

# A Skipper's Guide to Fishing Vessel Stability & Modifications

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*Photo courtesy Kelly Roupe*

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## **I. Introduction**

### **A. Casualties**

Commercial fishing is one of the most dangerous occupations with over ninety deaths each year. While statistics vary from year to year, the numbers from 1996 remain typical - one hundred thirty six (136) U.S. fishing vessels were lost. Of this total, 45 were in some way "stability related", and nine of these vessels accounted for 19 lives lost.

According to the U.S Department of Health and Human Services publication "Commercial Fishing Fatalities in Alaska" (September 1997), "an average of 34 fishing vessels and 24 lives are lost in the commercial fishing industry" each year in Alaskan waters. "This represents an occupational fatality rate of 140 per 100,000 per year, 20 times the national average."

It is important to understand the term "stability related". At least 75% - 80% of "stability related" sinkings are caused by either overloading, or flooding through deteriorated systems or boundaries, non-tight closures, or other openings added for operational convenience. These events impair or invalidate the designed stability characteristics of an otherwise seaworthy vessel. The remaining vessel losses are for unknown reasons, as there were no survivors, and combinations of weather, icing, or initial loading can be suspected but not clearly defined.

Obsolete stability guidance is another factor with the potential to increase stability-related risks. All vessels experience weight growth over time, and a good rule of thumb is to have a naval architect review stability every five years, or when vessel modifications are made. Undocumented changes are especially dangerous since the vessel crew may not be aware that the stability guidance is obsolete. Modifications affecting stability include any weight changes, watertight bulkhead alterations, tank boundary changes, fishing method changes, freeing port alterations, lifting gear changes, windage changes, ventilation terminal changes, bilge keel area changes, and repowering.

While the risks are high, so can be the profits. The fisherman must weigh the risks of his occupation against the benefits. Many losses result from deferring maintenance of watertight & weathertight closures, or the lure of potential profit overcoming common sense, such as pulling an overloaded net on deck, or returning to port with holds plugged and fish on deck.

### **B. History of Stability Criteria**

United States fishing vessel casualties are consistent with worldwide experience. In view of the staggering casualty statistics, stability criteria have been developed which have proved to significantly reduce the incidence of casualties when used properly. Up until the late 1960's, there were very few criteria available to the Naval Architect for judging a vessel's stability. In 1968, a United Nations study committee, called the Intergovernmental Maritime Consultative Organization (IMCO), published a recommendation for intact stability for fishing vessels. This recommendation was based on a statistical study of fishing boat casualties worldwide, and quickly became the accepted standard (now called the IMO standard).

The current arsenal of stability criteria goes far beyond the original IMO standard. The Naval Architect can now determine the effect of wind & waves, lifting devices, towing nets, water on deck, etc.. The revolution in the computer industry has made stability analysis much faster and more detailed, with some programs simple enough to be used by the Master on board his own boat. Stability criteria are continuing to develop as more data is added to the pool of knowledge each year. It is important to understand, however, that no stability criteria can make up for poor



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seamanship or improper loading. The Master is still the one that decides whether it is safe to pull up that last net, or stack that next tier of pots.

### **C. Responsibilities of the Master**

The Master is responsible at all times to ensure the stability and safety of his vessel. A qualified Naval Architect can supply him with the necessary information to accurately determine the stability of his vessel under normal operating conditions. He can also supply a method of determining stability under unusual circumstances. He cannot, however, stand over the Master's shoulder and force him to follow the stability recommendations. The Master must understand basic stability concepts, be familiar with his stability booklet, and use every means at his disposal to ensure that the stability of his vessel is adequate to meet the sea and weather conditions encountered. It is also paramount that the Master ensure that proper vessel maintenance and repair is carried out, including maintaining the hull and systems watertight & weathertight consistent with the stability criteria.



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## **II. Stability Criteria**

### **A. Discussion of Righting Arms & Metacentric Height**

In common terminology, a stiff boat (with a quick roll) has high initial (upright) stability. A vessel with a slow roll generally has lower initial stability. It must be remembered that initial stability has little bearing on the ability of a vessel to right itself at larger heel angles. A very stiff boat may have poor stability at high heel angles, while a boat with low initial stability may have excellent stability at the higher heel angles.

