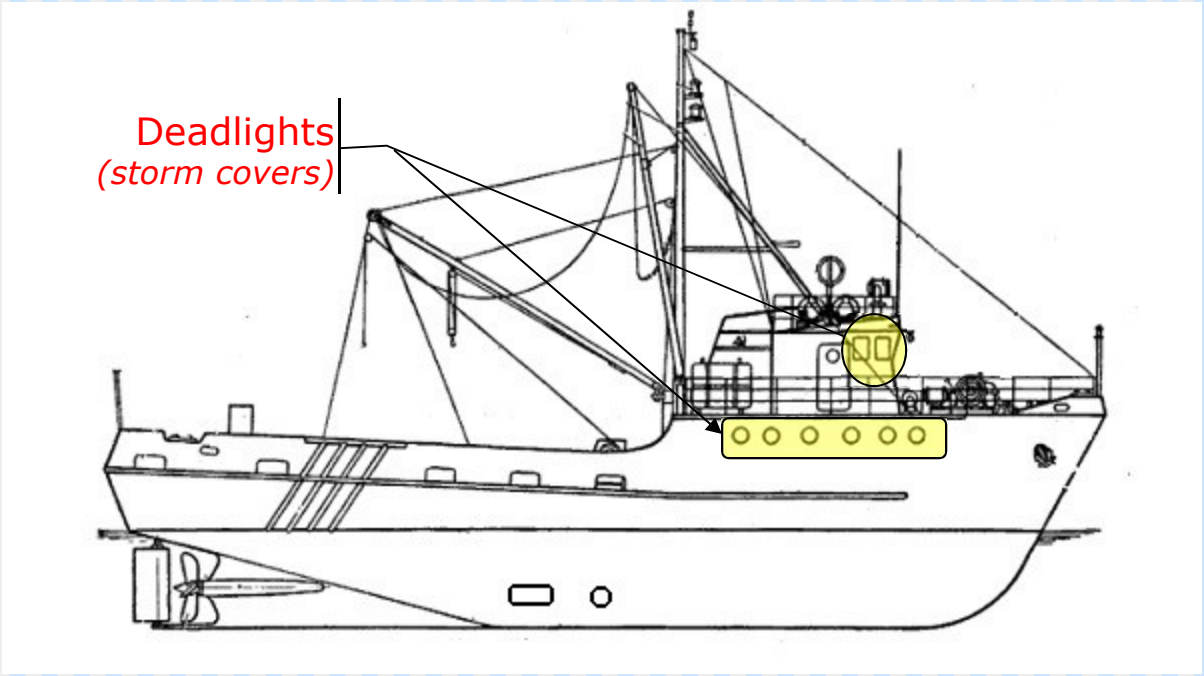

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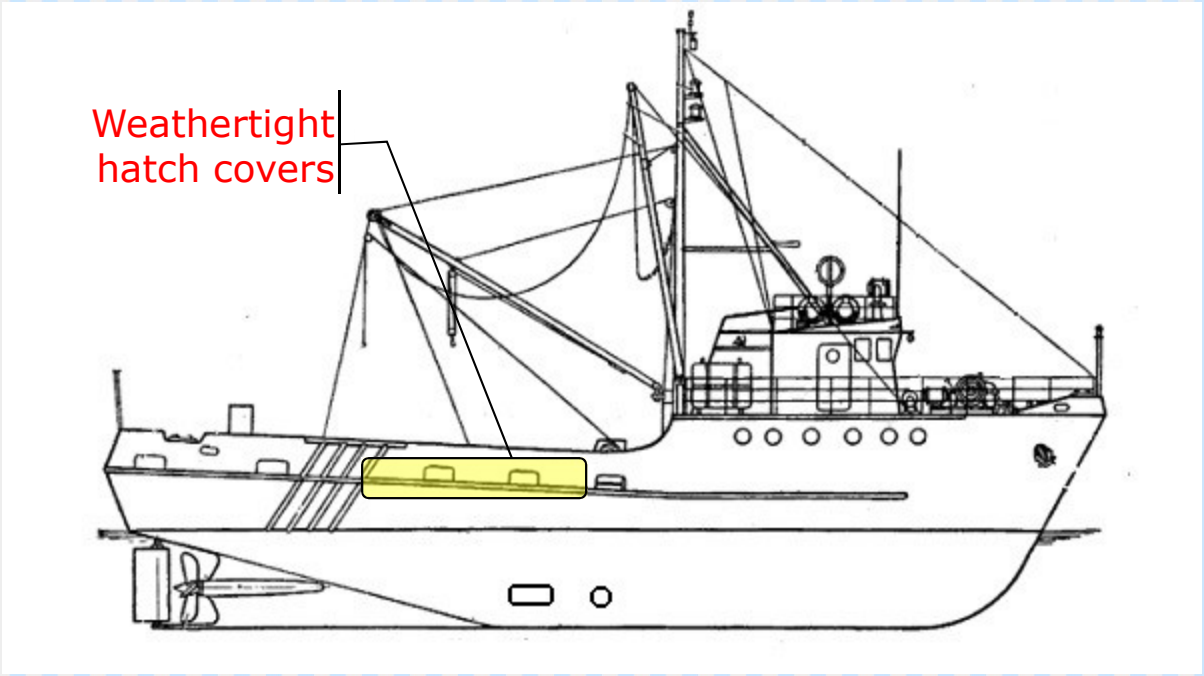

