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REPORT NO.

CG-B-003-80

AD A088174

FLOTATION STANDARD TEST PROCEDURE

U. S. Coast Guard Office of Boating, Public and Consumer Affairs

Boating Technical Division

2100 Second Street SW

Washington, D. C. 20593



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July 1980

Final Report

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National Technical Information Service
Springfield, Virginia 22161

PREPARED FOR

U.S. DEPARTMENT OF TRANSPORTATION

UNITED STATES COAST GUARD

WASHINGTON, D.C. 20593

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(18) USCG-B

Technical Report Documentation Page

1. Report No. CG-B-003-80		2. Government Accession No. AD-A088174		3. Recipient's Catalog No.	
4. Title and Subtitle USCG FLOTATION STANDARD TEST PROCEDURE		5. Report Date July 1980		6. Performing Organization Code	
7. Author(s)		8. Performing Organization Report No. Final report		9. Performing Organization Name and Address Wyle Laboratories, EASTERN OPERATIONS P. O. Box 1008 Huntsville, Alabama 35807	
10. Sponsoring Agency Name and Address USCG HQ 2100 Second Street SW Washington, D. C. 20593		11. Contract or Grant No. DOT-CG-12377-A		12. Type of Report and Period Covered TEST PROCEDURE	
13. Supplementary Notes Supersedes AD-758427		14. Sponsoring Agency Code U. S. Coast Guard (G-BBT)		15. Abstract This report describes in detail a Flotation Standard Test Procedure for boats rated for outboard engines larger than two horsepower, boats rated for outboard engines two horsepower or less, for inboard boats, inboard-outdrive boats and airboats and a flotation materials test. The Flotation Standard Test Procedure is designed to determine whether or not a given boat meets the flotation requirements outlined in the Federal Boat Safety Act of 1971 (P. L. 92-75) and the rules and regulations in the Federal Register: 37 FR 15782, Aug. 4, 1972 as amended at 37 FR 17388, Aug. 26, 1972; 39 FR 10899, Mar. 22, 1974; 41 FR 11290, Mar. 18, 1976; 43 FR 56858, Dec. 4, 1978.	
16. Key Words Level Flotation Test Gasoline Vapor Stability Test Test Basic Flotation Test Flotation Material Test		17. Distribution Statement Document is available to the U. S. public through the National Technical Information Service, Springfield, Virginia 22161			
18. Security Classif. (of this report) Unclassified		19. Security Classif. (of this page) Unclassified		20. No. of Pages 75	

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METRIC CONVERSION FACTORS

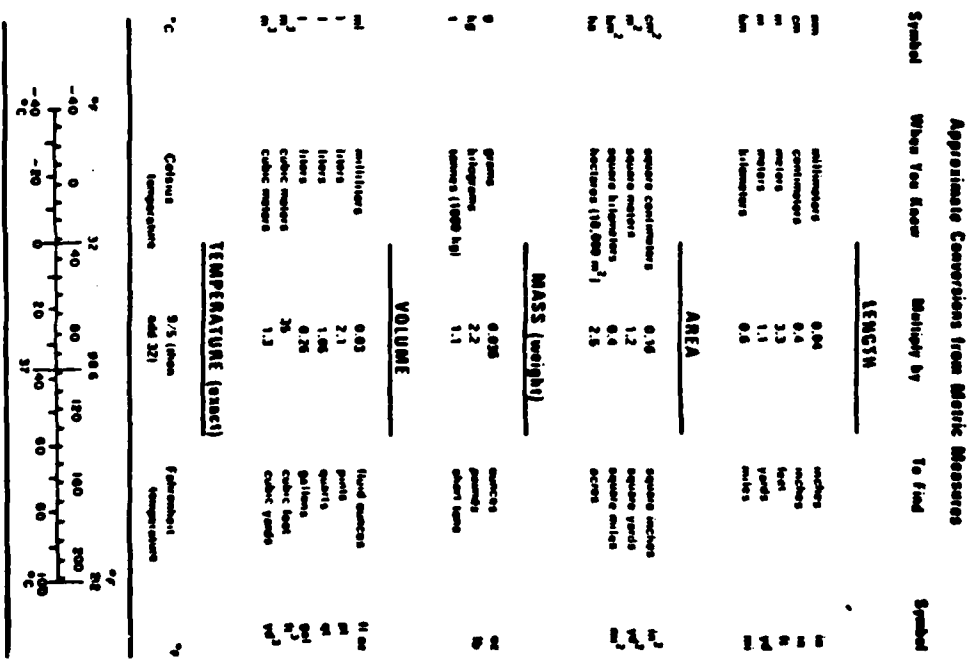
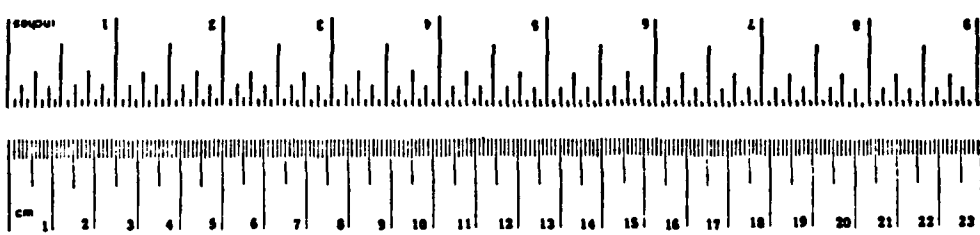
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
m	meters	2.5	centimeters	cm
km	kilometers	1,000	meters	m
mm	millimeters	1,000	centimeters	cm
cm	centimeters	10	millimeters	mm
AREA				
m ²	square meters	1.1	square centimeters	cm ²
km ²	square kilometers	2.5	square miles	mi ²
ha	hectares	2.5	square meters	m ²
acres	acres	0.4	hectares	ha
MASS (weight)				
g	grams	2.2	ounces	oz
kg	kilograms	2.2	pounds	lb
tonnes (1,000 kg)	tonnes (1,000 kg)	0.9	short tons (2,000 lb)	ton
VOLUME				
l	liters	1.06	quarts	qt
ml	milliliters	0.034	fluid ounces	fl oz
cl	centiliters	0.34	fluid ounces	fl oz
dl	deciliters	3.4	fluid ounces	fl oz
l	liters	1.06	quarts	qt
cl	centiliters	0.34	fluid ounces	fl oz
dl	deciliters	3.4	fluid ounces	fl oz
TEMPERATURE (Celsius)				
Fahrenheit temperature	5/9 (F - 32)		Celsius temperature	°C
Celsius temperature	9/5 (C + 32)		Fahrenheit temperature	°F

* 1 in a 2.54 centimeters. For other exact conversions, see metric tables, NBS Mon. Publ. 755. Units of length and mass, NBS, 1975. 50 Celsius No. C1318 298

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
cm	centimeters	0.39	inches	in
m	meters	3.3	yards	yd
km	kilometers	0.62	miles	mi
AREA				
cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	sq yd
ha	hectares	2.5	square miles	mi ²
acres	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	0.035	grams	g
lb	pounds	2.2	kilograms	kg
ton	short tons (2,000 lb)	1.1	tonnes (1,000 kg)	tonnes
VOLUME				
fl oz	fluid ounces	0.03	centiliters	cl
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
cu ft	cubic feet	0.03	centimeters	cm ³
cu yd	cubic yards	1.3	centimeters	cm ³
TEMPERATURE (Celsius)				
Fahrenheit temperature	5/9 (F - 32)		Celsius temperature	°C
Celsius temperature	9/5 (C + 32)		Fahrenheit temperature	°F



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1. SCOPE

1.A APPLICABILITY OF FLOTATION STANDARD

The Flotation Standard applies to most monohull boats less than 20 feet in length, the construction of which is begun on or after 1 August 1973.

1.B EXCEPTIONS TO FLOTATION STANDARD

The Flotation Standard does not apply to sailboats, canoes, kayaks, inflatable boats, submersibles, surface effect vessels, amphibious vessels and raceboats.

2. INTRODUCTION

2.A PURPOSE

With certain exceptions all recreational boats less than 20 feet in length, the construction of which is begun on or after 1 August 1978, must comply with the new Coast Guard flotation standard.

This is an amended test procedure. It extends the scope of the Coast Guard compliance test procedure beyond a simple "pass" or "fail". Testing using this test procedure will enable boat manufacturers to determine not only whether their boats comply with the new flotation standard, but also the amount of additional flotation material which may be required and where it must be installed.

This test procedure is not intended to instruct manufacturers in boat design, but it is intended to show them how to test their boats for compliance with the new flotation standard.

NOTE

Excerpts from the flotation regulations appear in boxes in each section of the test procedure. They are intended to make it easier to understand the regulations and should not be confused with the actual test procedure.

2.B GOOD HOUSEKEEPING

The contractor shall maintain the entire boat testing area, test fixtures, and instrumentation in a neat, clean, and painted condition with test instruments set up in an orderly manner consistent with good test laboratory housekeeping practices.

2.C SECURITY

The contractor shall provide appropriate security measures to protect each manufacturer's test boats, engines, and equipment from unauthorized personnel during the entire test program. He shall further protect and segregate the data obtained from testing each boat.

2.D CALIBRATION OF TEST INSTRUMENTATION

Before the contractor starts the flotation standard test procedure, a test instrumentation calibration system shall be implemented and maintained in accordance with established calibration practices. Guidelines for setting up and maintaining such calibration systems are described in MIL-C-45662A, "Calibration System Requirements" and MIL-HDBK-52, "Evaluation of Contractor's Calibration System". The calibration system shall be set up and maintained as follows:

- a. Standards for calibrating the measuring and test equipment shall be stored and used under appropriate environmental conditions to assure their accuracy and stability.
- b. All measuring instruments and standards shall be calibrated by the contractor, or a commercial facility, against a higher order standard at periodic intervals not exceeding 6 months. Records showing the calibration traceability to the National Bureau of Standards shall be maintained for all measuring and test equipment.
- c. All measuring and test equipment and measuring standards shall be labeled with the following information:
 - (1) Date of calibration.
 - (2) Date of next scheduled calibration.
 - (3) Name of the technician who calibrated the equipment.

d. A written calibration procedure shall be provided by the contractor which includes as a minimum the following information for all measurement and test equipment:

- (1) Type of equipment, manufacturer, model number, etc.
- (2) Measurement range.
- (3) Accuracy.
- (4) Calibration interval.

(5) Type of standard used to calibrate the equipment. Calibration traceability of the standard must be evident.

e. Records of calibrations for all test instrumentation shall be kept by the contractor in a manner which assures the maintenance of established calibration schedules. All such records shall be readily available for inspection when requested by the Coast Guard. The calibration system must be accepted by the Coast Guard before testing may begin.

2.E TEST TANK AND WATER CONDITIONS

The flotation test must be conducted in a test tank that is at least two feet deeper than the overall height of the test boat, including the windshield if one is installed. Record the temperature and density of the test tank water on Data Sheet #2.

NOTE

Fresh water (not salt water) must be used to produce the required buoyancy forces on the boat. The water must be clear in order to obtain clear photographic documentation of the flooded boat, equipment and dummy weights. Photographs are enhanced by a light colored paint on the interior walls of the tank. The tank and water should be deep enough to assure that the test boat, when swamped, does not rest on the tank bottom, which could cause erroneous measurements.

2.F HANDLING RIGS

Handling rigs and associated equipment used to lift the test boat into and out of the test tank must be designed to satisfy the following requirements:

- a. The handling rigs must have a rated load capacity greater than the dry weight of the boat plus the dry weight of any manufacturer-supplied accessories.

NOTE

Dummy weights need not be included in the lifting capacity of the handling rigs since these dummy weights can be placed in and removed from the boat after it is placed in the test tank. This practice is recommended in order to eliminate undue strain on the boat structure.

- b. All slings or hooks used to lift the test boat must be designed so that they do not puncture the hull or cause any damage to the boat structure.

- c. During the flotation test, the handling rigs should be removed so that they add no extra load or buoyancy to the test boat.

NOTE

The flotation tests should be conducted in such a manner that damage to the boat structure is minimal. Place slings in the test tank and under the boat so that they do not touch the boat, but so that the slings can catch and support the boat in the event that the boat sinks. This will eliminate damage to the boat hull that would otherwise occur from impact against the bottom of the tank.

2.6 LOAD CELLS

Three load cells or spring type scales accurate to within ten pounds, and capable of raising a sunken test boat to a level attitude are required. These load cells must be supported by a rig with spreaders arranged so that pendants attached to the load cells may be affixed to the test boat at three points; one forward and two aft. The pendants must be positioned so that they hang perpendicular to the surface of the water when supporting the boat. This is to assure that the measurements taken from the load cells are accurate indications of the lift or buoyancy required to raise the test boat.

3 GLOSSARY

The definitions in this glossary describe how certain terms are used in this test procedure and in the flotation regulation.

The definitions of these terms are not necessarily commonly accepted.

Aft Reference Area - The aft most 2 feet of the top surface of the hull or deck (See Figure 1).

Cockpit - See Passenger Carrying Area.

Dead Weight - (For inboards, I/O's, and airboats): the maximum weight capacity marked on the boat minus the persons capacity marked on the boat.

(For outboards): the maximum weight capacity marked on the boat less the weight shown in Column 6 of Table II for maximum horsepower marked on the boat; less the persons capacity marked on the boat.

Forward Reference Area - The forward most 2 feet of the top surface of the hull or deck (See Figure 1).

Passenger Carrying Area - Each area in a boat in which persons can sit in a normal sitting position, or stand while the boat is in operation. Breadth and length are measured as illustrated in Figures 2 and 3. If a boat has a cabin, the passenger carrying area is measured where there is at least two feet of air space between the swamped waterline and the cabin ceiling, measured in a continuous length.

Reference Depth - The minimum distance between the upper most surface of the submerged reference area of a boat, and the surface of the water, measured at the centerline (See Figure 1).

4. PROCEDURES

4.A RECEIVING INSPECTION

1. Unpacking - The test boat shall be unpacked immediately upon arrival at the test facility to make certain that the article shipped is complete according to the packing list. Make a preliminary inspection to determine whether the article has been damaged due to careless handling during shipping. If possible, conduct the preliminary inspection with the shipping agent present to expedite processing possible damage claims. Enter all pertinent data in the spaces provided on Data Sheet #1.