Righting arms are a measure of reserve buoyancy, or how much watertight structure is available to provide buoyancy above the waterline. As a vessel heels to one side, the center of buoyancy shifts outboard in the direction of the heel. The horizontal distance from the center of gravity (G) outboard to a vertical line through the center of buoyancy (B) is the righting arm (GZ) (see figure 1). As the vessel continues to heel the righting arm will increase until the deck edge immerses. Heeling further past this point, the center of buoyancy stops shifting outboard, and the vertical line through the center of buoyancy becomes closer to the center of gravity reducing the righting arm. Eventually the center of buoyancy and the center of gravity will line up and the righting arm becomes zero. The area under the righting arm curve up to a given angle is a measure of the energy required to heel the vessel up to that angle. The area from a given angle to the angle of zero righting arm is the vessel's reserve buoyancy. The maximum peak of the righting arm curve represents the maximum return-to-center force the vessel can exert.

As shown in figure 1, the intersection of the vertical line through the center of buoyancy (B) and the centerline of the boat is called the metacenter (M). Since the metacenter shifts with heel angle, the term metacentric height "GM" (the distance from G to M) is defined only at very small heel angles. Hence the metacentric height is only a measure of the initial stability of a vessel.

### **B. Available Criteria**

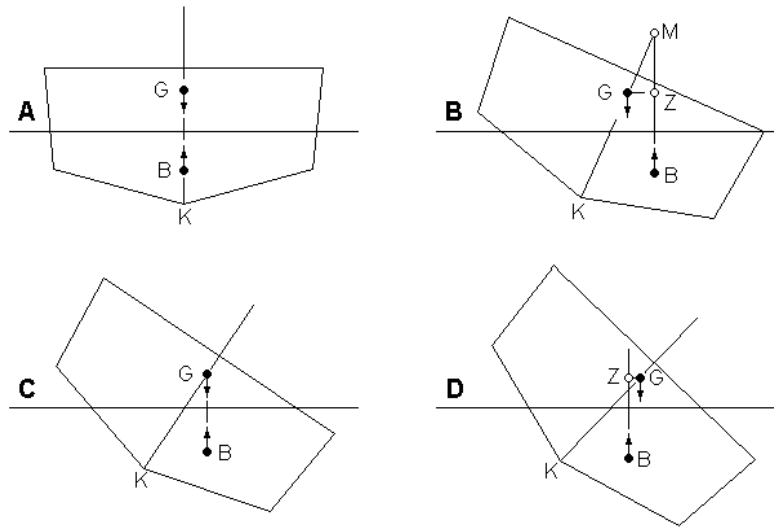
The stability criteria currently available are based on stability in calm water with sufficient safety margins to cover the dynamic conditions of heavy seas. Over time, this has proved to be a successful approach. Very few vessels that meet the two basic criteria described below are lost due to stability problems.

The most widely applied stability criteria in use today is Torremolino's criteria, which sets forth minimum values for the initial metacentric height (GM) and the righting arm (GZ) curve for a vessel (ref 46 CFR 28.570):

1. GM at least 1.15 ft
2. GZ max at least 0.656 feet at 30 degrees or greater heel
3. Area 0 - 30 degrees at least 10.34 ft-deg
4. Area 0 - 40 degrees (or flooding angle) at least 16.92 ft-deg
5. Area 30 - 40 degrees (or flooding angle) at least 5.64 ft-deg
6. Angle at GZ peak = 25 degrees or greater.
7. Range of positive GZ = 60 degrees or greater.

An alternate criterion originally developed for offshore supply vessels is also widely used (ref 46 CFR 170.173c). This criterion is useful for vessels that have difficulty meeting Torremolino criteria 6 & 7:

1. GM at least 1.15 ft
2. Area 0 - Peak at least  $10.34 + 0.187 \times (30 - \text{Peak Angle})$
3. Area 0 - 40 degrees (or flooding angle) at least 16.92 ft-deg
4. Area 30 - 40 degrees (or flooding angle) at least 5.64 ft-deg
5. Angle at GZ peak = 15 - 30 degrees
6. Range of positive GZ = 50 degrees or greater.