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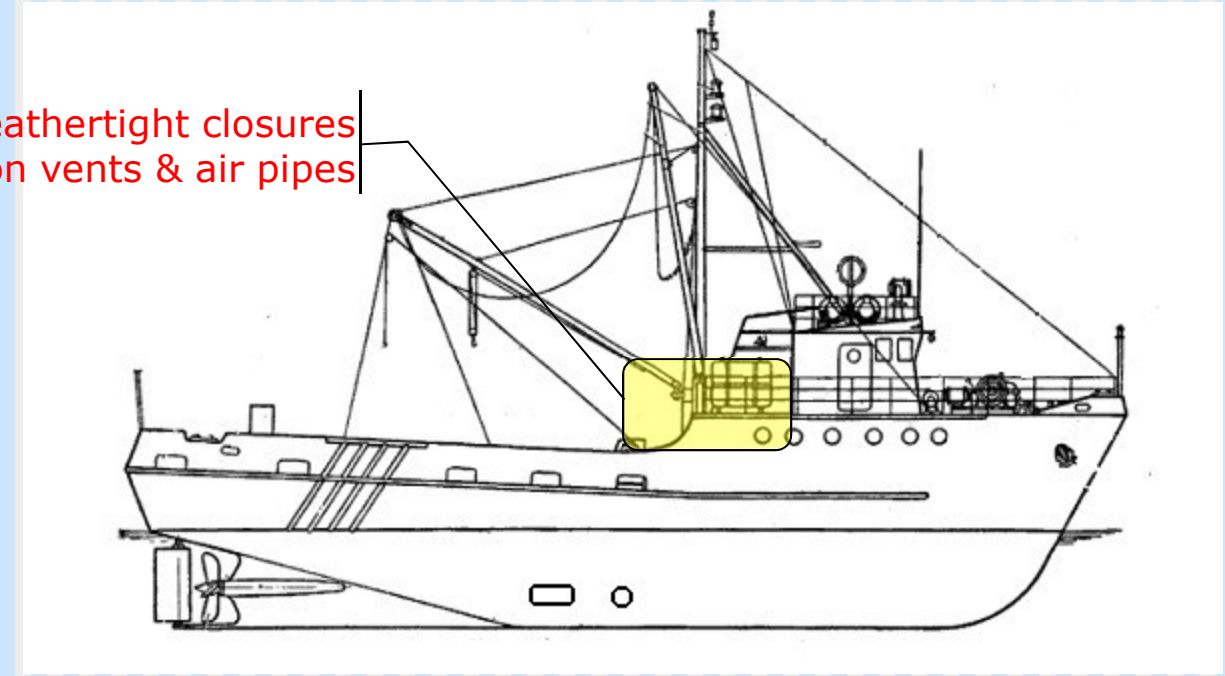

