- SMALL PASSENGER VESSELS -
SIMPLIFIED STABILITY TEST PROCEDURE

(In accordance with 46 CFR 171.030)

DEPARTMENT OF
TRANSPORTATION
U.S. COAST GUARD
CG-4006 (Rev. 7-94)

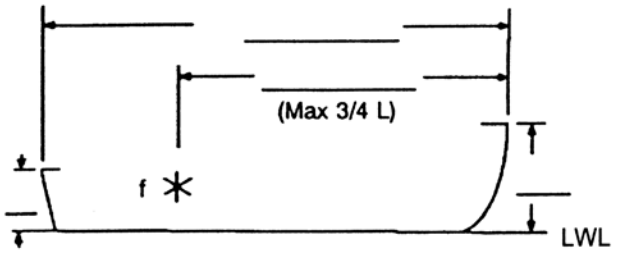
Name of Vessel _____ Documentation No. _____ Date _____

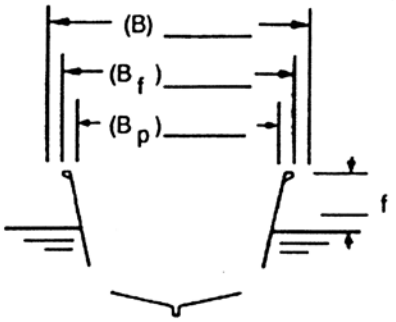
Owner/Representative _____ Inspector _____

Location _____ Wind: Relative Direction _____ Vel ____ mph

Mooring Arrangement _____

Route _____ Check One: ☐ Exposed ☐ Partially Protected ☐ Protected





Indicate on above Sketch

1) Profile of sheer line.
2) Length overall (L).
3) Station for measuring Reference Freeboard (f) above load waterline (LWL), located in way of least freeboard or at a point 3/4 (L) from the stem if the least freeboard is aft of this point.
4) Freeboard at bow.
5) Freeboard at stern. *

Indicate on above Sketch

1) Round or vee bottom.
2) Maximum beam (B) to outside of shell; greater or equal to (B_f).
3) Maximum beam (B_p) accessible to passengers.
4) Maximum beam (B_f) on deck in way of Reference Station.
5) Reference Freeboard (f), height of sheer line above the LWL, in way of Reference Station. *
6) Height of weather deck (including cockpit deck, if any) above load waterline in way of Reference Station.

All of the above measurements are to be taken in the loaded condition without list. Measurements for (L), (B), and (B_f) are to exclude rub rails. If the vessel carries passengers on diving excursions, the total weight of the diving gear must be included in the loaded condition. If the vessel has a cockpit or well deck, show same by dotted line on the above sketches and indicate length (/).

* Freeboard shall be the distance from the sheer line to the load waterline. The sheer line shall be taken as the intersection of the side shell with the weather deck. Where calculations require "gunwale top" to be used, the following applies:
For a cockpit vessel, the gunwale top shall be measured along an imaginary extension of the sheer line in way of the cockpit. For an open boat, the gunwale top shall be considered the sheer line.

(1) TOTAL TEST WEIGHT REQUIRED:

_____ X _____ = _____

# of Pass Wt/Pass Total Test Wt. (W)

Notes:
a) "Test Weight" defines only the weight to be moved during the test. Weights used to represent missing equipment or stores shall be considered part of the "loaded condition."
b) The maximum number of passengers shall not exceed the number computed in accordance with 46 CFR 176.01-25.
c) Weight per passenger equals 72.6 kg (160 lbs), except that on "protected waters" when passenger loads consists of men, women, and children; a weight per passenger of 63.5 kg (140 lbs) may be used.