M = Metacenter	K = Keel
G = Center of Gravity	GZ = Righting Arm
B = Center of Buoyancy	GM = Metacentric Height

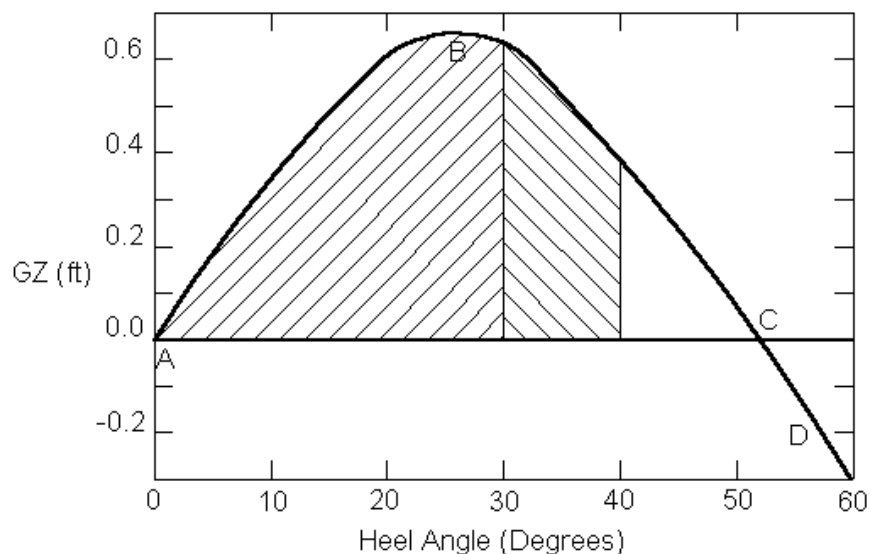


Figure 1



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In addition to one of these basic criteria, others are applied which take into account service conditions:

- "Severe Wind and Rolling" (SWR) criteria subjects the vessel to a blast of wind, and limits the vessel to 14 degrees of induced heel and specified righting energy ratios (ref 46 CFR 28.575).
- "Wind Heel" criteria places minimum limits on the metacentric height (GM) based on wind profile area (ref 46 CFR 170.170).
- Vessels involved in towing should meet the "Towline Pull" criteria which places minimum limits on the metacentric height (GM) based on power, freeboard, towline height above propellers, etc. (ref 46 CFR 173.095).
- Vessels engaged in crane lifting operations at sea should meet "Lifting" criteria which limits the resulting heel to 10 degrees and the area between the righting arm and heeling arm to a minimum of 15 ft-deg up to a specified angle (ref 46 CFR 28.545 & 173.005).
- Vessels with large open decks which ship high volumes of water should meet "Water on Deck" criteria (ref 46 CFR 28.565).

### **C. Selection of Criteria**

For United States flag vessels, existing government regulations apply to vessels 79 ft and over in length. In October 1992, proposed regulations for vessels less than 79 feet in length were published for public comment. Due to the large number of comments received, the final regulations are currently being re-written by the U.S. Coast Guard.

Your Naval Architect should select the appropriate criteria based upon vessel size and service to ensure compliance with effective regulations, as well as fundamental safety considerations.

### **D. Flooding & Watertight Integrity**

As shown in Section B above, the righting arm curve (GZ) is assumed to terminate when flooding occurs through open vents, unchecked tank airpipes, etc.. Such openings can significantly restrict the vessel's operation and carrying capacity. Your Naval Architect may recommend modifications to openings, such as adding manual or automatic closures to increase the usable righting energy.

It is extremely important to maintain reserve buoyancy above the main deck, because it creates the forces that right the vessel at higher roll angles. When rolling in a seaway, an open porthole, vent, or door can allow water to enter on each roll. A vessel may capsize if too much water enters, either because of excessive free surface, or loss of freeboard.



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### **III. The Stability Test (Incline Experiment)**

#### **A. Preparation**

A stability test is a scientific experiment designed to gather the data required to determine the weight and center of gravity of a vessel. As such the vessel operator must set aside dedicated time to conduct the experiment when no work is being done and no crew is on board.

Your Naval Architect will require certain technical information prior to the test. This includes an Arrangement Drawing and a Lines Plan. If a lines plan is not available, the boat must be hauled out of the water and measured.

You will also need to supply a set of incline weights (usually concrete blocks) and a crane to move them. The weights should be weighed on a certified scale prior to the test. Your Naval Architect will tell you how much weight you will need. Incline weights are available from most shipyards, or "ecology blocks" may be purchased from concrete suppliers at minimal cost. Since concrete blocks absorb rain water, they should be covered between the weighing and the stability test.

During an incline test, long pendulums are read which accurately measure the heel angle caused by the movement of the incline weights. Adverse weather conditions may be cause for postponement of the test since wind & waves may make pendulum reading impossible. Icing is also cause for postponement since the ice buildup will increase the weight and raise the vessel's center of gravity. If ice is present, it must be removed prior to the test.