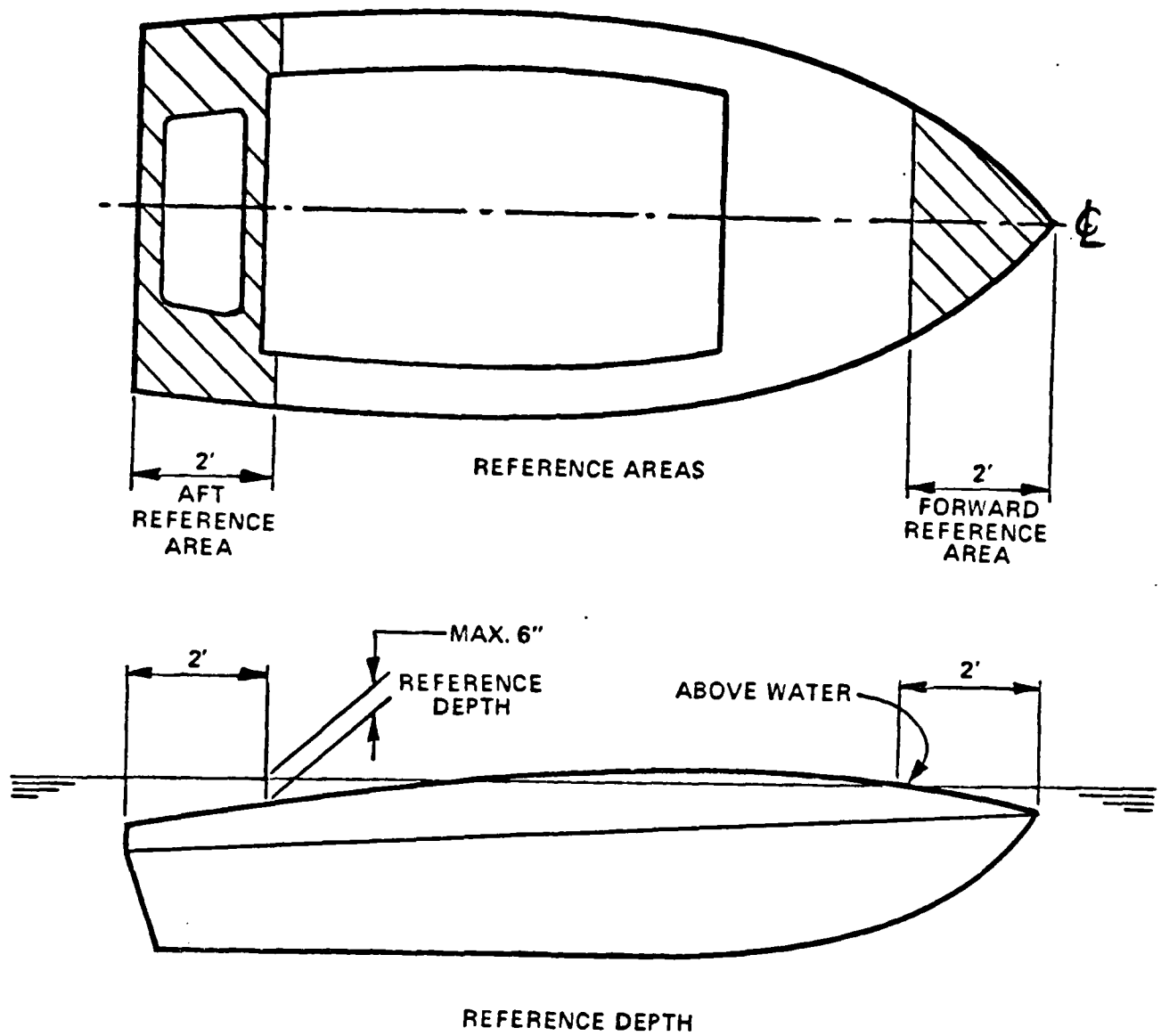


Figure 1 Reference Area Locations

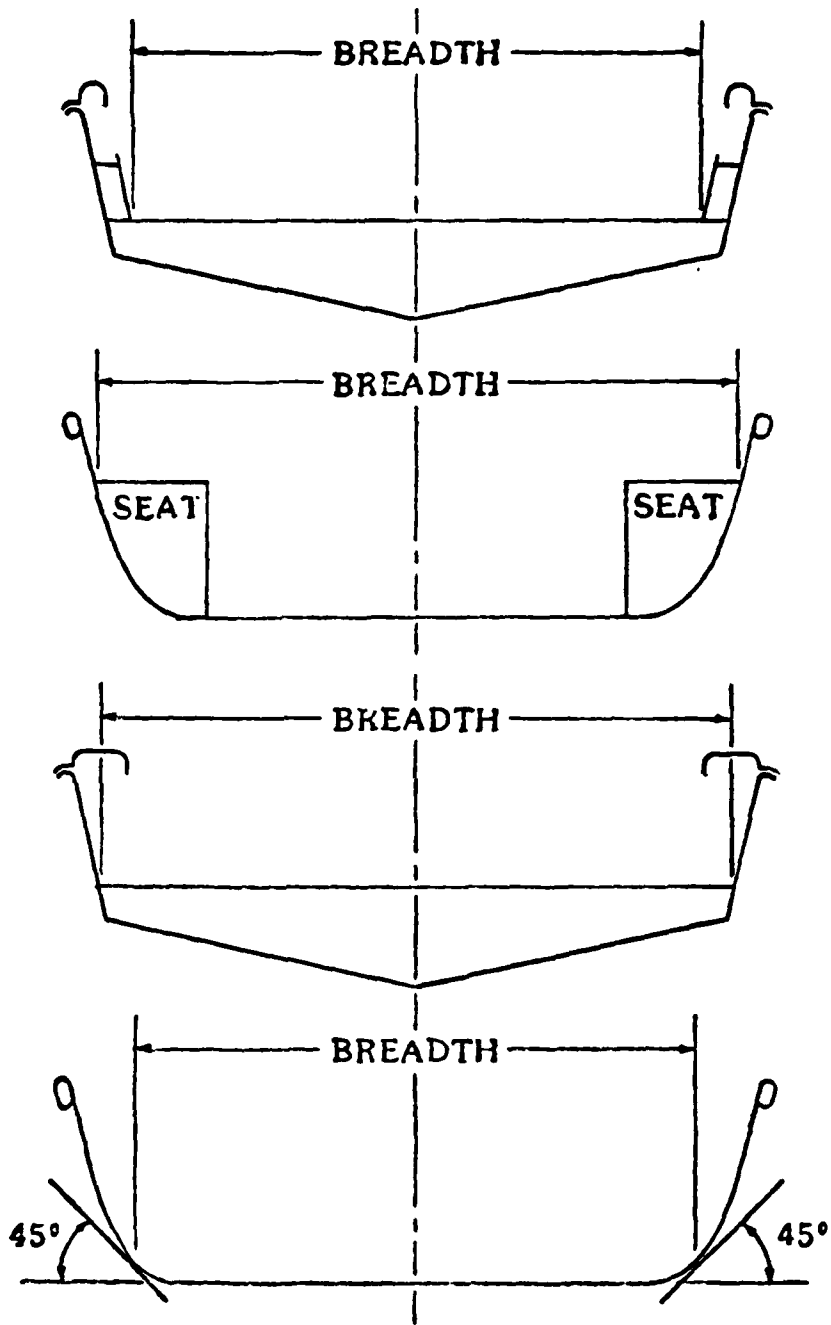


Figure 2 Measuring Passenger Carrying Area Breadth

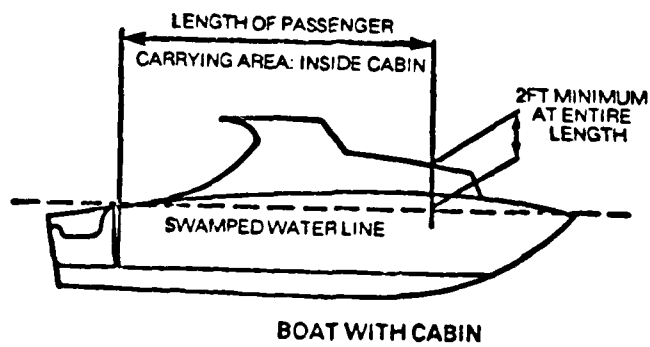
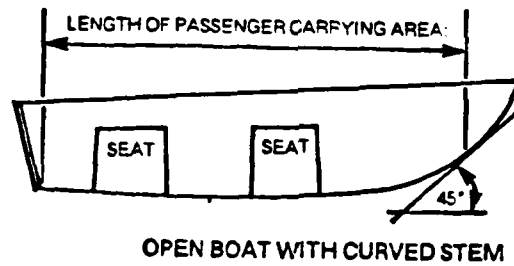
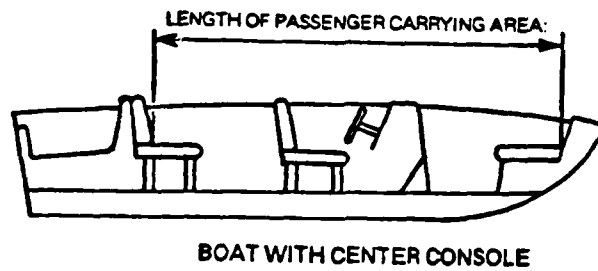
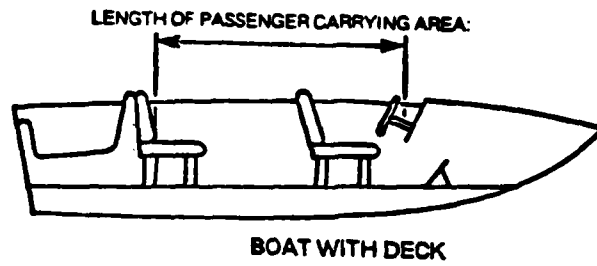


Figure 3 Measuring Passenger Carrying Area Length

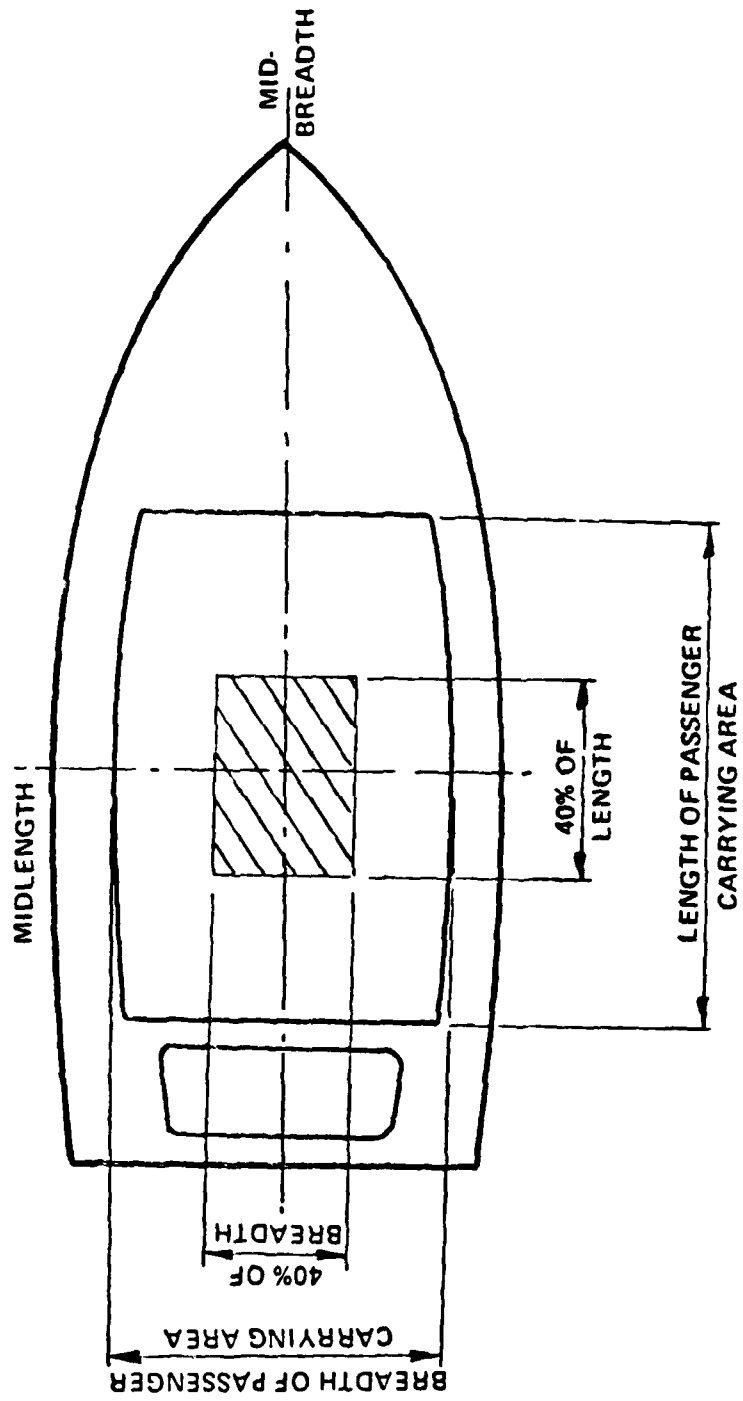


Figure 4 Location of Center of Gravity, Level Flotation

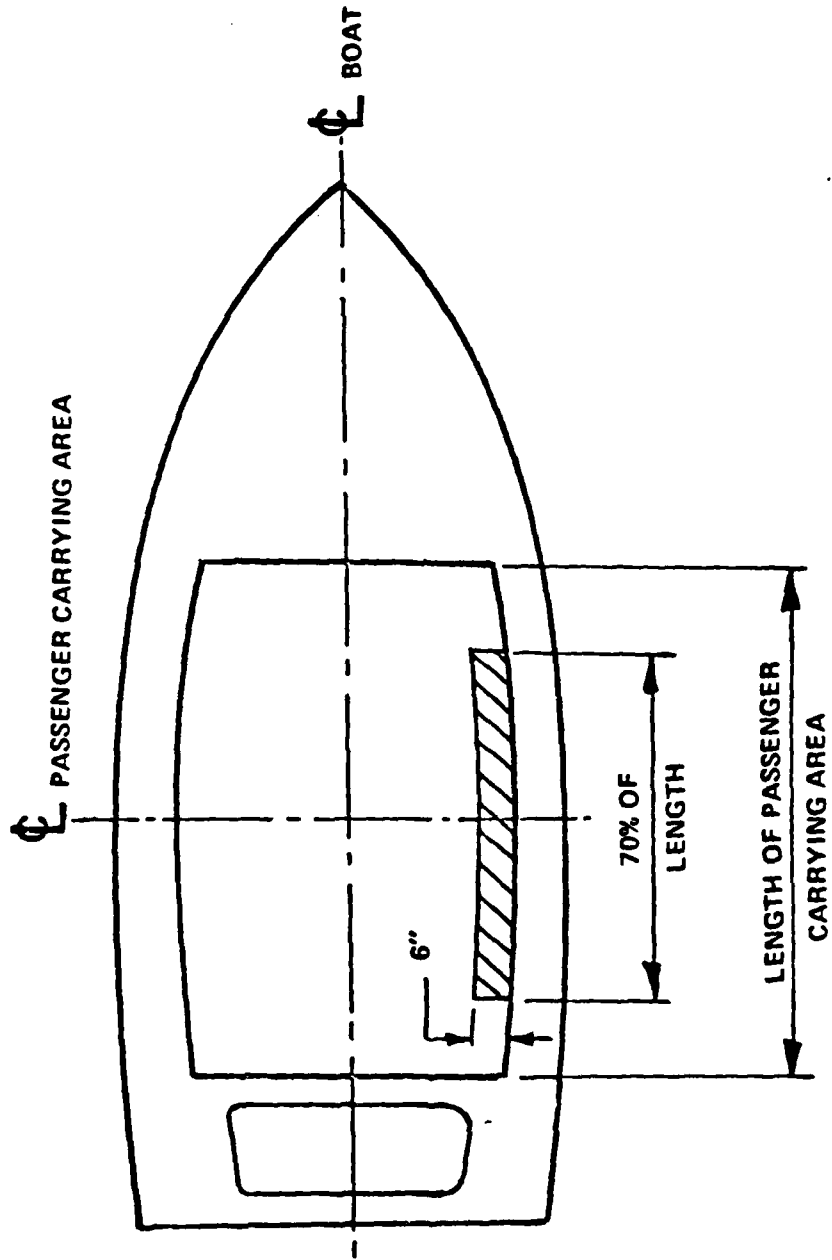


Figure 5 Location of Center of Gravity of Weights: Stability Test Starboard Side

Note
A line across the top
of the supports must
be horizontal.