(2) DISTRIBUTION OF TEST WEIGHT:

a) Distribute the test weight fore and aft so as to obtain the normal operating trim.
b) Arrange the test weight so that its vertical center of gravity (CG) is approximately 76.2 centimeters (30 inches) above deck.
c) The vertical distribution of the test weight shall be such as to simulate the most unfavorable vertical CG likely to occur in service. On vessels having one upper deck above the main deck available to passengers, the distribution shall not be less severe than the following:

Total test weight (W) . . . . . = _____

Passenger capacity of upper deck:

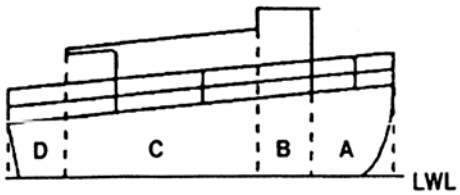
_____ X _____ X 1.33 = - _____ Weight on Upper Deck

# of Pass Wt/Pass

_____ Weight on Main Deck

(3) WIND HEEL CALCULATION:

a) With the vessel in the loaded condition, block off the profile of the vessel into rectangles using vertical lines starting at the load waterline, as shown below. Include passenger railings, canopies, and spotting towers.
b) Measure, on the vessel, the length (L) and height (V) of each rectangle and enter into the table below.
c) Complete the calculations in the table, add the products in the last column and enter the sum in Section (4)(b). Multiply this sum by the appropriate (P) value to obtain the Wind Heeling Moment (M_w) in Section (4) (b) on page 3.

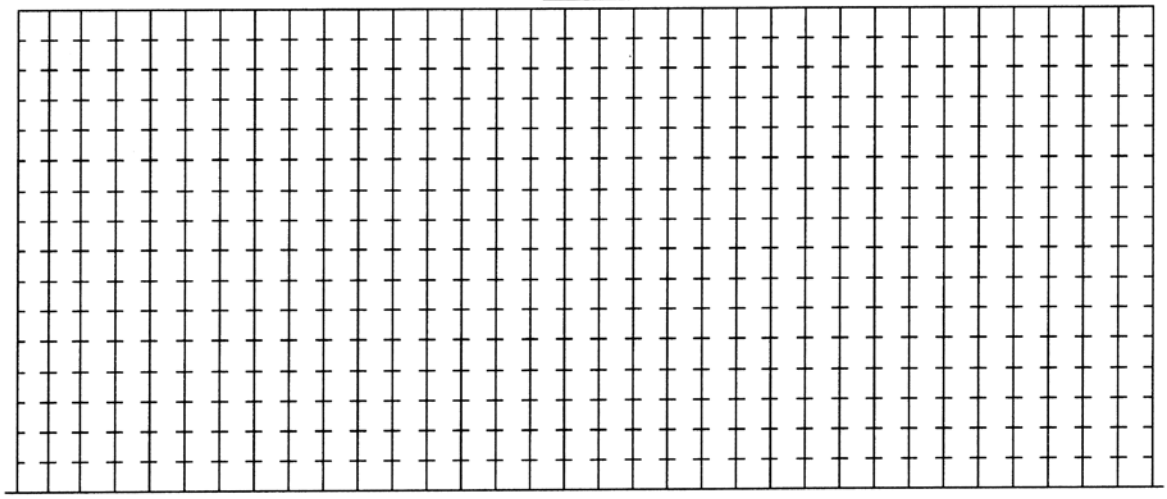


Values of (P)	2	2
Exposed	73.2	15.0
Partially Protected	48.8	10.0
Protected	36.6	7.5

(continued on page 3)

(3) continued:

- Profile -



Load Waterline

Scale: 1 square =_____

- Calculations -

Section	L	V	A (L x V)	H (0.5V)	A x H
A					
B					
C					
D					
E					
F					
G					
				Sum (A x H)	

(4) REQUIRED HEELING MOMENT:

Apply (a) or (b), whichever is greater:

(a) Passenger Heeling Moment (M_p) = (W x Bp)/6 =

(_____ X _____)/6 = _____

Total Test Wt. (W) — Max Beam Open to Passengers (B_p)

(b) Wind Heeling Moment (M_w) =

_____ X _____ = _____

Wind Pressure (P) — Sum (A x H)

(5) LOCATION OF IMMERSION MARK (i) ABOVE LOAD WATERLINE PRIOR TO APPLICATION OF HEELING MOMENT:

The freeboard measurement (f) shall be taken with the weight required in Step (1) on board. The height of the immersion mark (i) shall be the lesser of the two values provided by (a), (b), (c), or (d) according to vessel type, or (e) for all vessels. The mark (i) shall be placed on the hull above the LWL at the reference station.

i = _____

a) **Flush Deck Type Sailing Vessels** (or well deck vessels that operate on protected waters, have non-return scuppers, and the reference freeboard is not more than one-quarter of the distance from the waterline to the top of the gunwale).
Reference freeboard (f) is measured to the top of the weather deck at the side of the vessel.