On vessels with chines, the chine should be immersed at the transom during the test. This is because the waterplane changes dramatically with small heel angles on boats with fairly flat bottoms aft. This change in the waterplane may throw off the results and require a re-test.

The vessel must be free to move during the experiment. There must be adequate water depth to ensure that the boat does not come aground. If there are tides in the area where the test is to be conducted, the incline may need to be scheduled during high tide. No other boats should be rafted to the boat being tested, and all mooring lines should be loose.

All large or wide tanks should be either completely empty or completely full. Small narrow tanks may be slack. Any cross connected tank pairs should have the cross connect closed. Sea water holds should be empty. Your Naval Architect will consult with you in advance of the test to determine what the tankage should be during the test. For Load Line incline tests, all tanks must have a visual means of verifying the liquid level, either by having the tank manholes off, using sight glasses, or overflowing the tank vent. Tankage should be arranged such that trim is minimized and list less than 1/2 degree.

Any gear and equipment which does not belong with the boat should be removed or weighed. Foodstuffs, pots & pans, ship's books, charts, linens, spare parts, fishing gear, crew's effects, etc. which are part of a vessel's normal inventory may remain on board, but will need to be weighed if they are out of position. For Load Line stability tests, all weight except inventoried engine spares, life saving gear, dishes & galley equipment, and ship's books & charts must be accounted for either by removal or weighing.

Bilge water should be minimal (bilges should be dry for Load Line stability tests). If this is a problem they should be sucked out prior to the test.



Pendulums are usually hung in one or more holds, usually in the locations that give the longest pendulum lengths. Your Naval Architect will tell you where. The hatch covers need to be removed in those locations. You will need to supply two lengths of lumber (2 x 4s) long enough to span the hatch at each pendulum position.

## **B. Running the Test**

There are nine basic steps that your Naval Architect will perform during the test:

1. Skipper Conference - Discussion of vessel condition (tanks & deadweight) and operation (fuel burnoff sequence, hold loading sequence, fishing equipment, etc.)
2. Pendulum Setup - Pendulums will be set up in positions that are sheltered from the wind and yield the longest pendulum lengths. This is normally in holds with the pendulums suspended from one or more deck levels above. A board is typically placed across a hatch opening from which the pendulums are hung. In the hold bottom a marking board is placed transversely on sawhorses. The pendulum bobs are weighted X shaped vanes that are submerged in buckets of water or oil for motion damping. For Load Line tests, the three pendulums are ideally set up in different locations and the damping fluid is oil. Each pendulum is measured to determine its length.
3. Weight Placement - The inclining weights are normally placed on the widest portion of open deck available, either at the rail or near centerline. Weights are normally staggered so that each weight can be moved all the way across the deck to the other rail. The block positions are marked on deck so that movement distances can be measured.
4. Deadweight Survey - Your Naval Architect will inspect all spaces in the vessel for deadweight and prepare a list of weights and locations. For large vessels where the deadweight survey is lengthy it may be performed the day before the test. All spaces must be unlocked.
5. Tank Survey - The levels in all tanks will be determined by visual inspection. This is usually accomplished by reading sight gauges or sounding tubes. Full tanks should be completely full into the vent or fill lines above the tank. Empty tanks should be sucked down until the stripping pump loses suction. For Load Line stability tests, empty tanks must have their manholes removed, and if the bottom corner is not visible from the manhole they must be gas free - safe for men.
6. Freeboards - At pre-determined positions along the length of the vessel on both sides, a sounding tape is dropped over the side and the freeboard (distance from the deck to the water) is measured. By using the lines plan in conjunction with these freeboards and the specific gravity of the water (see item 7 below) an accurate representation of the waterline and displacement (vessel's total weight) will be developed.
7. Specific Gravity - The density of the water the vessel is floating in varies depending on its salinity and temperature. A hydrometer is used to determine its specific gravity.
8. Block Movement/Pendulum Reading - Once steps 1-7 are completed the incline can begin. All non-essential personnel will be asked to leave. Those remaining on board will need to supply their weight to the Naval Architect, and must remain perfectly still in the same positions during each pendulum reading. The mooring lines are slacked off and then initial upright pendulum readings are taken. All subsequent pendulum readings are measured from the initial readings. One block is then moved across the deck, its new position measured, and another set of pendulum readings are taken. This is done twice on each side with an intermediate pendulum reading taken with the weights back in their starting positions. For Load Line stability tests, three movements are done on each side.