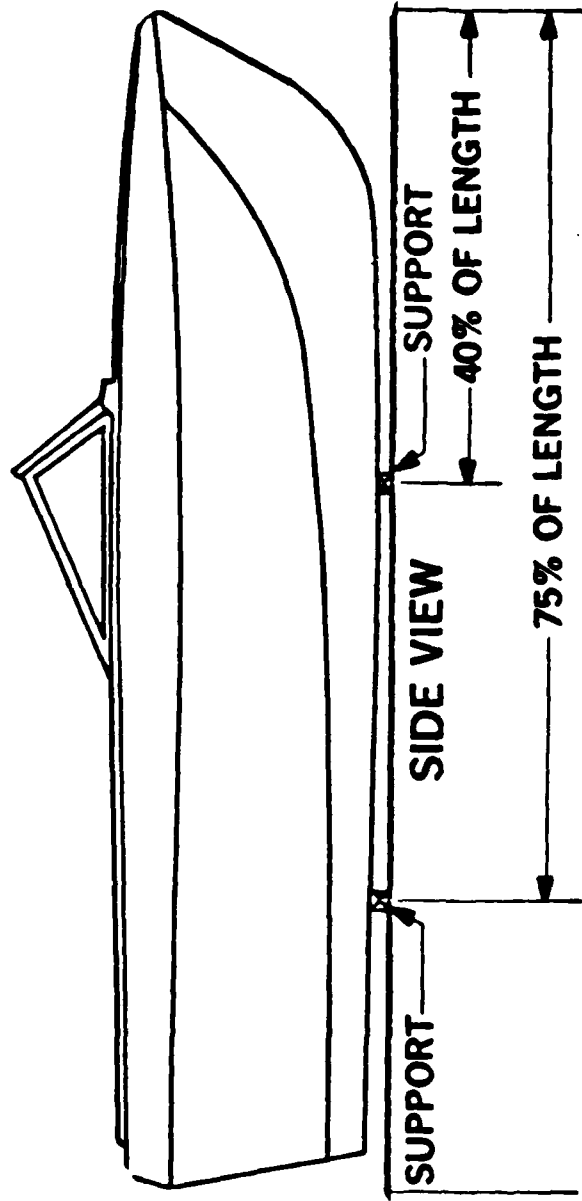


Figure 6 Location of Supports for Level Boat

2. Identification - The test boat shall be assigned a test article identification number by the project engineer. The identification number, preceded by the words USCG TEST BOAT, shall be displayed on both sides of the hull above the waterline, approximately amidships. The characters shall be at least 3 inches high and colored to contrast with the boat's hull for easy visibility and photographing. The material on which the number is printed must be sufficiently durable to withstand swappings in fresh water. The test article number shall be entered on Data Sheet #1. At least three photographs of the test boat shall be taken to show the following:

- a. A three-quarter front view of the top.
- b. A close-up of the capacity information label with 6-inch scale taped alongside to show size of label and lettering.
- c. A view showing the location of the capacity label.

All photographs shall include the test article number lettered against a contrasting background. The numbers shall be of sufficient size and boldness to be readable from a 5" x 7" photograph.

3. Inventory - Make an inventory of all machinery and equipment included with the test boat, and list them on Data Sheet #1 with each accessory manufacturer's name, model and part number, when available. The list shall include information concerning engines, outdrive units, fuel tanks, controls, navigation and electronic equipment, batteries, fire extinguishers, anchors, etc.

4. Log Book - The Project Engineer shall maintain a test boat log containing the following information:

- a. Test boat number
- b. Description of test boat
- c. Date received
- d. Condition upon receipt (incoming inspection)
- e. Action taken for damage claims, etc.
- f. Inventory of equipment supplied with the test boat
- g. Photographs of the test boat taken before, during, and after the tests

The log book shall also include notes and comments by the Project Engineer on any phase of the test procedure that may be helpful in justifying a compliance or non-compliance ruling at test completion. Each entry in the log book shall be dated and initialed by the Project Engineer.

4.B TEST PROCEDURE, BOATS RATED FOR OUTBOARD ENGINES LARGER THAN 2 HORSEPOWER

1. Preconditioning for Tests - Prepare the test boat for the flotation tests in accordance with §183.220 of the regulation. All measurements must be accurate to within $\pm 1/2$ inch.

§183.220(a) Manufacturer supplied permanent appurtenances such as windshields and convertible tops must be installed on the boat.

- a. Inspect boat to determine if all manufacturer supplied equipment is installed and in its proper place within the boat. Remove all other objects.
- b. Place test boat in a level attitude longitudinally by supporting it at 40 percent and 75 percent of its length measured back from the bow (See Figure 6).
- c. Mark off forward and aft reference areas as follows:
 - (1) Measure back exactly two feet from the forward and aft most points of the top surface of the hull or deck (See Figure 1).
 - (2) Use waterproof tape marker or grease pencil to mark off these areas so that they are readily visible when photographed.
- d. Mark off the floor of the boat to show the center of gravity location for the persons capacity test weights as follows (See Figure 4):
 - (1) Measure the length of the passenger carrying area and mark the midlength on the floor of the boat.
 - (2) Measure the breadth of the passenger carrying area and mark the midbreadth on the floor of the boat.

- (3) Measure 40% of the length of the passenger carrying area, centered at the midlength, and mark it off on the floor of the boat.

NOTE

For boats with cabins estimate the location of the forward end of the passenger carrying area by assuming that there must be at least two feet between the inside top of the cabin and the surface of the water when the boat is swamped. Correct the estimate if subsequent swamping shows that it was incorrect.

- (4) Measure 40% of the breadth of the passenger carrying area centered at the midbreadth, and mark it off on the floor of the boat.
 - (5) Use waterproof tape, marker or grease pencil to mark off the outline of the shaded area illustrated so that it is readily visible when photographed.
- e. Mark off the gunwales to show the center of gravity locations for the stability test weights as follows (See Figure 5):
- (1) Measure 70% of the length of the passenger carrying area, centered at the midlength, and mark it off on the starboard gunwale.
 - (2) Repeat D above for the port gunwale.
- f. Drill holes in the top and bottom of the two largest air chambers used for flotation, and all air chambers integral with the hull.

§183.220(e) Permanent fuel tanks must be filled with fuel, and each external opening into the fuel tank must be sealed.

- g. Fill all permanent fuel tanks with fuel, and seal all external openings with putty and waterproof tape.

§183.220(f) The boat must be keel down in the water.

- h. Place the slings of the handling rig under the hull of the boat.
- i. Lift boat out of its cradle, trailer or dolly, and lower it, keel down, into the water, keeping the boat supported on the slings.

§183.220(b) The boat must be loaded with a quantity of weight that when submerged is equal to the sum of . . . 50 percent of (the first) 550 pounds of the persons capacity marked on the boat and 12-1/2 percent of the remainder of the persons capacity . . . (plus) Twenty-five percent . . . of the following calculation, but not less than zero: the maximum weight capacity . . . less the weight shown in column 6 of Table 4 for maximum (rated) horsepower . . . less the (rated) persons capacity . . .

j. Record on Data Sheet #2 the MAXIMUM HORSEPOWER, MAXIMUM PERSONS CAPACITY, and MAXIMUM WEIGHT CAPACITY information from the capacity label.

k. Calculate the amount of weight needed using the following example:

EXAMPLE

Label Information

MAXIMUM HORSEPOWER 40
 MAXIMUM PERSONS CAPACITY (POUNDS) 480
 MAXIMUM WEIGHT CAPACITY
 (PERSONS, MOTOR & GEAR)(POUNDS) 815

Since the persons capacity is less than 550 pounds, take 50% of the whole 480 pounds.

50% of 480 = 240 pounds

-PLUS-

25% of (815 minus 300 minus 480)

25% of 35 = 8.75 pounds

240 + 8.75 = 248.75 pounds

§183.220(c) The weights . . . must be placed . . . so that the center of gravity . . . is within the shaded area illustrated (Figure 4).

1. Place weights in the boat so that the center of gravity falls within the area shown in Figure 4.

§183.220(d) Weight must be placed in the normal operating position of the motor and controls and the battery in lieu of this equipment . . . The required quantity . . . depends upon the maximum rated horsepower . . . and is specified in Columns 2 and 4 of Table 1.

m. Substitute weights for outboard motor, controls, and batteries using columns 2 and 4 of Table II to determine quantities.

n. Lower boat into the water and allow slings to go slack. Adjust test tank slings so that the boat can sink but not hit the bottom of the test tank.

§183.220(g) The boat must be swamped, allowing water to flow between the inside and outside of the boat, either over the sides, through a hull opening, or both. Entrapped air in the flooded portion of the boat must be eliminated.

o. Swamp the boat or fill it with water so that the water in the boat and in the tank are at the same level.

p. Eliminate entrapped air by sloshing and tilting boat, drilling 1/4" to 3/8" diameter vent holes or filling air pockets directly with a water hose. Eliminate entrapped air from seat cushions and upholstery by making openings in the covering material.

§183.220(h) Water must flood the two largest air chambers and all air chambers integral with the hull.

q. Drill holes in the top and bottom of the two largest air chambers and flood them, if they are used for flotation.

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COLUMN No.

Boat Horsepower Rating	Motor and Control weight		Battery Weight		Full Portable Fuel Tank Weight	1+3+5
	Motor and Control weight		Battery Weight			
	Dry	Swamped	Dry	Submerged		
0.1 to 2-----	25	20				25
2.1 to 3.9-----	35	30				35
4.0 to 7.0-----	55	48			25	80
7.1 to 15.0-----	75	65	20	11	50	145
15.1 to 25-----	100	88	45	25	50	195
25.1 to 45-----	155	135	45	25	100	300
45.1 to 80-----	240	210	45	25	100	385
80.1 to 150-----	315	275	45	25	100	460
150.1 to 250-----	420	300	45	25	100	565
TRANSOMS DESIGNED FOR TWIN MOTORS						
50.1 to 90-----	310	270	90	50	100	500
90.1 to 160-----	480	420	90	50	100	670
160.1 to 300-----	630	550	90	50	100	820

Table II WEIGHTS OF OUTBOARD MOTOR AND RELATED EQUIPMENT FOR VARIOUS BOAT HORSEPOWER RATINGS

NOTE: (1)

A weight in pounds equal to 62.4 times the volume of the air chambers in cubic feet may be used in lieu of flooding the chambers with water.

NOTE: (2)

The weights may be shifted to achieve an approximately level attitude as long as the center of gravity of the weights for both the persons capacity and the deadweight is within the shaded area as shown in Figure 4.

- r. Flood all air chambers integral with the hull.
- s. Keep boat swamped for at least 18 hours prior to testing.
- t. Take photographs showing swamped condition.

2. Level Flotation Test for Persons Capacity - After the test boat has remained swamped for 18 hours, test the boat for level flotation in accordance with §183.225 of the standard.

§183.225 Flotation Standard . . . the boat must float in fresh, calm water as follows:

(a) The angle of heel does not exceed 10 degrees from the horizontal.

- a. Determine water conditions, and record the information in the space provided on Data Sheet #2.
- b. Check to make sure the test weights are still in place.
- c. Measure the heel angle of the swamped boat. Record on Data Sheet #2.

§183.225(b) Any point on either the forward or aft reference area is above the surface of the water.

d. Determine if any point on either forward or aft reference area is above the water surface. Record on Data Sheet #2.

§183.225(c) The reference depth at the reference area that is opposite the reference area that is above the surface of the water is 6 inches or less.

e. Measure the reference depth as illustrated on Figure 1. Record on Data Sheet #2.

f. If not in compliance, the weights may be moved as long as the center of gravity of the weights for both the persons capacity and the deadweight is within the shaded area shown in Figure 4.

g. If, after the boat has remained swamped for 18 hours, it fails to meet the attitude criteria for level flotation, use the following procedure to determine how much additional flotation is required.

(1) Position load cell rig above the boat with one pendant above the bow and the other two on each side of the engine.

(2) Attach the pendants to points on the boat deck under which additional foam can be placed to bring the boat up to its proper attitude.

(3) Raise each of the three pendants until the boat reaches the proper attitude. Record the number of pounds of lift at each point that is necessary to bring the boat up.

3. Stability Test - After completion of the flotation test for persons capacity, test the boat for stability in accordance with §183.230 of the standard.

§183.230(b) Quantity of weight used. Load the boat with a quantity of weight that, when submerged, is equal to the sum of the following:

- (1) One-half the quantity of weight required by §183.220(b)(1); and
- (2) The quantity of weight required by §183.220(b)(2).

a. Hoist the boat up to an approximately level position and keep it supported while moving the weights.

b. Remove half of the weight used to simulate persons capacity in the preceding test.

c. Be sure that weights representing deadweight and the engine, battery, and controls are still in place.

§183.230(c) Placement of quantity of weight: starboard side.

Place the weight required by (b) of this section in the boat so that:

(1) . . . (it) is uniformly distributed . . . along the starboard side of the passenger carrying area (and extending over) at least 30% of the length of the passenger carrying area. The center of gravity is located within the shaded area in Figure (5) . . . (with) the center of gravity of each (floor) weight . . . at least 4 inches above the floor, . . . and of each (seat) weight . . . at least 4 inches above the seat.

d. Move the remaining half of the persons capacity weights to the starboard side of the passenger area so that the center of gravity falls in the shaded area of the boat illustrated in Figure 5. The vertical center of gravity must fall at least 4 inches above the seats or floor.

e. Distribute the weight along at least 30 percent of the passenger area length, placing weights on the floor and seats.

f. Lower the boat back into the water and allow the slings to go slack. Adjust slings so that the boat can sink but not heel over 30 degrees or hit the bottom of the test tank.

g. Swamp the boat to allow a free flow of water between outside and inside.