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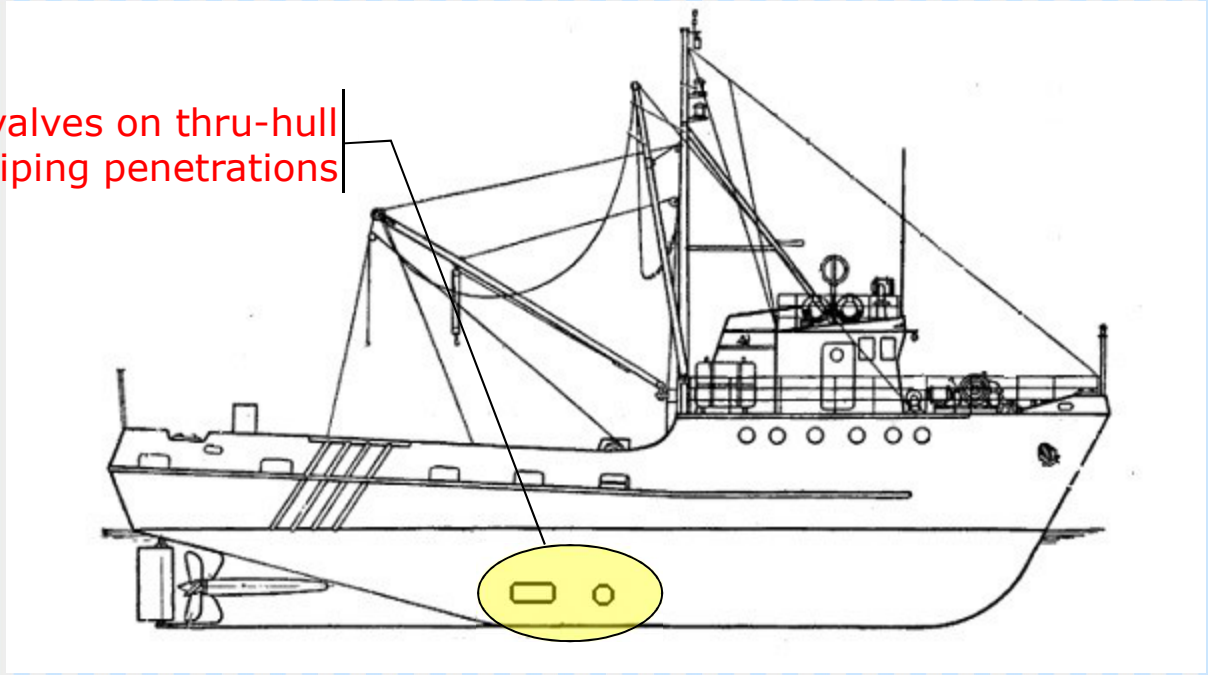

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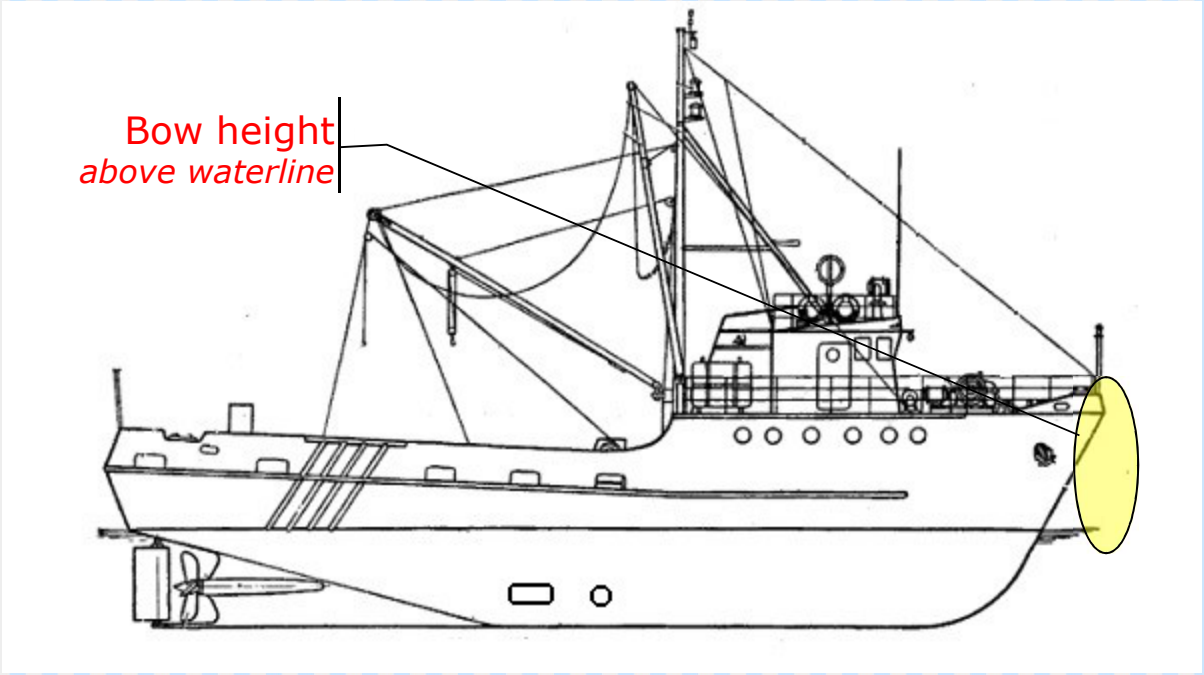


Fishing industry vessels built since 1991 might already incorporate many LL features, such as…

Existing [non-LL] Fishing Vessels

…But the big unknowns are:

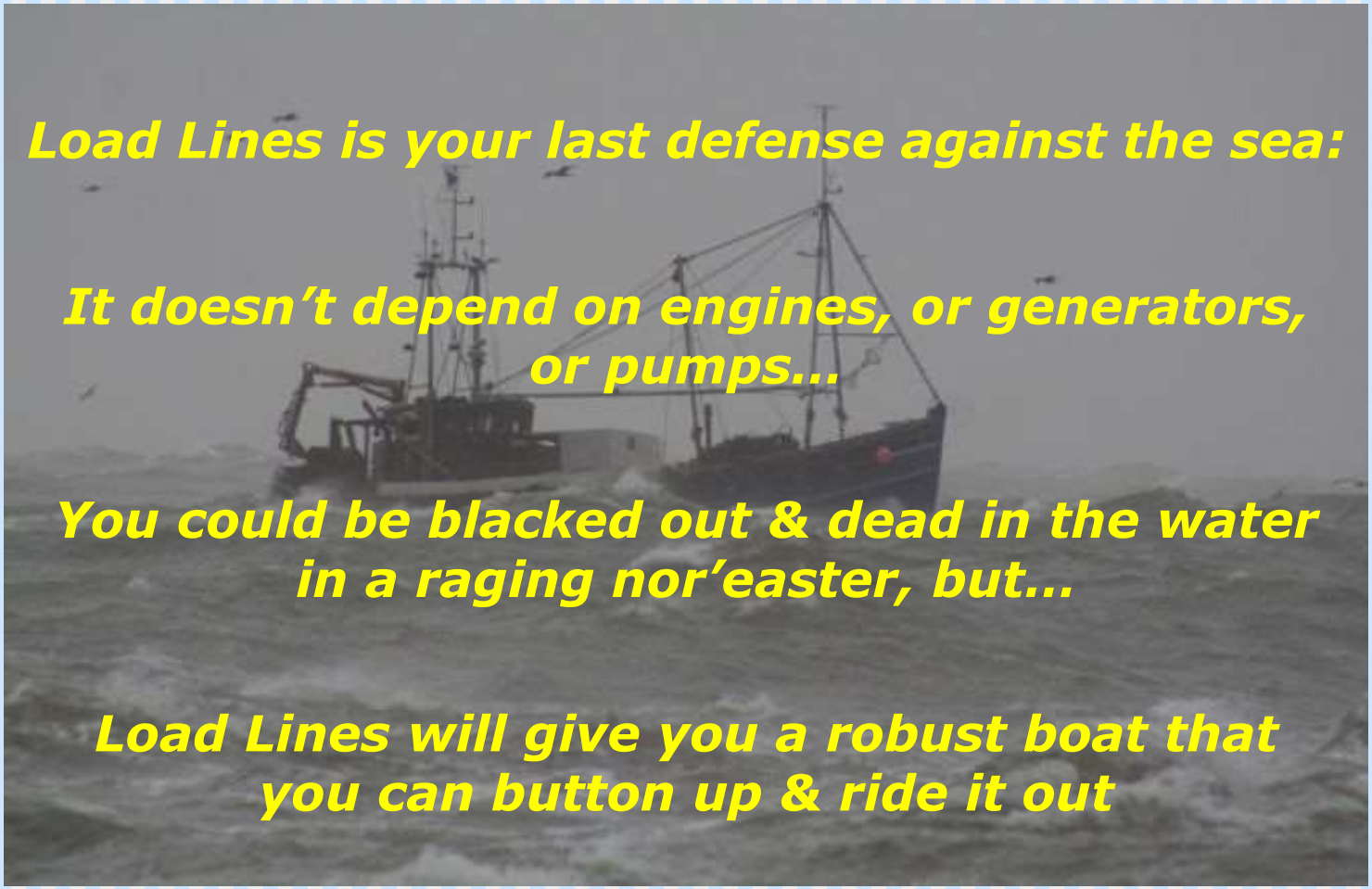
- *What is current condition of the LL safety features?*
  - *Weathertight closures (vents, door & hatch dogs, etc)*
  - *Watertight closures (shut-off & check valves, etc)*
  - *Guard rails*
  - *How well maintained?*
  - *Are they in operable condition?*
- *What is current condition of underwater hull?*
  - *Drydocking & inspection records*
  - *Gauging & corrosion*
  - *Repairs (inserts vs doublers, etc)*

Existing [non-LL] Fishing Vessels

…And:

- *What structural modifications have been made?*
  - *Above-deck & below-deck*
  - *Robust construction & condition?*
  - *Compromise the weathertight/watertight integrity of interior?*
- *What is current stability status?*
  - *When was last inclining, deadweight survey?*
  - *What weight changes since then, and how well documented?*
    - *Structural modifications*
    - *Equipment change-outs*
    - *Weight & moment (W&M) records (weight, LCG and VCG)*

Conclusion


Load Lines is your last defense against the sea:
It doesn't depend on engines, or generators, or pumps…
You could be blacked out & dead in the water in a raging nor'easter, but…
Load Lines will give you a robust boat that you can button up & ride it out

Conclusion

For more LL information:

www.dco.uscg.mil/Load_Lines

Conclusion

Any questions?

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