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9. Calculations - The final step is to perform approximately five minutes of calculations to determine the validity of the results. This is done only to determine if the test was successful, not to give any stability results. If the data is bad, steps 5 through 9 will be repeated. Typical sources for bad data are excessive tank free surface, high waves & wind, tight mooring lines, grounding, and open tank cross connects.

### **C. Stability Analysis**

Once the stability test has been completed, a detailed set of calculations will be performed in the Naval Architect's office. These calculations will determine "Lightship", which is the total weight of the vessel (without liquids in tanks or deadweight), and its center of gravity. With this information any vessel condition may be analyzed on a computer to determine operational limits.



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## **IV. Stability Recommendations**

These general recommendations are applicable to most vessels.

### **A. Operating Instructions**

After a stability test is complete, the Naval Architect will prepare a stability report that provides specific guidance for the vessel including deck and hold load limits for various tank levels, lifting limits and minimum freeboards based on the stability criteria limits. This guidance is tailored to the specific configuration of the vessel at the time of the stability test. The Master should review the instructions before each port departure to verify that loading restrictions can be met for the expected operations and should follow them throughout the voyage.

### **B. Calculation Method**

For some vessels, a calculation method is provided that allows the operator to examine vessel stability for specific loading conditions.

### **C. Free Surface**

Free surface is the sloshing of liquid in a tank from side to side. As a vessel heels to one side, the center of gravity of the liquid in a slack tank shifts in the direction of the heel, making the heel worse. Narrow tanks have very little free surface, and are not generally a cause for concern. Wide tanks (larger than 1/3 of the beam) with free surface can cause severe stability problems. Only one pair of fuel storage tanks and one pair of fresh water tanks should be slack at any time.

### **D. Ballast Tanks**

The operator should always know the levels of the ballast tanks. If water inadvertently enters an empty ballast tank or seeps out of a full ballast tank free surface will result. Ballast tanks should be kept either completely full or completely empty, and be checked on a regular basis.

### **E. Sea Water Holds**

Due to the potentially high free surface of sea water holds, they should be operated only in a completely empty or completely full condition, and checked periodically to ensure that the level does not change causing free surface to develop. Sea water holds should be filled and emptied with the greatest care, by seeking shelter, or by assuming a favorable heading into wind and sea. No more than one centerline or pair of P/S holds shall be filled or emptied at a time. When operating with slush or crushed ice in a hold tank, excess water should be continually pumped out to minimize free surface effects. Many insurers now require a level alarm to be installed at the top of each flooded sea water hold so that the crew is alerted if the water level falls below that point.

### **F. Freezer Holds**

Holds that store frozen cargo need to be loaded with care, and secured as necessary. In heavy seas, loose cargo may shift and result in a dangerous list situation.



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## **G. Vessel List**

Never correct a list until you know the cause. If cargo has shifted resulting in a list, pumping from tanks on one side to the other can result in a dangerous situation by dramatically increasing tank free surface.

## **H. Icing**

Stability reports generally give restrictions for operating under icing conditions. For the Bering Sea, the ice accumulation is usually assumed to be approximately 1.32 inches on decks and 0.33 inches on the sides, based on IMO recommendations. During severe "icing" conditions the vessel may encounter ice loads of much greater magnitude. Due to the lack of predictability in icing conditions we strongly recommend that vessels take action to minimize ice build-up by heading downwind or taking shelter.

## **I. Cranes**

The use of on-board cranes at sea can cause a dangerous situation if the resulting list is too great, leading to a reduction of reserve buoyancy. A stability report usually incorporates recommendations on usage of cranes at sea. A good rule of thumb is never to submerge more than half of the available freeboard in the act of lifting.

When including crane loads in stability calculations described in paragraph B above, the load's location must be input at the crane boom's tip. As a vessel pitches and rolls, the crane load shifts to align with the crane boom's tip. This effect shifts the apparent center of gravity from the load up to the point of suspension.

## **J. Freeing Ports**

Freeing ports and scuppers should be kept clear of debris at all times to maintain their effectiveness.

## **K. Factory Operations (ref: 46 CFR 28.255)**

A space supplied with water for the sorting or processing of fish must be fitted with a dewatering system capable of dewatering the space under normal conditions of list and trim at the same rate as water is introduced. Pumps used as part of the processing of fish do not count for meeting this requirement. The dewatering system must be interlocked with the pumps supplying water to the space so that in the event of failure of the dewatering system the water supply is shut off.