§183.230(a) Flotation Standard . . . the boat must float in fresh calm water as follows:

(1) The angle of heel does not exceed 30 degrees from the horizontal.

(2) Any point on either the forward or aft reference area is above the surface of the water.

(3) The reference depth of the reference area that is opposite the reference area that is above the surface of the water is 12 inches or less.

h. Measure the heel angle. Record on Data Sheet #2.

i. Determine if any point on either the forward or aft reference area is above the water surface. Record on Data Sheet #2.

j. Measure the reference depth as illustrated in Figure 2. Record on Data Sheet #2.

k. If after moving the weights for the stability test the boat fails to meet the attitude criteria, use the following procedure to determine how much additional foam is required:

(1) Position load cell rig above the boat with one pendant above the bow and the other two on each side of the engine. Attach the pendants to points on the boat deck under which additional foam can be placed to raise the boat to the proper attitude.

(2) Raise each of the three pendants until the boat reaches the proper attitude. Record the number of pounds of lift at each point that is necessary to bring the boat up.

§183.230(d) Placement of quantity of weight: port side . . .

1. Repeat steps a. through k. above, placing the weights on the port side.

4. Level Flotation Test Without Weights for Persons Capacity - After completion of the test for stability, test the boat for level flotation without weights for persons capacity and deadweight in accordance with §183.235 of the standard.

§183.235 . . . When the conditions prescribed in §183.220(a), (d) through (h) are met, the boat must float in fresh calm water as follows:

- (a) The angle of heel does not exceed 10 degrees from the horizontal.
- (b) Any point on either the forward or aft reference area is above the surface of the water.
- (c) The reference depth at the reference area that is opposite the reference area that is above the surface of the water is 6 inches or less.

a. Hoist the boat up to an approximately level position and keep it supported while removing the weights.

b. Remove all weights for persons capacity and deadweight.

c. Leave only the dummy weights for engine, batteries, and controls.

d. Lower the boat back into the water and allow the slings to go slack. Adjust the slings so that the boat can sink but not hit the bottom of the test tank.

e. Swamp the boat or fill it with water so that the water in the boat and in the tank are at the same level.

- f. Measure the heel angle. Record on Data Sheet #2.
- g. Determine if any point on either the forward or aft reference area is above the water surface. Record data on Data Sheet #2.
- h. Measure the reference depth as illustrated on Figure 2. Record on Data Sheet #2.
- i. If, after all the weights for persons capacity have been removed, the boat fails to meet the attitude requirement for level flotation, use the following procedure to determine how much additional flotation is required:
 - (1) Attach the pendants to points on the boat deck under which additional foam can be placed to bring the boat up to its proper attitude.
 - (2) Raise each of the three pendants until the boat reaches the proper attitude. Record the number of pounds of lift at each point that is necessary to bring the boat up.
- j. Remove the test boat from the water in accordance with paragraph 4.E. of these test procedures.

4.C TEST PROCEDURE, BOATS RATED FOR OUTBOARD ENGINES 2 HORSEPOWER OR LESS

- 1. Preconditioning for Tests - Prepare the test boat for the flotation tests in accordance with §183.320 of the regulation.

§183.320(a) Manufacturer supplied permanent appurtenances such as windshields and convertible tops must be installed on the boat.

- a. Inspect boat to determine if all manufacturer supplied equipment is installed and in its proper place within the boat. Remove all other objects.
- b. Place test boat in a level attitude by supporting it at 40 percent and 75 percent of its length measured back from the bow.

c. Mark off forward and aft reference areas as follows:

- (1) Measure back exactly two feet from the forward and aft most points of the top surface of the hull or deck (See Figure 1).
- (2) Use waterproof tape, marker, or grease pencil to mark off these areas so that they are readily visible when photographed.

d. Mark off the floor of the boat to show the center of gravity location for the persons capacity test weights as follows (See Figure 4):

- (1) Measure the length of the passenger carrying area and mark the midlength on the floor of the boat.
- (2) Measure the breadth of the passenger carrying area and mark the midbreadth on the floor of the boat.
- (3) Measure 40% of the length of the passenger carrying area, centered at the midlength, and mark it off on the floor of the boat.
- (4) Measure 40% of the breadth of the passenger carrying area, centered at the midbreadth, and mark it off on the floor of the boat.
- (5) Use waterproof tape, marker, or grease pencil to mark off the outline of the shaded area illustrated so that it is readily visible when photographed.

e. Mark off the gunwales to show the center of gravity locations for the stability test weights as follows (See Figure 5):

- (1) Measure 70% of the length of the passenger carrying area, centered at the midlength, and mark it off on the starboard gunwale.
- (2) Repeat D. above for the port gunwale.

§183.320(e) Permanent fuel tanks must be filled with fuel and each external opening into the fuel tank must be sealed.

f. Fill all permanent fuel tanks with fuel and seal all external openings with putty and waterproof tape.

§183.320(f) The boat must be keel down in the water.

g. Place the slings of the handling rig under the hull of the boat.

h. Lift boat out of its cradle, trailer or dolly, and lower it keel down into the water, keeping the boat supported on the slings.

§183.320(b) The boat must be loaded with a quantity of weight that, when submerged is equal to the sum of . . . Two-fifteenths of the persons capacity marked on the boat . . . (plus) Twenty-five percent . . . of the following calculation, but not less than zero: the maximum weight capacity . . . less the weight shown on column 6 of Table 4 for maximum (rated) horsepower . . . less the (rated) persons capacity . . .

i. Record on Data Sheet #2 the MAXIMUM HORSEPOWER, MAXIMUM PERSONS CAPACITY, and MAXIMUM WEIGHT CAPACITY information from the capacity label.

j. Calculate the amount of weight needed, using the following example:

EXAMPLE

Label Information

MAXIMUM HORSEPOWER 2
MAXIMUM PERSONS CAPACITY (POUNDS) 205
MAXIMUM WEIGHT CAPACITY
(PERSONS, MOTOR & GEAR)(POUNDS) 240

$$2/15 \text{ of } 205 = 27.33$$

-PLUS-

$$25\% \text{ of } (240 \text{ minus } 35 \text{ minus } 205)$$

$$25\% \text{ of } 0 = 0$$

$$27.33 + 0 = 27.33 \text{ pounds}$$

§183.320(c) The weights . . . must be placed . . . so that the center of gravity . . . is within the shaded area illustrated (Figure 1).

k. Place the weights in the boat so that the center of gravity falls within the area shown in Figure 4.

§183.320(d) Weight must be placed in the normal operating position of the motor and controls in lieu of this equipment. . . . The required quantity . . . depends upon the maximum rated horsepower . . . and is specified in Column 2 of Table 4.

l. Substitute weights for outboard motor and controls using column 2 of Table II to determine quantities.

m. Lower boat into the water and allow slings to go slack. Adjust slings so that the boat can sink but not hit the bottom of the test tank.

§183.320(g) The boat must be swamped, allowing water to flow between the inside and outside of the boat, either over the sides, through a hull opening, or both. Entrapped air . . . must be eliminated.

- n. Swamp the boat or fill it with water so that the water in the boat and in the tank are at the same level.
- o. Eliminate entrapped air by sloshing and tilting the boat, drilling 1/4" to 3/8" diameter vent holes or filling air pockets directly with a water hose. Eliminate entrapped air from seat cushions and upholstery by making openings in the covering material.

NOTE

The weights may be shifted to achieve an approximately level attitude as long as the center of gravity for both persons capacity and dead-weight is within the shaded area shown in Figure 4.

- p. Keep boat swamped for at least 18 hours prior to testing.
- q. Take photographs showing swamped condition.

2. Level Flotation Test for Persons Capacity - After the test boat has remained swamped for 18 hours, test the boat for level flotation in accordance with §183.325 of the standard.

§183.325 Flotation Standard . . . the boat must float in fresh, calm water as follows:

(a) The angle of heel does not exceed 10 degrees from the horizontal.

- a. Determine water conditions and record the information in the spaces provided on Data Sheet #2.
- b. Check to make sure the test weights are still in place.

c. Measure the heel angle of the swamped boat. Record on Data Sheet #2.

§183.325(b) Any point on either the forward or aft reference area is above the surface of the water.

d. Determine if any point on either forward or aft reference area is above the water surface. Record on Data Sheet #2.

§183.325(c) The reference depth at the reference area that is opposite the reference area that is above the surface of the water is 6 inches or less.

e. Measure the reference depth as illustrated on Figure 2. Record on Data Sheet #2.

f. If not in compliance, the weights may be moved as long as the center of gravity of the weights for both the persons capacity and the deadweight is within the shaded area shown in Figure 4.

g. If, after the boat has remained swamped for 18 hours, it fails to meet the attitude criteria for level flotation, use the following procedure to determine how much additional flotation is required:

- (1) Position load cell rig above the boat with one pendant above the bow and the other two on each side of the engine.
- (2) Attach the pendants to point on the boat deck under which additional foam can be placed to bring the boat up to its proper attitude.
- (3) Raise each of the three pendants until the boat reaches the proper attitude. Record the number of pounds of lift at each point that is necessary to bring the boat up.

3. Stability Test - After completion of the flotation test for persons capacity, test the boat for stability in accordance with §183.330 of the standard.

§183.330(b) Quantity of weight used. Load the boat with a quantity of weight that, when submerged, is equal to the sum of the following:

- (1) One half the quantity of weight required by §183.320(b)(1); and
- (2) The quantity of weight required by §183.320(b)(2).

- a. Hoist the boat up to an approximately level position and keep it supported while moving the weights.
- b. Remove half of the weight used to simulate persons capacity in the preceding test.
- c. Be sure that weights representing deadweight, the engine and controls are still in place.

§183.330(c) Placement of quantity of weight starboard side. Place the quantity of weight required by (b) of this section in the boat so that -

- (1) . . . (it) is uniformly distributed . . . along the starboard side of the passenger carrying area (and extending over) at least 30 percent of the length of the passenger carrying area. The center of gravity is located within the shaded area in Figure (5) . . . (with) the center of gravity of each (floor) weight . . . at least 4 inches above the floor . . . and of each (seat) weight . . . at least 4 inches above the seat.

d. Move the remaining half of the persons capacity weights to the starboard side of the passenger area so that the center of gravity falls in the area of the boat illustrated in Figure 5. The vertical center of gravity, must fall at least 4 inches above the seats or floor.

e. Distribute the weight along at least 30 percent of the passenger area length, placing weights on the floor and seats.

f. Lower the boat back into the water and allow the slings to go slack. Adjust slings so that the boat can sink but not hit the bottom of the test tank.

g. Swamp the boat or fill it with water so that the water in the boat and in the tank are at the same level.

§183.330(a) Flotation Standard . . . the boat must float in fresh, calm water as follows:

(1) The angle of heel does not exceed 30 degrees from the horizontal.

(2) Any point on either the forward or aft reference area is above the surface of the water.

(3) The reference depth of the reference area that is opposite the reference area that is above the surface of the water is 12 inches or less.

h. Measure the heel angle. Record on Data Sheet #2.

i. Determine if any point on either the forward or aft reference area is above the water surface. Record on Data Sheet #2.

j. Measure the reference depth as illustrated in Figure 2. Record on Data Sheet #2.

k. If, after moving the weights for the stability test, the boat fails to meet the attitude criteria, use the following procedure to determine how much additional foam is required:

- (1) Position load cell rig above the boat with one pendant above the boat and the other two on each side of the engine.
- (2) Attach the pendants to points on the boat deck under which additional foam can be placed to raise the boat to the proper attitude.
- (3) Raise each of the three pendants until the boat reaches the proper attitude. Record the number of pounds of lift at each point that is necessary to bring the boat up.

§183.330(d) Placement of quantity of weight: port side . . .

1. Repeat steps a. through k. above, placing the weights on the port side.

4. Level Flotation Test Without Weights for Persons Capacity -
After completion of the test for stability, test the boat for level flotation without weights for persons capacity and deadweight in accordance with §183.335 of the standard.

§183.335 . . . When the conditions prescribed in §183.320(a), (d) through (g) are met, the boat must float in fresh, calm water as follows:

- (a) The angle of heel does not exceed 10 degrees from the horizontal.
- (b) Any point on either the forward or aft reference area is above the surface of the water.
- (c) The reference depth at the reference area that is opposite the reference area that is above the surface of the water is 6 inches or less.

a. Hoist the boat up to an approximately level position and keep it supported while removing the weights.

b. Remove all weights for persons capacity and deadweight.

c. Leave only the dummy weights for engines, batteries, and controls.

d. Lower the boat back into the water and allow the slings to go slack. Adjust the slings so that the boat can sink but not hit the bottom of the test tank.

e. Swamp the boat or fill it with water so that the water in the boat and in the tank are at the same level.

f. Measure the heel angle. Record on Data Sheet #2.

g. Determine if any point on either the forward or aft reference area is above the water surface. Record on Data Sheet #2.

h. Measure the reference depth as illustrated in Figure 2. Record on Data Sheet #2.

i. If, after all the weights for persons capacity have been removed, the boat fails to meet the attitude requirement for level flotation, use the following procedure to determine how much additional foam can be placed to bring the boat up to its proper attitude.

(1) Attach the pendants to points on the boat deck under which additional foam can be placed to bring the boat up to its proper attitude.

(2) Lift up at the three points, one at a time, with the scale until the boat reaches the proper attitude. Record the number of pounds of lift at each point that is necessary to bring the boat up.

j. Remove test boat from the water in accordance with paragraph 3.F. of these test procedures.

4.D TEST PROCEDURE, INBOARD BOATS, INBOARD/OUTDRIVE BOATS AND AIRBOATS

1. Preconditioning for Test - Prepare the test boat for the flotation test in accordance with §183.105 and §183.110 of the regulations and the following:

a. Inspect boat to determine if all manufacturer supplied equipment is installed and in its proper place within the boat. Remove all other objects.

b. Drill holes in the top and bottom of all air chambers integral with the hull. Then place a weight in the test boat equal to 62.4 times the volume in cubic feet of the two largest flotation air chambers with its center of gravity in the same location, or drill holes in the top and bottom of the two largest air chambers used for flotation.

- c. Fill all permanent fuel tanks with fuel and seal all openings with putty and waterproof tape.
- d. Prepare the engine for submersion as follows:
- (1) Remove carburetor, breather, distributor, coil, alternator, and starter.
 - (2) Substitute weights for all parts removed.
 - (3) Seal all openings that would allow water ingress to the engine - exhaust, intake, breather, distributor, starter, etc., using waterproof tape, Permagum or tub caulking as necessary.
 - (4) Substitute weights for the amount of air space left in the engine and exhaust system, using 62.4 pounds of weight for each cubic foot of air space.
- e. Place the slings of the handling rig under the hull of the boat.
- f. Lift the boat out of its cradle, trailer, or dolly and lower it, keel down in the water, keeping the boat supported on the slings.
- g. Eliminate entrapped air by sloshing and tilting the boat, drilling 1/4" to 3/8" diameter vent holes or filling air pockets directly with a water hose. Eliminate entrapped air from seat cushions and upholstery by making openings in the covering material.