_____	=	_____
Reference Freeboard (f)		Height of (i) above LWL

b) **Flush Deck Type Vessels** (including all well deck vessels except those noted in (a) above)
For well deck vessels, freeboard (f) to the lowest deck exposed to the weather must equal or exceed 25.4 centimeters (10 inches).
If less than 25.4 centimeters, use 5 (d) Open-boat Type formula.

_____ /2 =	_____
Reference Freeboard (f)	Height of (i) above LWL

c) **Cockpit Type Vessels**
Freeboard to cockpit deck must equal or exceed 25.4 centimeters (10 inches)
If less than 25.4 centimeters, use 5 (d) Open-boat Type formula.

Length overall . . . . . (L)
Length of cockpit . . . . . (/)
Reference freeboard . . . . . (f)
(measured to top of gunwale)
Height of immersion mark above LWL . . . . . (i)
all measurements shall be meters (feet)

Exposed Waters

$$(i) = \frac{f (2L - 1.5 /)}{4L}$$

Partially Protected or Protected Waters

$$(i) = \frac{f (2L - /)}{4L}$$

d) **Open-boat Type Vessels**
Reference freeboard (f) is measured to top of gunwale.

_____ /4 =	_____
Reference Freeboard (f)	Height of (i) above LWL

e) **All Vessel Types**
To limit the final angle of list to 14° for any type of vessel as required by 46 CFR 171.030 (e) (4), the height of the immersion mark (i) shall in no case exceed the value below. If this value is less than that produced by (a), (b), (c), or (d) above, whichever applicable, then this value shall be used for (i).

_____ /8 =	_____
Beam at Ref. Station (B_f)	Max Height of (i) above LWL for any type of vessel

(6) WEIGHT MOVEMENT:

a) The heeling moment required by Section (4) shall be obtained by a transverse movement of the test weights.
b) The test shall be conducted with all tanks 3/4 full, ballast aboard in place, all portlights secured, and any non-return valves or flaps on scuppers or deck drains restrained in the open position.
c) The vessel shall be fully afloat and all mooring are to be slack during the test.
d) During the loading and moving of test weights, care should be taken if there is evidence of low stability. This may be assumed to be the case whenever the effect of any added or shifted weight increment is noted to be more than that of the preceding increment of the same size, or when the chine or bilge amidships comes out of the water as a result of the heel.
e) Care is to be exercised that the vessel is not heeled excessively either due to weight movement or superimposed roll which could cause the test weights to topple or ship's gear to become adrift.
f) While the vessel is heeled, check for open seams, loose hull fittings, etc., which are not normally immersed and which could cause flooding of the vessel.

Quantity	Weight per Unit	Distance Moved	Moment
		Total Heeling Moment	

(7) HEIGHT OF IMMERSION MARK (i) ABOVE WATERLINE AFTER WEIGHT MOVEMENT:

i = _____

a) If the vessel lists to the immersion mark (i) before the full heeling moment is applied, the test shall be stopped and the vessel fails the test.
b) When the moment required in Section (4) has been developed, measure the resulting height of the immersion mark (i) above the waterline.
c) If any portlights are found to be near the waterline at the final angle of the list, such portlights on each side shall be permanently closed.
d) If any scuppers or drains are found to be below the waterline at the final angle of list so as to permit entry of water into the or onto the deck, such openings on each side shall be fitted with automatic non-return valves.

(8) GENERAL STABILITY INFORMATION (for documentation purposes only)

Tankage:

Tank	Capacity	Approximate Location of CG @ 100% Cap.	
		Aft of Stem	Above Top of Keel

Ballast:

Material	Weight	Approximate Location of CG	
		Aft of Stem	Above Top of Keel

TWENTY-FIVE PERCENT TEST

(This test is not a necessary part of the Simplified Stability Test Procedure but may be used as a preliminary check when the stability is believed to be marginal.)