## **L. Trash Chutes**

A trash chute from a watertight processing space should have a non-return flapper and a means of securing it closed watertight from outside the space. The area in way of the chute should be kept clear of machinery and stores for access in an emergency. The flapper should never be secured in an open position. The chute's operation should be checked periodically.

## **M. Weather Tightness**

All weather deck doors, air ports, and vents should be kept closed and securely dogged when operating in heavy weather conditions. All watertight doors should be kept closed except when used for passage under safe conditions.



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#### **N. Bilges**

Bilges should be kept pumped to a minimum level at all times. Bilge system requirements for all fishing vessels are described in 46 CFR 28.250 & 28.255.

#### **O. Modifications**

No permanent ballast or other such weights should be added, removed, altered, and/or relocated, and no watertight bulkheads or watertight boundaries should be removed or altered unless the effect on stability has been investigated by your Naval Architect.

#### **P. Anti-Roll Tanks**

Vessels with exceptional stability may be equipped with an anti-roll tank. These tanks are designed such that the liquid sloshes from side to side out of sync with the vessel's roll. In a correctly designed tank, the liquid will slosh to the high side of the tank to reduce the vessel's roll amplitude, and give a much more comfortable ride. In a poorly designed tank the liquid will shift to the low side of the tank, increasing the rolling amplitude. Anti-roll tanks must be "tuned" to each vessel. Since a vessel will behave differently in a light condition than a heavy condition, an anti-roll tank may be ineffective or dangerous in an out-of-tune condition. For this reason, an anti-roll tank should never be put into operation without first calculating its potentially negative effect on stability.

#### **Q. Stability in a Seaway**

Care should be exercised when steering with a following sea. Going too fast may drive the vessel through the swell ahead onto the downside where the following swell can catch the stern and throw the vessel broadside to the swells. This "broaching to" may cause the vessel to capsize. An equally dangerous situation may result if the vessel's speed is close to the speed of the swell upon which it is riding causing a loss of steering control.

#### **R. Freeboard**

Freeboard is the vertical distance measured from the water to the deck at side. In some instances your Naval Architect may recommend a minimum overall freeboard corresponding to the deepest possible draft.

#### **S. Deck Loads**

Each stability report will provide guidance for the maximum load (crab pots, cod ends, etc.) which may be safely placed on deck. All deck loads must be secured in a fashion that will prevent shifting in a seaway. You may also be limited by the strength of the deck supporting the load. If you are concerned about deck strength you should request that your Naval Architect perform a structural analysis.



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## V. Effect of Vessel Configuration on Stability

Each vessel has its own stability characteristics and will tend to be restricted by perhaps two or three of the criteria limits described in Section II-B. Because a similar size boat was able to place a larger winch on his deck does not mean that your boat can. It is very important to discuss any proposed changes with your Naval Architect beforehand to ensure that the stability will not be impaired.

### A. Adding Weight

Adding weight high will raise the center of gravity and reduce stability. Adding weight low will lower the center of gravity and increase initial (upright) stability, but this is not always beneficial. Adding weight on vessels with low freeboard causes the deck edge to submerge at a smaller heel angle, and the righting arm curve to drop off sooner.

### B. Removing Weight

Removing weight below the main deck will reduce the initial stability, but may increase the range of stability (the angle where the righting arm drops to zero). Removing weight above the main deck will increase both the initial stability and the range of stability.

### C. Weight Growth

All vessels will get heavier and experience a rise in the center of gravity as time passes, **which degrades stability**. This is because equipment, spares, dirt, paint, etc. tend to accumulate. You should make an effort to keep your vessel in a clean condition to reduce this potential problem. It is also advisable to perform an annual vessel cleanout, removing nonessential equipment & gear.

**The Master should log all weight changes made to the vessel before each fishing season, including description, weight, and location. Consult your Naval Architect to determine whether the changes are significant enough to warrant and update to the stability guidance.**

We recommend a new stability test and report be prepared every five years, and whenever you add/remove/relocate major pieces of equipment.