2. Basic Flotation Test - Test the boat for basic flotation in accordance with the following:

§183.105(a) Each boat (must be) . . . submerged in calm, fresh water for at least 18 hours and loaded with:

- (1) A weight that, when submerged, equals two-fifteenths of the persons capacity marked on the boat;
- (2) A weight that, when submerged, equals 25 percent of the deadweight; and
- (3) A weight in pounds that, when submerged, equals 62.4 times the volume in cubic feet of the two largest air chambers, if air chambers are used for flotation.

a. Record on Data Sheet #2 the MAXIMUM PERSONS CAPACITY and the MAXIMUM WEIGHT CAPACITY from the capacity label.

b. Calculate the amount of weight needed, using the following example:

EXAMPLE

Label Information

MAXIMUM PERSONS CAPACITY 600 lbs
MAXIMUM WEIGHT CAPACITY 800 lbs

$$2/15 \text{ of } 600 = 80$$

-PLUS-

25% of the deadweight

$$\text{Deadweight} = 800 - 600 = 200$$

$$25\% \text{ of } 200 = 50$$

$$80 + 50 = 130$$

Drill holes in the top and bottom of all air chambers integral with the hull. Then place a weight in the test boat equal to 62.4 times the volume in cubic feet of the two largest flotation air chambers with its center of gravity in the same location, or drill holes in the top and bottom of the two largest air chambers used for flotation.

$$3 \times 62.4 = 187.2$$

Total Weight $130 + 187.2 = 317.2$

c. Lower the boat into the water and allow the slings to go slack. Adjust the slings so that the boat can sink but not hit the bottom of the test tank.

d. Swamp the boat to allow a free flow of water between outside and the inside. Allow to remain swamped for at least 18 hours.

NOTE

Prevent the stern of the boat from touching the bottom of the test tank by placing the weights as far forward as possible. If

necessary, attach a load cell to the stern and lift it off the bottom. Add weights forward to equal the amount of lift recorded on the load cell.

e. After 18 hours, determine if any portion of the boat is above the surface of the water.

f. If, after the boat has remained swamped for 18 hours, it fails to show any portion above water, use the following procedure to determine how much additional flotation is required:

- (1) Attach the pendant from one of the load cells to the bow of the boat (or whichever portion of the boat is closest to the water surface).
- (2) Lift up at the point until it is above the water surface. Record the pounds of lift that were necessary to bring the boat up.

g. Remove the test boat in accordance with paragraph 3.E. of the test procedures.

4.E. FLOTATION MATERIAL TEST PROCEDURE - BUOYANCY MATERIALS IMMERSION TEST

§183.112(a) Flotation materials must meet the requirements in §183.114 as listed in table 5 when used in the: (1) Engine room bilge, (2) engine room, or (3) bilge, unless located in a sealed compartment.

§183.112(b) Air chambers used to meet the flotation requirements of this subpart must not be integral with the hull.

4.E.1 SCOPE

This test procedure describes the method for determining buoyancy changes in recreational boat flotation materials when immersed under a two-inch head of various test fluids. The method presented here is based upon and represents a minor modification of the ASTM Standard Test Method D2842-69.

4.E.2 SUMMARY OF METHOD

The buoyant force of an object less dense than the fluid in which it is immersed is equal to the weight of the volume of fluid it displaces when submerged, less the dry weight of the object. Absorption of the

fluid or physical changes due to the effects of the fluid (swelling, degradation) will cause change in buoyancy. Direct measurements of buoyant force during the test can be utilized to draw conclusions regarding the suitability of a given material for buoyancy use.

4.E.3 SIGNIFICANCE

The purpose of this method is to provide a means of comparing relative buoyancy change tendencies between different flotation materials. It is intended for use in the evaluation of flotation materials for marine flotation application. It is applicable to this end use to the extent that testing fluids are those which would commonly be encountered in a marine environment and the two-inch head specified for testing can be considered representative of the depth of bilge water which may be encountered in actual practice.

Buoyancy testing is subject to several variables which, if not considered may result in differences in results of tests among various testers. The formulation of this method is designed to take the most serious of the possible sources of error into account.

NOTE 1: Errors due to initial rapid changes in buoyancy are taken into account by the many measurements made over an extended period of time. This extended period has been found to be sufficient to clearly delineate any trend in the buoyancy change.

NOTE 2: The increase in volume which occurs with some materials when immersed is countered by basing all buoyancy calculations on the initial volume of the specimen. This method has been chosen because all flotation material requirements for a desired buoyancy are designed from the dry volume of the material by the boat manufacturer per paragraph 183.67 of CFR 183.

NOTE 3: The problem of air bubbles clinging to the specimens and affecting the various measurements is minimized by specifying deaerated distilled water and appropriate methods for removing clinging air bubbles at each measuring session.

NOTE 4: Difficulties involved in calculating the specimen volume based upon direct measurement of the dimensions are eliminated by determining the volume of each specimen by a fluid displacement method immediately after immersion.

4.E.4 APPARATUS

A balance capable of weighing up to 2500 gm to $0.1 + 0.05$ gm is required. It must have a provision for attaching a wire sling below balance platform for making submerged weighings.

Underwater Weighing Jig constructed so that the specimen floats against jig ceiling 4" x 4" specimen face in the horizontal position. Jig should

trap no air when submerged. Approximate dry weight should be 1500 g. + 500g. The heavier the jig, the less influence of disturbances in the fluid.

Immersion Vessel - For non-volatile fluid testing, any convenient immersion vessel may be used. For this purpose an open top tank capable of holding at least three specimens with the top 4" x 4" facing in the horizontal position and with additional space for the weighing jig is recommended. For volatile fluid testing, any convenient containers which can be easily accommodated in a fume hood, such as cans, can be used. Some provision for restraining the specimens at a two-inch depth must be made. Wire mesh screening is preferred for this purpose, since this minimizes the contact of the top surface of the specimen with any solid object.

Fume Hood: For testing with volatile fluids a fume hood of sufficient size to accommodate the desired number of test containers and permit convenient operation of the testing apparatus is to be used.

Balance Platform: A convenient method for supporting the balance and immersion containers may be used as long as all measurements are made with a two-inch head. It is suggested that a separate container of fluid without a specimen be used to expedite the determination of the jig tare weight. However, if open top tanks are used it may be found more convenient to use a mounting platform placed across the top of the tank to support the balance. A hole in the platform should be provided at an appropriate location to accommodate the wire sling from the balance to the jig.

Hydrometer: For measuring the specific gravity of the test fluid.

pH Meter: To determine the pH of the test fluid, in particular that of the artificial sea water.

4.E.5 REAGENTS AND MATERIALS

For the purposes of the test, it is usually desirable to use the liquids with which the flotation materials will come into contact during actual service, such as gasoline, common bilge cleaner and fresh and salt water. For comparative tests with liquids of unknown or doubtful composition, samples of liquid from the same drum or shipment shall be used.

ASTM Reference Fuels - When gasolines are to be encountered in service, the test should be conducted in ASTM reference Fuel B (see ASTM Test Standard D471-42, Section 4 and Table 2).

Any non-fuel test liquid, such as bilge cleaner, shall be used in accordance with the manufacturer's recommended concentrations.

For fresh water tests and dilution purposes a sufficient amount of freshly deaerated distilled water to maintain a two-inch head over specimens and jig at all times shall be used.

Salt Water - For salt water tests any commercial product which simulates sea water, such as a premixed bag of salts, may be used, providing the following properties of sea water are met: salinity of 32 to 34 parts per thousand, pH of 8 ± 0.2 and a specific gravity of 1.03 ± 0.005 , 68% of the salinity is due to NaCl and 5% due to $MgCl_2$. Other salts contribute individually to a much smaller degree.

Gas Barrier Film - A layer of low permeance (polyethylene, saran or equivalent) plastic film covering surface of liquid in open tank tests to retard pickup of air and evaporation is recommended.

4.E.6 TEST SPECIMENS

Three test specimens shall be tested for each sample.

Test Specimen Size

The recommended test specimen size is 4 inches in width by 4 inches in length by 1 inch in thickness for any material which can be cut to this size from larger stock without substantially changing its original character. The specimen may be as large as the smallest size actually used in the boat.

Test specimen size shall be 4 inches in width by 4 inches in length by the actual thickness for materials having less than 1 inch overall thickness. The specimen shall be cut to 1 inch thickness for materials in which the sample stock is more than 1 inch in thickness.

Test specimens should be machined or sawed from the sample so as to have smooth surfaces without any skins remaining from the molding process. Resulting dust should be blown from specimens.

In most free expansion materials large blow holes may be encountered during preparation of the specimens. These blow holes should not be excised. Age the cut specimen for 60 days at room temperature.

4.E.7 PROCEDURE

§183.114(b) 24-hour gasoline test. The flotation material must not reduce in buoyant force more than 5 percent after being immersed for 24 hours at 23 plus or minus 2°C in reference fuel B, of ASTM D-471, dated March 28, 1975.

§183.114(c) 30-day gasoline test. The flotation material must not reduce in buoyant force more than 5 percent after being immersed for 30 days at 23 plus or minus 2°C in reference fuel B, of ASTM D-471, dated March 28, 1975.

§183.114(d) 24-hour oil test. The flotation material must not reduce in buoyant force more than 5 percent after being immersed for 24 hours at 23 plus or minus 2°C in reference oil No. 2, of ASTM D-471, dated March 28, 1975.

§183.114(e) 30-day oil test. The flotation material must not reduce in buoyant force more than 5 percent after being immersed for 30 days at 23 plus or minus 2°C in reference oil No. 2, of ASTM D-471, dated March 28, 1975.

§183.114(f) 24-hour bilge cleaner test. The flotation material must not reduce in buoyant force more than 5 percent after being immersed for 24 hours at 23 plus or minus 2°C in a 5-percent solution of trisodium phosphate in water.

§183.114(g) 30-day bilge cleaner test. The flotation material must not reduce in buoyant force more than 5 percent after being immersed for 30 days at 23 plus or minus 2°C in a 5-percent solution of trisodium phosphate in water.

Weigh each specimen prior to immersion to $\pm 0.1g$ and record (W_1).

Fill immersion vessel with test fluid such that an approximate two-inch head is obtained. Place hold-down mechanism in vessel.

Measure specific gravity and pH of fluid at $70F \pm 5F$.

Place underwater weighing jig attached to balance in immersion vessel such that the top horizontal surface of the jig is two inches below the fluid surface when balanced. Be sure the immersed jig is free of air bubbles. Weigh jig to nearest $0.1g$ and record. This procedure should be carried out at the beginning and end of each weighing session for an average tare weight (W_{j1} , W_{j2}).

Take the specimens one at a time and place them in the jig. Make sure that the specimen is clear of clinging air bubbles and weigh immediately. Do not remove any specimens from the vessel after weighing. Record the weight to the nearest $0.1g$ (W_2).

After specimens have been weighed under fluid, adjust the fluid level to yield a two-inch head.

Leave specimens immersed for 720 h. (30 days) or 24 h. while maintaining the two-inch head of test fluid at $70F \pm 5F$. The specimens should not be in contact with one another.

NOTE 6: The following schedule should be followed for specimen weighing: during the first 7 days at least three approximately equally spaced weighings, including the first, should be made. Thereafter, weighings may be made once a week at the same time each week until the end of the test period. In addition, the specimens should be weighed on the last test day.

4.E.7 CALCULATIONS

Definition of Symbols

W_1 = Initial dry weight of each specimen in gms.

W_2 = Weight of submerged specimen and jig at each measuring session, in gms.

W_{j1} , W_{j2} = Weight of submerged jig at beginning and end of each measurement session respectively, in gms.

W_j = Average weight of submerged jig at each weighing session, in gms.

B_F = Calculated buoyancy factor, a constant conversion factor different for each specimen in $\text{lb/ft}^3/\text{g}$.

p = Density of test fluid at $70F \pm 5F$, in gms/cm^3 .

W_{ji} = Weight of immersed jig for initial measurement, in gms.

W_{2i} = Weight of submerged specimen and jig for initial measurement, in gms.

F = Calculated buoyancy of specimen in lb/ft^3 .

Calculate average submerged weight of underwater weighing jig from measured quantities as follows:

$$W_j = \frac{W_{j1} + W_{j2}}{2}$$

Record to nearest 0.1g for each weighing session.

Calculate buoyancy of each specimen as follows:

$$F = \frac{62.26p (W_j - W_2)}{(W_{ji} - W_{2i} + W_1)} = B_F (W_j - W_2)$$

Record to nearest 0.01 lb/ft^3 for each specimen at each weighing session.

NOTE 7 The constant factor:

$$B_F = \frac{62.26p}{(W_{ji} - W_{2i} + W_1)}$$

is different for each specimen and it may be found most convenient to tabulate these values for use in the buoyant force calculations.

4.E.9 REPORT

The report shall consist of a graph of buoyant force versus time for each flotation material and test fluid. The data points should appear on the graph as follows:

- (1) Highest buoyancy calculated at a given point for any of the three sample specimens.
- (2) Lowest buoyancy calculated at a given point for any of the three sample specimens.
- (3) Average value of buoyancy calculated at a given point for all three sample specimens.

5.E FLOTATION MATERIAL TEST PROCEDURE - GASOLINE VAPOR TEST

§183.114(a) Vapor test. The flotation material must not reduce in buoyant force more than 5 percent after being immersed in a fully saturated gasoline vapor atmosphere for 30 days at a minimum temperature of 38°C.

5.E.1 This method covers the determination of buoyancy changes in materials used for marine flotation resulting from exposure to a gasoline-saturated atmosphere. The method presented here is based upon and represents a modification of the ASTM Standard Test Method D2842-69.

5.E.2 SUMMARY OF METHOD - The buoyant force of a plastic foam less dense than water is equal to the dry weight of the volume of water it displaces when submerged, less the dry weight of the object. Absorption of any fluid (e. g., gasoline) or physical changes due to the effects of this fluid (swelling, degradation) will cause change in buoyancy. Direct measurements of buoyant force can be utilized to draw conclusions regarding the suitability of these foams for use as flotation material.

5.E.3 SIGNIFICANCE

The purpose of this method is to provide a means of comparing relative buoyancy change tendencies of different flotation materials. It is intended for use in the evaluation of the flotation materials for marine flotation application.

Buoyancy testing is subject to several variables which, if not considered, may cause insufficient agreement among various testers. Attempts have been made in the formulation of this method to take the most serious of the possible sources of error into account.

NOTE 1: The increase in volume which may occur is countered by basing all

buoyancy calculations on the initial volume of the specimen. This method has been chosen because all flotation material requirements for a desired buoyancy are designed from the dry volume of the material by the boat manufacturer per paragraph 183.67 of CFR 183.