1. After the Total Test Weight (W) has been placed on board and the Reference Freeboard (f) has been measured, rig a pendulum free to swing athwartships at any convenient location on the vessel. Arrange it so that the bob is approximately 3 millimeters (1/8 inch) above the deck. Place a chalk mark on the deck directly beneath the bob. Measure the pendulum length (pend. 1.) as the distance from pivot to deck.

2. Move the test weight to obtain a heeling moment equal to one-quarter of the Required Heeling Moment in Section (4) on page 3. It is suggested that the weights having the longest levers be moved as to minimize the amount of weight handled.

One-quarter Heeling Moment: _____ /4 = _____
Req'd H.M. (4)

3. After the weight has been moved, place a chalk mark on the deck directly beneath the pendulum bob. Measure the pendulum deflection (pend. d.) as the distance between chalk marks.

4. Before proceeding with the Simplified Stability Test Procedure, the following calculations may be carried out to anticipate the results:

Approximate Maximum allowable Heeling Moment:

$$\frac{2 \times \underset{\text{1/4 H.M.}}{____} \times \underset{\text{pend. 1.}}{____} \times \underset{\text{Height of (i)}}{____}}{\underset{\text{pend. d.}}{____} \times \underset{\text{Beam at Ref. Station } (B_f)}{____}} = ____$$

If the Maximum Allowable Heeling Moment is LESS than the Required Heeling Moment in Section (4) on page 3, the vessel will probably fail the test by the difference indicated below:

Required Heeling Moment = _____

Allowable Heeling Moment = _____

Difference = _____

If Passenger Heel (4a) applies:
Approximate Number of Passengers in Excess

$$\frac{6 \times \underset{\text{Difference}}{____}}{\underset{\text{Wt/Pass}}{____} \times \underset{(B_p)}{____}} = \underset{\text{\# of Pass}}{____}$$

If Wind Heel (4b) applies:
Approximate Excess Wind Moment (Sum A x H)

$$\underset{\text{Difference}}{____} / \underset{(P)}{____} = \underset{\text{Moment}}{____}$$

STABILITY TEST PROCEDURE FOR VESSELS CARRYING PASSENGERS AND CARGO

(1) For vessels carrying cargo as well as passengers, follow the same test procedure as for vessels carrying passengers alone except that, in addition to the passenger test weight, the maximum deadweight of cargo permitted shall be on board, in place and so arranged as to simulate the most unfavorable vertical center of gravity likely to occur in service.

(2) Specify the maximum cargo deadweight permitted to be carried:

Weight of Cargo	Approximate Location of CG	
	Aft of Stem	Above Top of Keel

(3) Complete the Twenty-Five Percent Test based on the Passenger Heeling Moment or the Wind Heeling Moment, whichever is applicable, and note the anticipated test results.

(4) If the anticipated results of the test indicates that the vessel will fail, the entire test must be repeated with a reduced number of passengers and/or a reduced amount of cargo, or by utilizing any other corrective measures available.

(5) If the anticipated results of the test indicates that the vessel will pass, then with the vessel in the heeled condition and being cautious not to disturb any of the test weights which were shifted in order to heel the vessel; remove approximately one-quarter of the cargo from the vessel exercising great care to remove it symmetrically about the centerline.

(a) If the pendulum deflection DECREASES or remains unchanged -- replace the cargo which was removed and complete the stability test procedure.

(b) If the pendulum deflection INCREASES -- the cargo may be improving the stability of the vessel. Therefore, remove all of the cargo from the vessel, replace the test weights in their original positions so as to remove all list, remeasure the Reference Freeboard (f), and repeat the Twenty-Five Percent Test in its entirety for the new condition of loading. If the second Twenty-Five Percent Test indicates that the vessel will pass, complete the stability test procedure.

(6) If the vessel passes the stability test procedure under these conditions, it is deemed to have adequate stability for the safe carriage of passengers allowed regardless of whether or not cargo, not in excess of the amount specified in Item (2) above, is carried.