### D. Weathertightness and Seaworthiness

**All vessel components experience wear and tear as time passes. The Master should conduct and log an inspection of all exterior boundaries to ensure weather tightness before each fishing season. The inspection should include intake and exhaust vents, airports, windows, doors, and trash chutes. The inspection should include operability of closures, dogs, and the condition of sealing gaskets. Sea valves of open systems which would flood the vessel upon failure, hinged freeing ports, and deck scuppers should also be inspected and logged. Deficiencies should be corrected before departure.**

**The Master should log all changes made to watertight bulkheads or boundaries (including new penetrations) before each fishing season, including description, weight, and location. Consult your Naval Architect to determine whether the changes are significant enough to warrant an update to the stability guidance.**



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## **E. Hull Form Modifications**

There are various methods of altering an existing hull that can significantly alter load carrying and stability characteristics, including sponsoning, midbody extension, deepening, adding raised poop decks, stern extensions, and house additions. As a general statement, any hull alteration which creates additional freeboard has the potential for improving stability and/or increasing vessel payload. Each of the listed techniques can have different benefits and costs for a particular vessel design.

Any hull alteration is expensive. To obtain the best benefit to cost factor, advance consultation with your Naval Architect concerning your project objectives can pay high dividends. The same computer models used for stability calculations can be utilized to forecast stability and loading performance of different configurations. A few words relative to each modification technique follow:

1. Sponsoning - Sponsons are extensions to the beam of a vessel, usually resulting in a second set of wing tanks. A carefully designed set of sponsons will be almost unnoticeable to the eye, and will dramatically improve stability and cargo carrying capacity. Wider vessels tend to have a faster roll period (time to complete one roll cycle), which may not be desirable in extreme cases.
2. Midbody Extension - For vessels with good stability, a midbody lengthening is a good way to increase the cargo carrying capacity. Vessels with poor stability may not benefit from a midbody lengthening because the stability is changed very little, and the extra cargo space may not be usable.
3. Deepening - Adding watertight space on top of existing working decks increases freeboard, thereby improving stability. This can be very effective when a wet hold vessel is over tanked (too much weight and too little buoyancy), or more combined deck and hold cargo is desired.
4. Raised Poop Decks - A raised poop is a modified form of deepening. The additional buoyancy aft does not increase freeboard, but does increase righting arms as a vessel rolls. This relatively minor modification can significantly improve stability characteristics.
5. Stern Extension - A stern extension typically has very little effect on the overall stability. Its common uses are to get the stern further out of the water if the aft deck is very wet, and to increase working space on the aft deck.
6. Adding a House - The addition of a full width house will make a vessel heavier and reduce upright stability, but will increase righting arms as the vessel rolls. If your boat has sufficient upright stability but has difficulty meeting the stability range requirements, the addition of a watertight house may be helpful to the stability.



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## **VI. Fishing Vessel Regulations**

On September 15, 1991, safety regulations for United States flag commercial fishing industry vessels were published by the U.S. Coast Guard and became effective. Subpart E, Stability, is currently applicable to vessels 79 ft or longer. Additional regulations will be published in the future for vessels less than 79 feet in length. In general, the regulations impose requirements for new vessels and vessels which are modified after the effective date.

There are two very important definitions: "Substantial Alteration" and "Major Conversion". There is no clear boundary between these definitions. A vessel undergoing a "Major Conversion" must meet several additional stability criteria, which may further limit operations.

New vessels built on or after September 15, 1991 must meet unintentional flooding (damaged stability) per 46 CFR 28.580, which may be extremely difficult or impossible to meet for vessels with large open holds or engine rooms. This requires vessels to survive flooding with stability margin when damaged lengthwise 10% of the vessels length (or 10 feet if less), and transversely 30" from the side shell. All spaces with through-hull fittings, such as engine rooms and lazarettes, must also be assumed simultaneously flooded. The alternative to meeting this criterion is obtaining and maintaining a Load Line.

An evaluation of the regulatory impact will be essential for all future changes to hull form or carrying capacity. Two essential stages of project planning will be:

1. Clear determination of applicable regulatory requirements.
2. Preliminary engineering verification that the modified vessel will satisfy the regulations.

In unique circumstances for which no precedent has yet been established, the correctness of a preliminary evaluation of applicable requirements should be offered to the local U.S. Coast Guard OCMI for confirmation. Qualified Naval Architects can then verify that a planned alteration will satisfy both the vessel Owner's objectives and regulatory requirements.



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## **VII. License Limitation Program (formerly Fishing Vessel Moratorium)**

The former Fishing Vessel Moratorium has been superseded by the License Limitation Program. The full text of the regulations may be found 50 CFR 679.4, which is also available on the following web site: <http://www.fakr.noaa.gov/regs>. This program limits certain catcher and catcher-processor vessels in Alaska groundfish and Bering Sea/Aleutian Island crab fisheries to a maximum length overall (MLOA) shown on the groundfish license.