NOTE 2: The problem of air bubbles clinging to the specimens and affecting the various measurements is minimized by specifying deaerated distilled water and appropriate methods for removing clinging air bubbles at each measuring session.

NOTE 3: Difficulties involved in calculating the specimen volume based upon direct measurement of the dimensions are eliminated by determining the volume of each specimen by a fluid displacement method immediately after immersion.

5.E.4 APPARATUS

A balance capable of weighing up to 2500 gm to $0.1 + 0.05$ gm is required. It must have a provision for attaching wire sling below balance platform for making submerged weighings.

Underwater Weighing Jig constructed so that the specimen floats against jig ceiling with 4" x 4" specimen face in the horizontal position. The jig should trap no air when submerged. Approximate dry weight should be 1500 g + 500 g. (The heavier the jig, the less the influence of disturbances in the fluid).

Buoyancy Vessel. Any convenient vessel, such as an open-top tank, may be used.

Balance Platform. Any convenient method for supporting the balance and jig may be used as long as all measurements are made with a two-inch head of water.

Hydrometer. For measuring the specific gravity of water and the reference fuel.

Sample Environment. Any convenient container may be used as long as the sample environment is saturated with reference fuel vapor maintained at the specified temperature and 1 atm. Samples should be at least .50 inches apart. The flammable nature of gasoline vapor should be considered when designing the container.

5.E.5 REAGENTS AND MATERIALS

For the purposes of the test, it is desirable to use gasoline to saturate the sample environment and water to determine buoyancy.

ASTM Reference Fuel. In place of gasoline this test is to be conducted

in ASTM reference fuel B. (See ASTM Standard D471-42, Section 4 and Table 2). Samples of this liquid from the same drum shall be used.

For the buoyancy tests, sufficient amount of freshly deaerated distilled water at 70°F to maintain a two-inch head over specimens and jig shall be used.

5.E.6 TEST SPECIMENS

Thirty-six samples of each plastic foam shall be used.

The test specimen size is 4 inches in width by 4 inches in length by 1 inch in thickness. The specimen may be as large as the smallest size actually used in the boat. Test specimens should be machined or sawed from the sample so as to have smooth surfaces without any skins remaining from the molding process. Resulting dust should be blown from specimens.

In most free expansion materials large blow holes may be encountered during preparation of the specimens. These should not be used. Age the cut specimen for 60 days in room temperature.

5.E.7 TESTING PROCEDURE

Weigh each specimen to $\pm 0.1g$ and record (W_1).

Measure and record buoyancy of each specimen as described in Section 8.

Store three control samples in an air only atmosphere maintained at the specified saturation temperature and one atmosphere.

Place 30 samples in an atmosphere saturated with the vapor of the reference fuel maintained at the specified temperature and one atmosphere. Record the specific gravity of the reference fuel.

Choose a length of time which will permit a complete determination of the effects of the fuel vapor on the specimen. Divide this into 10 equal increments. At the end of each of these increments withdraw three samples from the saturated atmosphere. Measure and record the following: time of exposure, buoyancy (per Section 8), and specific gravity of reference fuel.

5.E.8 BOUYANCY PROCEDURE

Fill buoyancy vessel with water such that an approximate two-inch head is obtained.

Measure specific gravity of water (70°F).

Place underwater weighing jig attached to balance in buoyancy vessel such that the top horizontal surface of the jig is two inches below the surface when balanced. Be sure the immersed jig is free of air bubbles. Weigh jig to nearest 0.1g and record. This procedure should be carried out at the beginning and end of each weighing session for an average tare weight (W_{j1} , W_{j2}).

Take the specimens one at a time and place them in the vessel. Make sure that the specimen is free of clinging air bubbles and weigh immediately. Record the weight to the nearest 0.1g (W_2).

5.E.9 CALCULATIONS

Definition of Symbols

W_1 = Initial dry weight of each specimen in gms

W_2 = Weight of submerged specimen at each measuring session, in gms

W_{j1} , W_{j2} - Weight of submerged jig at beginning and end of each measurement session respectively, in gms

W_j = Average weight of submerged jig at each weighing session, in gms

B_F = Calculated buoyancy factor, a constant conversion factor different for each specimen in $\text{lb/ft}^3/\text{g}$

p = Density of test fluid at $70F \pm 5F$, in gms/cm^3

W_{ji} = Weight of immersed jig for initial measurement, in gms

W_{2i} = Weight of submerged specimen for initial measurement, in gms

F = Calculated buoyancy of specimen in lb/ft^3

Calculate average submerged weight of underwater weighing jig from measured quantities as follows:

$$W_j = \frac{W_{j1} + W_{j2}}{2}$$

Record to nearest 0.1g for each weighing session.

Calculate buoyancy of each specimen as follows:

$$F = \frac{62.26p}{(W_{ji} - W_{2i} + W_1)} \quad (W_j - W_2) = B_F (W_j - W_2)$$

Record to nearest 0.01 lb/ft^3 for each specimen at each weighing session.

NOTE 4: The constant factor

$$B_F = \frac{62.26p}{(W_{ji} - W_{2i} + W_1)}$$

is different for each specimen and it may be found most convenient to tabulate these values for use in the buoyant force calculations.

5.E.10 REPORT

The report shall consist of a graph of buoyant force versus time in days for each flotation material. The data points should appear on the graph as follows:

- (1)
- (2)
- (3)

(1) Highest buoyancy calculated at a given point for any of the three sample specimens.

(2) Lowest buoyancy calculated at a given point for any of the three sample specimens.

(3) Average value of buoyancy calculated at a given point for all three sample specimens.

Tables of initial sample weight, buoyancy factor, sample buoyancy with time, average buoyancy with time and specific gravity of reference fuel and water with time, as well as an explanation of procedure and construction of apparatus should be reported.

§183.222 Flotation material and air chambers. (a) Flotation materials must meet the requirements in §183.114 as listed in Table 5 when used in the bilge, unless located in a sealed compartment.

(b) Air chambers used to meet the flotation requirements of this subpart must not be integral with the hull.

§183.322 Flotation materials. (a) Flotation materials must meet the requirements in §183.114 as listed in table 5 when used in the bilge, unless located in a sealed compartment.

TABLE 3 - FLOTATION PERFORMANCE TESTS

Area 103.110		(b) Engine Room Bilge	(c) Engine Room Unless Open to Atmosphere	(d) Bilge
Test 103.114				
(a)	Vapor Test		X	
(b)	24 Hour Gasoline Test			X
(c)	30 Day Gasoline Test	X		
(d)	24 Hour Oil Test			X
(e)	30 Day Oil Test	X		
(f)	24 Hour Bilge Cleaner Test			X
(g)	30 Day Bilge Cleaner Test	X		

6.E TEST BOAT REMOVAL AND STORAGE

1. Removal

a. If the test boat is sunk, remove sufficient dummy weights from the boat so that it floats. These shall be carefully removed in order to eliminate major shifting of the dummy weights which could lead to overturning of the boat and possible damage to the boat structure.

b. With the test boat afloat, constraint lines shall be tied to the boat to permit safe removal of all of the dummy weights.

c. The handling rigs shall then be used to raise the gunwales just above water so that a pump of sufficient capacity can be used to pump most of the water out of the boat. These rigs shall then be used to raise the boat above the water and tilt the boat so that nearly complete drainage can be accomplished.

d. The test boat shall then be completely removed from the test tank for storage.

2. Conditioning and Storage

- a. Remove test boat drain plug.
- b. Support test boat in bow-high attitude to facilitate drainage.
- c. Remove all sealants from fuel fill and vent lines.

NOTE

Steps d. through k. apply to inboards, I/O's, and airboats only.

- d. Remove all sealants which were applied.
- e. Remove all dummy weights.
- f. Drain water from inlet manifold.
- g. Remove and dry spark plugs.
- h. Using starter, turn over motor to remove water from cylinders.
- i. Drain and replace crankcase oil.
- j. Replace spark plugs, carburetor, and place boat in tank and start motor.
- k. Allow motor to run for 15 minutes at idle speed after operating temperature is reached.

7. TEST RECORDS AND REPORTS

7.A TEST SPECIMEN LOG

A test log shall be maintained for each test specimen or group of specimens. The log shall include a description of the testing performed on a daily basis, a summary of test results, and any pertinent information regarding the status of the test specimen. The test log shall also document any circumstance of non-conformance. This test log shall be submitted with the final test report. Each entry in the test log shall be reviewed, dated and initialed by the responsible engineer.

7.B REPORTING

1. Notice of Non-Conformance - Any indication of a non-conformance shall be communicated immediately by telephone to the Coast Guard Contract Monitor or his designated representative and followed up in writing within three working days after detecting the non-conformance. This written Notice of Non-Conformance shall be submitted using the form shown on page 40, and shall be accompanied by photographs, sketches, and copies of any necessary test data required to convey the nature and extent of the non-conformance.

The Notice of Non-Conformance shall be signed by the responsible test engineer signifying that the written information and photographs accurately depict the test conditions at the time the non-conformance was detected. The Test Department Manager, or other responsible test agency officer, shall also sign the Notice of Non-Conformance.

A signature block has been provided for a test witness from the Coast Guard. The provisions for this signature are not mandatory, but have been provided to allow complete documentation of a non-conformance if the Coast Guard test witness (monitor) is present during the inspection and elects to direct disposition of the test specimen. For example, "note all circumstances and continue the inspection," or "discontinue the inspection of the applicable specimens and collect all data for Coast Guard review."

2. Compliance Test Data Sheets

a. Required Use - The Compliance Test Data Sheets included at the end of this test procedure are mandatory for use in documenting the inspection and test data observed or recorded during performance of the test procedure.

b. Reproduction - The test data sheets have been designed to provide a standard means of identifying and reporting the test and inspection information required. Each test data sheet can be readily reproduced on any type of dry copy machine when more than one sheet is required for recording the results of a series of like specimens or the repetitive test of any specific test specimen. All entries on these Test Data Sheets shall be recorded in black ink or black type.

c. Standard Format - The test data sheets have been prepared to reflect the specific test data requirements outlined in this test procedure. The information on the forms has been standardized as much as possible, paralleling the degree to which the test procedures have been standardized. For example, all of the compliance test procedures require test specimen identification and information resulting from the receiving inspection. These requirements can be described on the forms in a standard format. Conversely, the type of tests to be performed and the results to be recorded differ from one test to the other, thus, necessitating provisions for different data sheet formats for each test.

d. Submission - It shall be the responsibility of the test agency to submit the completed Compliance Test Data Sheets to the Coast Guard in the final report unless otherwise directed.

3. Formal Test Report - For each test or series of tests, a formal test report shall be prepared and submitted for USCG approval. Formal test reports shall contain the following major sections:

a. Administrative data including identification of Subpart E, F, G, or H of Part 183 of Title 33, CFR; name of test laboratory; test laboratory report number or USCG task number; test article identification number; manufacturer's model number and serial number.

b. Detailed tabular and narrative results of each test including a complete description of any non-conformance, test irregularities, equipment problems, etc. The results shall explicitly state that the test article(s) did or did not meet the test requirements.

c. Copies of all data sheets.

d. Copies of all test log sheets.

e. Photographs of each test set-up and any test article degradation that is detected.

All reports shall be signed by the report writer and shall have the signature of a responsible test laboratory official.

NOTICE OF NON-CONFORMANCE

Page of

- Test Specimen Non-Conformance
- Test System or Other Out-of-Tolerance Condition

Job No. _____
NC No. _____
Contract No. _____
Date _____

To: _____

Attn: _____

Part Name _____ Serial No. _____

USCG No. _____ Specimen I.D. No. _____

Test _____

Test Procedure _____ Paragraph No. _____

Notification Made To: _____

Date _____ By _____ Via _____

Specification Requirements:

Description and Cause of Non-Conformance:

Specimen Disposition: _____

Comments - Recommendations:

USCG Test Witness: _____ Engineer: _____ (Signature)
Title: _____ Dept. Mgr. _____ (Signature)

12. Description of Areas Which Might be Subject to Damage by Loading:

13. Receiving Inspection Results:

	Signature	Date
Test Conductor	_____	_____
Witness	_____	_____
Approved	_____	_____

Water Conditions

Temp. _____

Density _____

DATA SHEET #2

STANDARD TEST PROCEDURE

FLOTATION TESTS

OUTBOARD BOATS RATED OVER 2 HP

Manufacturer _____

Test Boat I.D. No. _____

Model _____

Test No. _____

CAPACITY LABEL INFORMATION

LINE 1. MAXIMUM HORSEPOWER

LINE 2. MAXIMUM PERSONS CAPACITY (POUNDS).

LINE 3. MAXIMUM WEIGHT CAPACITY (PERSONS,
MOTOR, AND GEAR) (POUNDS)

LEVEL FLOTATION TEST FOR PERSONS CAPACITY

LINE 4. 50% of the first 550 pounds of Line 2
.50 X _____ =

LINE 5. 12 1/2% of the remainder
.125 X _____ =

LINE 6. Engine weight from Column 6
of Table 1 for the rated
horsepower (Line 1)

LINE 7. 25% of Line 3 less Line 6 less Line 2

.25 X (___ - ___ - ___) =

LINE 8. Total test weight equals Line 4 + Line 5 + Line 7

___ + ___ + ___ =

LINE 9. Heel Angle in Degrees (10° maximum)

LINE 10. Reference Area Above Water.

Forward Aft Neither

LINE 11. Reference Depth (6" maximum)

STABILITY TEST

STARBOARD

LINE 12. 50% of Line 7

.50 X _____ =

LINE 13. Heel Angle in Degrees (30° maximum)

LINE 14. Reference Area Above Water

Forward Aft Neither

LINE 15. Reference Depth (12' maximum)

PORT

LINE 16. Heel Angle in Degrees (30° maximum)

LINE 17. Reference Area Above Water

Forward Aft Neither

LINE 18. Reference Depth (12' maximum)

LEVEL FLOTATION TEST WITHOUT WEIGHTS FOR PERSONS CAPACITY

LINE 19. Heel Angle in Degrees (10° maximum)

LINE 20. Reference Area Above Water

Forward

Aft

Neither

LINE 21. Reference Depth (6' maximum)

Water Conditions

PAGE 1 of 2

Temp. _____

Density _____

DATA SHEET #3

STANDARD TEST PROCEDURE

OUTBOARD BOATS RATED FOR 2 HP OR LESS

Manufacturer _____

Test Boat I.D. No. _____

Model _____

Test No. _____

CAPACITY LABEL INFORMATION

LINE 1. MAXIMUM HORSEPOWER

LINE 2. MAXIMUM PERSONS CAPACITY (POUNDS).

LINE 3. MAXIMUM WEIGHT CAPACITY (PERSONS, MOTOR,
AND GEAR) (POUNDS).

LEVEL FLOTATION TEST FOR PERSONS CAPACITY

LINE 4. 2/15 of Line 2
2/15 X _____ =

LINE 5. Engine weight from Column 6
of Table 1 for the rated
horsepower (Line 1)

LINE 6. 25% of Line 3 less Line 5 less Line 2
.25 X (_____ - _____ - _____) =

LINE 7. Total Test Weight Equals Line 4 and Line 6
_____ + _____ =

LINE 8. Heel Angle in Degrees (10° maximum)

LINE 9. Reference Area Above Water

Forward Aft Neither

LINE 10. Reference Depth (6" maximum)

STABILITY TEST

STARBOARD

LINE 11. 50% of Line 6

.50 X _____ =

LINE 12. Heel Angle in Degrees (30° maximum)

LINE 13. Reference Area Above Water

Forward Aft Neither

LINE 14. Reference Depth (12" maximum)

PORT

LINE 15. Heel Angle in Degrees (30" maximum)

LINE 16. Reference Area Above Water

Forward Aft Neither

LINE 17. Reference Depth (12" maximum)

LEVEL TEST WITHOUT WEIGHTS FOR PERSONS CAPACITY

LINE 18. Heel Angle in Degrees (10° maximum)

LINE 19. Reference Area Above Water

Forward Aft Neither

LINE 20. Reference Depth (6" maximum)

Water Conditions

PAGE 1 of 1

Temp. _____

Density _____

DATA SHEET #4

STANDARD TEST PROCEDURE

INBOARDS, I/O'S, AND AIRBOATS

Manufacturer _____

Test Boat I.D. No. _____

Model _____

Test No. _____

CAPACITY LABEL INFORMATION

LINE 1. MAXIMUM PERSONS CAPACITY (POUNDS)

LINE 2. MAXIMUM WEIGHT CAPACITY (POUNDS).

BASIC FLOTATION TEST

LINE 3. 2/15 of Line 1

2/15 X _____ =

LINE 4. 25% of Line 2 less Line 1

.25 X (____ - ____) =

LINE 5. 62.4 Times the Volume (In Cubic Feet) of the
2 Largest Flotation Air Chambers

62.4 X _____ =

LINE 6. Total Test Weight Equals Line 3 plus Line 4 plus Line 5

_____ + _____ + _____ =

LINE 7. Any Portion of the Test Boat Above Surface
of the Water

YES

NO

TITLE 33—NAVIGATION AND NAVIGABLE WATERS

CHAPTER I—COAST GUARD, DEPT. OF TRANSPORTATION

Subpart E—Flotation

183.65 Flotation materials.

(a) The flotation required by § 183.63 must be made of materials that are—

- (1) Capable of withstanding the combined effects of contact with oil, oil products, or other liquids or compounds with which the material may be expected to come in contact during normal use, including fuel oil, gasoline, *mineral kerosene*, *mineral oil*, *mineral turpentine*, and salt and fresh water;
- (2) Capable of withstanding combined exposure to sunlight, vibration, shock, and temperature variations which may be expected during normal use;

(3) Installed in such a manner that the flotation is fully effective when the boat is flooded or capsized.

(b) Any air chamber used for flotation must not be an integral part of the hull.

183.67 Method for determining quantity of flotation.

The minimum quantity of flotation required by § 183.63(a) must be determined by the following method:

(a) Step 1: Determine the Submerged Weight of Boat (Ws) in the formula:

$$W_s = W_h K_1 + W_d K_2 + 0.69 W_e$$

Where:

Ws = Submerged weight of boat.

Wh = Dry weight of hull.

Wd = Dry weight of deck and superstructure.

We = Dry weight of permanent appurtenances.

K₁ and K₂ = Conversion factors for materials used from Table 183.67(b)

(b) Step 2: Determine submerged weight of engine and related equipment (G) as follows:

(1) For outboard boats, G equals the sum of the submerged motor and control weight, battery weight, and full fuel tank weight from Table 183.67(a) for maximum horsepower capacity marked on the boat in accordance with § 183.53.

(2) For inboard boats G equals 75 percent of the installed weight of engine, drive, and fuel system.

(c) Step 3: Determine dry weight of load (C) as follows:

(1) For outboard boats, C equals the maximum weight capacity as determined in § 183.35 minus the sum of dry motor and control weight, battery weight, and full fuel tank weight from Table 183.67(a).

183.61 Applicability.

This subpart applies to monohull boats, the construction or assembly of which is begun after July 31, 1973, but before August 1, 1978, that are less than 20 feet in length, except monohull boats that meet the requirements of Subparts F, G, or H of this Part, sailboats, canoes, kayaks, inflatable boats, submersibles, surface effect vessels, amphibious vessels, and raceboats.

183.63 Quantity of flotation required.

(a) Each boat must have—

(1) At least that quantity of flotation prescribed in § 183.67; or

(2) Enough flotation to keep any portion of the boat above the surface of the water when the boat is filled with water and loaded with:

(i) A weight that, when submerged, equals two-fifteenths of the persons capacity marked on the boat;

(ii) A weight that, when submerged, equals 25 percent of the dead weight;

(iii) A weight in pounds that, when submerged, equals 62.4 times the volume in cubic feet of the two largest air chambers, if air chambers are used for flotation; and

(iv) For outboard boats, a weight that, when submerged, equals the sum of the submerged motor, control, and battery weight from Table 183.67(a).

(b) For the purpose of this section, "dead weight" means:

(1) For outboard boats and boats without mechanical propulsion, the maximum weight capacity marked on the boat minus the sum of:

(i) Motor and control weight, battery weight (dry), and full portable fuel tanks from Table 183.67(a);

(ii) The persons capacity determined under § 183.41 for the boat; and

(2) For inboard boats, the maximum weight capacity marked on the boat minus the persons capacity determined under § 183.39 for the boat.

(c) Dead weight must be zero or a positive number.

(49 CFR 1.461X(1)) (CAG 78-176, 42 FR 2681, Jan. 13, 1977)

TABLE 183.67(b)

FACTORS FOR CONVERTING VARIOUS BOAT MATERIALS FROM DRY TO SUBMERGED WEIGHT

Material	Sp. Gr.	Factor
Steel	7.85	0.88
Aluminum	2.73	0.63
Fiberglass	1.50	0.33
A.B.S.	1.12	0.11
Oak	0.63	-0.58
Mahogany	0.56	-0.78
Ash	0.56	-0.78
Yellow Pine	0.55	-0.81
Fir Plywood	0.55	-0.81
Mahogany Plywood	0.54	-0.83
Royalton	0.50	-0.95
Cedar	0.33	-1.95
Balsa end grain	0.16	-5.24

[CGD 72-61R, 37 FR 15782, Aug. 4, 1972, as amended at 37 FR 17388, Aug. 26, 1972; 39 FR 10899, Mar. 22, 1974; CGD 75-110, 41 FR 11290, Mar. 18, 1976]

TITLE 33—NAVIGATION AND NAVIGABLE WATERS

(2) For inboard boats, C equals the maximum weight capacity as determined in § 183.33.

(c) Step 4: Determine flotation required (W) in the formula:

$$W = W(\text{Step 1}) + C(\text{Step 2}) + 0.25(\text{Step 3})$$

(e) Step 5: Determine the volume of flotation material (F) needed in the formula:

$$F = \frac{\text{Flotation required (W)}}{\text{Buoyancy of flotation material}} + \text{Chamber volume(V)}$$

where: "Flotation required" is that value of W determined in Step 4; "Chamber volume" is the volume of the two largest air chambers, if air chambers are used for flotation; and "Buoyancy of flotation material" is determined by subtracting from the density of fresh water the density of the flotation material. The density of the flotation material must be determined after the material has been immersed in fresh water for one-half hour. When air chambers are used, the "Buoyancy of flotation material" is 62.4 lbs./ft.³

TABLE 183.67(a)—Weights (in Pounds) of Outboard Motor and Related Equipment For Various Boat Horsepower Ratings

Boat horsepower rating	Motor & control weight		Battery weight		Full portable fuel tank weight ¹	
	Dry	Wet ²	Dry	Wet ²	Dry	Wet ²
Under 4.0	35	20				
4.0 to 5	55	34			25	-1
5.1 to 10	70	55	20	11	50	-1
10.1 to 30	105	86	45	25	50	-1
30.1 to 50	138	138	45	25	100	-3
50.1 to 75	240	173	45	25	100	-3
75.1 to 150	305	218	45	25	100	-3
150.1 to 250	420	300	45	25	100	-3
Transoms designed for twin motors:						
60.0 to 100	360	268	45	25	100	-3
100.1 to 150	480	328	45	25	100	-3
150.1 to 300	610	413	45	25	100	-3

¹Wet in this case means submerged.
²If boat has a permanent built-in fuel tank, the tank should be full for the test and the "full portable fuel tank weight" excluded.

TITLE 33—NAVIGATION AND NAVIGABLE WATERS

Subpart F—Flotation Requirements for Inboard Boats, Inboard/Outdrive Boats, and Airboats

183.101 Applicability.

This subpart applies to monohull inboard boats, inboard/outdrive boats, and airboats less than 20 feet in length, the construction or assembly of which is begun after July 31, 1978, except sailboats, canoes, kayaks, inflatable boats, submersibles, surface effect vessels, amphibious vessels, and raceboats.

183.105 Quantity of flotation required.

(a) Each boat must have enough flotation to keep any portion of the boat above the surface of the water when the boat has been submerged in calm, fresh water for at least 18 hours and loaded with—

- (1) A weight that, when submerged, equals two-fifteenths of the persons capacity marked on the boat;
 - (2) A weight that, when submerged, equals 25 percent of the dead weight; and
 - (3) A weight in pounds that when submerged, equals 62.4 times the volume in cubic feet of the two largest air chambers, if air chambers are used for flotation.
- (b) For the purpose of this section, "dead weight" means the maximum weight capacity marked on the boat minus the maximum persons capacity marked on the boat.

§ 183.110 Definitions.

For the purpose of this subpart, "ASTM" means American Society for Testing and Materials. The Coast Guard incorporates by reference ASTM Standard D-471, dated March 28, 1975, in § 183.114 of this subpart. This incorporation by reference was approved by the Director of the Office of the Federal Register on December 6, 1977. The Coast Guard also incorporates by reference ASTM Standard D-2842, dated November 14, 1969 (reapproved 1975), in § 183.114 of this subpart. This incorporation by reference was approved by the Director of the Office of the Federal Register on September 11, 1978. The incorporated standards are available for inspection at Coast Guard Headquarters, Room 4313, Trans Point Building, 2100 2nd St., SW., Washington, D.C. 20590 and at the Office of the Federal Register Library, Room 8401, 1100 L St., NW., Washington, D.C. 20408. The incorporated standards may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.

"Bilge" means the area in the boat, below a height of 4 inches measured from the lowest point in the boat where liquid can collect when the boat is in its static floating position, except engine rooms.

"Connected" means allowing a flow of water in excess of one-quarter ounce per hour from the engine room bilge into any other compartment with a 12 inch head of water on the engine room side of the bulkhead.

"Engine room bilge" means the area in the engine room or a connected compartment below a height of 12 inches measured from the lowest point where liquid can collect in these compartments when the boat is in its static floating position.

"Engine room" means the compartment where a permanently installed gasoline or diesel engine is installed, including connected compartments.

"Open to atmosphere" means a compartment that has at least 15 square inches of open area directly exposed to the atmosphere for each cubic foot of net compartment volume.

"Sealed compartment" means an enclosure that can resist an exterior water level of 12 inches without sep-

page of more than one-quarter fluid ounce per hour.

§ 183.112 Flotation material and air chambers.

(a) Flotation materials must meet the requirements in § 183.114 as listed in table 5 when used in the: (1) Engine room bilge, (2) engine room, or (3) bilge, unless located in a sealed compartment.

(b) Air chambers used to meet the flotation requirements of this subpart must not be integral with the hull.

§ 183.114 Test of flotation materials.

(a) *Vapor test.* The flotation material must not reduce in buoyant force more than 5 percent after being immersed in a fully saturated gasoline vapor atmosphere for 30 days at a minimum temperature of 38° C.

(b) *24-hour gasoline test.* The flotation material must not reduce in buoyant force more than 5 percent after being immersed for 24 hours at 23 plus or minus 2° C in reference fuel B, of ASTM D-471, dated March 28, 1975.

(c) *30-day gasoline test.* The flotation material must not reduce in buoyant force more than 5 percent after being immersed for 30 days at 23 plus or minus 2° C in reference fuel B, of ASTM D-471, dated March 28, 1975.

(d) *24-hour oil test.* The flotation material must not reduce in buoyant force more than 5 percent after being immersed for 24 hours at 23 plus or minus 2° C in reference oil No. 2, of ASTM D-471, dated March 28, 1975.

(e) *30-day oil test.* The flotation material must not reduce in buoyant force more than 5 percent after being immersed for 30 days at 23 plus or minus 2° C in reference oil No. 2, of ASTM D-471, dated March 28, 1975.

(f) *24-hour bilge cleaner test.* The flotation material must not reduce in buoyant force more than 5 percent after being immersed for 24 hours at 23 plus or minus 2° C in a 5-percent solution of trisodium phosphate in water.

(g) *30-day bilge cleaner test.* The flotation material must not reduce in

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Subpart G—Flotation Requirements for
Outboard Boats Rated for Engines of
More Than 2 Horsepower

GENERAL

183.201 Applicability.

- (a) This subpart applies to monohull outboard boats that are--
 - (1) Less than 20 feet in length;
 - (2) Rated for outboard engines of more than 2 horsepower; and
 - (3) Constructed or assembled after July 31, 1978.
- (b) This subpart does not apply to sailboats, canoes, kayaks, inflatable boats, submersibles, surface effect vessels, amphibious vessels, and raceboats.

183.202 Flotation and certification requirements.

Each boat to which this subpart applies must be manufactured, constructed, or assembled to pass the stability and flotation tests prescribed in §§ 183.225(a), 183.230(a), and 183.235(a).

183.205 Passenger carrying area.

- (a) For the purpose of this section a boat is level when it is supported on its keel at the two points shown in Figure 2.
- (b) As used in this subpart, the term "passenger carrying area" means each area in a boat in which persons can sit in a normal sitting position or stand while the boat is in operation. Passenger carrying areas are illustrated in Figures 3 through 8.
- (c) The length of the passenger carrying area is the distance along the centerline of the boat between two vertical lines, one at the forward end and one at the aft end of the passenger carrying area, when the boat is level as illustrated in Figures 3 and 4. For boats with a curved stern inside the passenger carrying area, the forward vertical line is where a line 45 degrees to the horizontal when the boat is level is tangent to the curve of the stern, as illustrated in Figure 5. For boats with cabins, the forward vertical line is where there is a minimum distance of two feet between the inside top of the cabin and the water line formed when the boat is swamped and loaded with weights under § 183.220 as illustrated in Figure 6.

buoyant force more than 5 percent after being immersed for 30 days at 23 plus or minus 2° C in a 5-percent solution of tribodinium phosphate in water.
(b) The buoyant force reduction in (a)-(p) is measured in accordance with ASTM D-2842, dated November 14, 1968 (reapproved 1975).