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## VIII. Vessels Requiring a Load Line or Classification

The following information is offered only as basic guidance. For the complete text of the law, please refer to 46 USC Chapter 51, and 46 CFR 42.03. The following definitions apply:

**Fishing Vessel** (as defined in 46 CFR 28.50): "a vessel that commercially engages in the catching, taking, or harvesting of fish or an activity that can reasonably be expected to result in the catching, taking, or harvesting of fish."

**Fish Processing Vessel** (as defined in 46 CFR 28.50): "a vessel that commercially prepares fish or fish products other than by gutting, decapitating, gilling, skinning, shucking, icing, freezing, or brine chilling."

**Fish Tender Vessel** (as defined in 46 CFR 28.50): "a vessel that commercially supplies, stores, refrigerates, or transports fish, fish products, or materials directly related to fishing or the preparation of fish to or from a fishing, fish processing or fish tender vessel or a fish processing facility."

**Existing Vessel** (as defined in 46 USC 5101): "a vessel on a domestic voyage, the keel of which was laid, or that was at a similar stage of construction, before January 1, 1986; and a vessel on a foreign voyage, the keel of which was laid, or that was at a similar stage of construction, before July 21, 1968."

### 46 USC 5102, Application (of Load Line Statutes) 2007

(a) Except as provided in subsection (b) of this section, this chapter applies to the following:

- (1) a vessel of the United States.
- (2) a vessel on the navigable waters of the United States.
- (3) a vessel--
  - (A) owned by a citizen of the United States or a corporation established by or under the laws of the United States or a State; and
  - (B) not registered in a foreign country.
- (4) a public vessel of the United States.
- (5) a vessel otherwise subject to the jurisdiction of the United States.

(b) This chapter does not apply to the following:

- (1) a vessel of war.
- (2) a recreational vessel when operated only for pleasure.
- (3) a fishing vessel.
- (4) a fish processing vessel of not more than 5,000 gross tons as measured under section 14502 of this title, or an alternate tonnage measured under section 14302 of this title as prescribed by the Secretary under section 14104 of this title that--
  - (A)
    - (i) was constructed as a fish processing vessel before August 16, 1974; or
    - (ii) was converted for use as a fish processing vessel before January 1, 1983; and
  - (B) is not on a foreign voyage.



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- (5) a fish tender vessel of not more than 500 gross tons as measured under section 14502 of this title, or an alternate tonnage measured under section 14302 of this title as prescribed by the Secretary under section 14104 of this title that--
    - (A)
      - (i) was constructed, under construction, or under contract to be constructed as a fish tender vessel before January 1, 1980; or
      - (ii) was converted for use as a fish tender vessel before January 1, 1983; and
    - (B)
      - (i) is not on a foreign voyage; or
      - (ii) is not engaged in the Aleutian trade (except a vessel in that trade assigned a load line at any time before June 1, 1992).
  - (6) a vessel of the United States on a domestic voyage that does not cross the Boundary Line, except a voyage on the Great Lakes.
  - (7) a vessel of less than 24 meters (79 feet) overall in length.
  - (8) a public vessel of the United States on a domestic voyage.
  - (9) a vessel excluded from the application of this chapter by an international agreement to which the United States Government is a party.
  - (10) an existing vessel of not more than 150 gross tons as measured under section 14502 of this title, or an alternate tonnage measured under section 14302 of this title as prescribed by the Secretary under section 14104 of this title that is on a domestic voyage.
  - (11) a small passenger vessel on a domestic voyage.
  - (12) a vessel of the working fleet of the Panama Canal Commission not on a foreign voyage.
  - (c) On application by the owner and after a survey under section 5105 of this title, the Secretary may assign load lines for a vessel excluded from the application of this chapter under subsection (b) of this section. A vessel assigned load lines under this subsection is subject to this chapter until the surrender of its load line certificate and the removal of its load line marks.
  - (d) This chapter does not affect an international agreement to which the Government is a party that is not in conflict with the International Convention on Load Lines currently in force for the United States.



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**46 CFR 28.720 Survey and Classification (of Fish Processing Vessels), 2008**

- (a)** Each vessel which is built after or which undergoes a major conversion completed after July 27, 1990, must be classed by the ABS, or a similarly qualified organization.
- (b)** Each vessel which is classed under paragraph (a) of this section must:
  - (1) Have on board a certificate of class issued by the organization that classed the vessel.
  - (2) Meet all survey and classification requirements prescribed by the organization that classed the vessel.