TABLE 3 - FLOTATION PERFORMANCE TESTS

Test 183.116	Area 183.119	(b) Engineers Bilge	(c) Engine Room Unless Open to Atmosphere	(d) Bilge
(a) Taper Test			X	
(b) 24 Hour Gasoline Test				X
(c) 30 Day Seepage Test		X		
(d) 24 Hour Oil Test				X
(e) 30 Day Oil Test		X		
(f) 24 Hour Bilge Cleaner Test				X
(g) 30 Day Bilge Cleaner Test		X		

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(d) The breadth of each passenger carrying area is the distance between two vertical lines at the mid-length, excluding consoles, of the passenger carrying area when the boat is level as illustrated in Figures 7 and 8. For boats with round chines inside the passenger carrying area, the vertical line is where a transverse line 45 degrees to the horizontal is tangent to the arc of the chine, as illustrated in Figure 8.

183.210 Reference areas.

- (a) The forward reference area of a boat is the forwardmost 2 feet of the top surface of the hull or deck, as illustrated in Figure 9.
- (b) The aft reference area of a boat is the aftmost two feet of the top surface of the hull or deck, as illustrated in Figure 9.

183.215 Reference depth.

Reference depth is the minimum distance between the uppermost surface of the submerged reference area of a boat and the surface of the water measured at the centerline of the boat, as illustrated in Figure 10. If there is no deck surface at the centerline of the boat from which a measurement can be made, the reference depth is the average of two depth measurements made on opposite sides of, and at an equal distance from, the centerline of the boat.

183.220 Preconditioning for tests.

A boat must meet the following conditions for at least 18 hours before the tests required by §§ 183.225, 183.230, and 183.235:

- (a) Manufacturer supplied permanent appurtenances such as windshields, convertible tops, and propellers must be installed on the boat.
- (b) The boat must be loaded with a quantity of weight that, when submerged, is equal to the sum of the following:
 - (1) The sum of 50 percent of 550 pounds of the persons capacity marked on the boat and 12 1/2 percent of the remainder of the persons capacity.
 - (2) Twenty-five percent of the result of the following calculation, but not less than zero: the maximum weight capacity marked on the boat, less

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the weight shown in Column 6 of Table 4 for maximum horsepower marked on the boat; less the persons capacity marked on the boat.

(c) The weights required by paragraph (b) of this section placed in the boat so that the center of gravity of each amount of weight required by paragraphs (b)(1) and (b)(2) of this section is within the shaded area illustrated in Figure 11. The location and dimensions of the shaded area are as follows:

- (1) The shaded area is centered at the mid-length of the passenger carrying area and at the mid-breadth of the boat;
 - (2) The length of the shaded area, measured along the centerline of the boat, is equal to 40 percent of the length of the passenger carrying area of the boat; and
 - (3) The breadth of the shaded area, measured at the midlength of the passenger carrying area, is equal to 40 percent of the breadth of the passenger carrying area of the boat.
- (d) Weight must be placed in the normal operating position of the motor and controls and the battery in lieu of this equipment. The required quantity of weight used for this purpose depends upon the maximum rated horsepower of the boat being tested and is specified in Columns 2 and 4 of Table 4 for the swamped weight of the motor and controls and for the submerged weight of the battery, respectively.
- (e) Permanent fuel tanks must be filled with fuel and each external opening into the fuel tank must be sealed.
- (f) The boat must be keel down in the water.
- (g) The boat must be swamped, allowing water to flow between the inside and outside of the boat, either over the sides, through a hull opening, or both. Entrapped air in the flooded portion of the boat must be eliminated.
- (h) Water must flood the two largest air chambers and all air chambers integral with the hull.

§ 183.222 Flotation material and air chambers.

- (a) Flotation materials must meet the requirements in § 183.114 as listed in table 5 when used in the bilge, unless located in a sealed compartment.
- (b) Air chambers used to meet the flotation requirements of this subpart must not be integral with the hull.

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TESTS

183.225 Flotation test for persons capacity.

Flotation standard. When the conditions prescribed in §§ 183.220 are met, the boat must float in fresh, calm water as follows:

- (a) The angle of heel does not exceed 10 degrees from the horizontal.
- (b) Any point on either the forward or aft reference area is above the surface of the water.
- (c) The reference depth at the reference area that is opposite the reference area that is above the surface of the water is 6 inches or less.

183.230 Stability test.

(a) *Flotation standard.* When the conditions prescribed in § 183.220(a), (d) through (h) and paragraphs (b) and (c) of this section are met, the boat must float in fresh, calm water as follows:

- (1) The angle of heel does not exceed 30 degrees from the horizontal.
 - (2) Any point on either the forward or aft reference area is above the surface of the water.
 - (3) The reference depth at the reference area that is opposite the reference area that is above the surface of the water is 12 inches or less.
- (b) *Quantity of weight used.* Load the boat with a quantity of weight that, when submerged, is equal to the sum of the following:

- (1) One-half of the quantity of weight required by § 183.220(b)(1).
 - (2) The quantity of weight required by § 183.220(b)(2).
- (c) *Placement of weight.* Place the weight required by paragraph (b) of this section in the boat so that—
- (1) The quantity of weight required by § 183.220(b)(2) is positioned in accordance with § 183.220(c); and
 - (2) One-half the quantity of weight required by § 183.220(b)(1) is uniformly distributed over a distance along the outboard perimeter of the starboard side of the passenger carrying area that is equal to at least 30 percent of the length of the passenger carrying area so that the center of gravity of the quantity of weight is located within the shaded area illustrated in Figure 12, the center of gravity of the amount of weight placed on the floor of the boat is at least 4 inches above the floor and the center of gravity of the amount of weight placed on a seat is at least 4 inches above the seat. The location and dimensions of the shaded area are as follows:

(i) The shaded area is centered at the mid-length of the passenger carrying area.

(ii) The length of the shaded area is equal to 70 percent of the length of the passenger carrying area; and

(iii) The breadth of the shaded area is 6 inches from—

(A) For weights placed on the floor, the outboard perimeter of the passenger carrying area; and

(B) For weights placed on a seat, a vertical line inside the passenger carrying area as illustrated in Figure 13.

(d) *Placement of quantity of weight: port side.* The quantity of weight required by paragraph (b)(1) of this section is placed along the port side of the passenger carrying area in accordance with the conditions prescribed in paragraph (c)(2) of this section.

183.235 Level flotation test without weights for persons capacity.

When the conditions prescribed in § 183.220(a), (d) through (h) are met, the boat must float in fresh, calm water as follows:

- (a) The angle of heel does not exceed 10 degrees from the horizontal.
- (b) Any point on either the forward or aft reference area is above the surface of the water.
- (c) The reference depth at the reference area that is opposite the reference area that is above the surface of the water is 6 inches or less.

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CHAPTER I—COAST GUARD, DEPT. OF TRANSPORTATION

Subpart H—Flotation Requirements for Outboard Boats Rated for Engines of 2 Horsepower or Less

GENERAL

183.301 Applicability.
183.302 Flotation requirements.
183.305 Passenger carrying area.
183.310 Reference areas.
183.315 Reference depth.
183.320 Preconditioning for tests.
183.322 Flotation material and air chambers.

TESTS

183.325 Flotation test for persons capacity.
183.330 Stability test.
183.335 Level flotation test without weights for persons capacity.

Subpart H—Flotation Requirements for Outboard Boats Rated for Engines of 2 Horsepower or Less

GENERAL

183.301 Applicability.

- (a) This subpart applies to monohull boats that are—
- (1) Less than 20 feet in length;
 - (2) Rated for manual propulsion or outboard engines of 2 horsepower or less; and
 - (3) Constructed or assembled after July 31, 1978.
- (b) This subpart does not apply to sailboats, canoes, kayaks, inflatable boats, submersibles, surface effect vessels, amphibious vessels, and raceboats.

183.302 Flotation requirements.

Each boat to which this subpart applies must be manufactured, constructed, or assembled to pass the stability and flotation tests prescribed in §§ 183.325(a), 183.330(a), and 183.335(a).

183.305 Passenger carrying area.

- (a) For the purpose of this section, a boat is level when it is supported on its keel at the two points shown in Figure 2.
- (b) As used in this subpart, the term "passenger carrying area" means each area in a boat in which persons can sit in a normal sitting position or stand while the boat is in operation. Passenger carrying areas are illustrated in Figures 3 through 8.
- (c) The length of each passenger carrying area is the distance along the centerline of the boat between two vertical lines, one at the forward end and one at the aft end of the passenger carrying area, when the boat is level, as illustrated in Figures 3 and 4. For boats with a curved stem inside the passenger carrying area, the forward vertical line is where a line 45 degrees to the horizontal when the boat is level is tangent to the curve of the stem, as illustrated in Figure 5. For boats with cabins, the forward vertical line is where there is a minimum distance of two feet between the inside top of the cabin and the water line formed when the boat is swamped and loaded with weights under § 183.220 as illustrated in Figure 6.

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(d) The breadth of the passenger carrying area is the distance between two vertical lines at the mid-length, excluding consoles, of the passenger carrying area when the boat is level as illustrated in Figures 7 and 8. For boats with round chines inside the passenger carrying area, the vertical line is where a transverse line 45 degrees to the horizontal is tangent to the arc of the chine, as illustrated in Figure 7.

183.310 Reference areas.

- (a) The forward reference area of a boat is the forwardmost 2 feet of the top surface of the hull or deck as illustrated in Figure 9.
- (b) The aft reference area of a boat is the aftmost two feet of the top surface of the hull or deck, as illustrated in Figure 9.

183.315 Reference depth.

Reference depth is the minimum distance between the uppermost surface of the submerged reference area of a boat and the surface of the water measured at the centerline of the boat as illustrated in Figure 10. If there is no deck surface at the centerline of the boat from which a measurement can be made, the reference depth is the average of two depth measurements made on opposite sides of, and at an equal distance from, the centerline of the boat.

183.320 Preconditioning for tests.

A boat must meet the following conditions for at least 18 hours before the tests required by §§ 183.325, 183.330, and 183.335:

- (a) Manufacturer supplied permanent appurtenances such as windshields, convertible tops, and propellers must be installed on the boat.
- (b) The boat must be loaded with a quantity of weight that, when submerged, is equal to the sum of the following:

- (1) Two-fifths of the persons capacity marked on the boat.
- (2) Twenty-five percent of the result of the following calculation, but not less than zero: the maximum weight capacity marked on the boat; less the weight shown in Column 6 of Table 4 for maximum horsepower marked on the boat; less the persons capacity marked on the boat.

(c) The weights required by paragraph (b) of this section must be placed in the boat so that the center of gravity of each amount of weight required by paragraphs (b)(1) and (b)(2) of this section is within the shaded area illustrated in Figure 11. The location and dimensions of the shaded area are as follows:

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- (1) The shaded area is centered at the mid-length of the passenger carrying area and at the mid-breadth of the boat;
- (2) The length of the shaded area, measured along the centerline of the boat, is equal to 40 percent of the length of the passenger carrying area of the boat; and
- (3) The breadth of the shaded area, measured at the mid-length of the passenger carrying area, is equal to 40 percent of the breadth of the passenger carrying area of the boat.
- (d) Weight must be placed in the normal operating position of the motor and controls in lieu of this equipment. The quantity of weight used for this purpose depends upon the maximum rated horsepower of the boat being tested and is specified in Column 2 of Table 4 for the swamped weight of the motor and controls.

(e) Permanent fuel tanks must be filled with fuel and each external opening into the fuel tank must be sealed.

(f) The boat must be keel down in the water.

(g) The boat must be swamped, allowing water to flow between the inside and outside of the boat, either over the sides, through a hull opening, or both. Entrapped air in the flooded portion of the boat must be eliminated.

TABLE 4.—Weights (pounds) of outboard motor and related equipment for various boat horsepower ratings

Test horsepower rating	Column No.					Full portable fuel tank weight
	Motor and control weight		Battery weight		Swamped weight	
	Dry	Swamped	Dry	Swamped		
3.1 to 5	25	25	25	25	25	25
5.1 to 10	45	45	45	45	45	45
10.1 to 15	75	75	75	75	75	75
15.1 to 25	100	100	100	100	100	100
25.1 to 45	145	145	145	145	145	145
45.1 to 60	200	200	200	200	200	200
60.1 to 75	240	240	240	240	240	240
75.1 to 90	275	275	275	275	275	275
90.1 to 100	300	300	300	300	300	300
TRAINING DEVICES FOR TESTS						
50.1 to 60	310	70	50	50	50	50
60.1 to 65	420	80	60	60	60	60
65.1 to 70	480	85	65	65	65	65

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§ 183.323 Flotation materials.

(a) Flotation materials must meet the requirements in § 183.114 as listed in table 5 when used in the bilge, unless located in a sealed compartment.

TESTS

183.325 Flotation test for persons capacity.

Flotation standard. When the conditions prescribed in § 183.320 are met, the boat must float in fresh, calm water as follows:

- The angle of heel does not exceed 10 degrees from the horizontal.
- Any point on either the forward or aft reference area is above the surface of the water.
- The reference depth at the reference area that is opposite the reference area that is above the surface of the water is 6 inches or less.

183.330 Stability test.

(a) *Flotation standard.* When the conditions prescribed in § 183.320(a), (d) through (g) and paragraphs (b) and (c) of this section are met, the boat must float in fresh, calm water as follows:

- The angle of heel does not exceed 30 degrees from the horizontal.
 - Any point on either the forward or aft reference area is above the surface of the water.
 - The reference depth at the reference area that is opposite the reference area that is above the surface of the water is 12 inches or less.
- (b) *Quantity of weight used.* Load the boat with quantity of weight that, when submerged, is equal to the sum of the following:
- One-half the quantity of weight required by § 183.320(b)(1).
 - The quantity of weight required by § 183.320(b)(2).

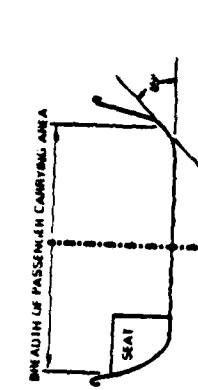


FIGURE 1 BREADTH OF PASSENGER CARRYING AREA

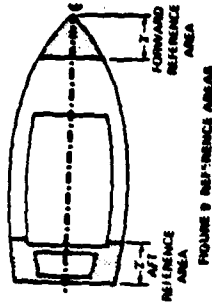


FIGURE 2 BOAT WITH ROUNDED CHINE

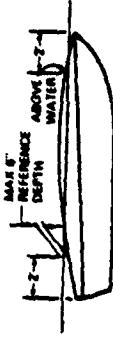


FIGURE 3 REFERENCE DEPTH

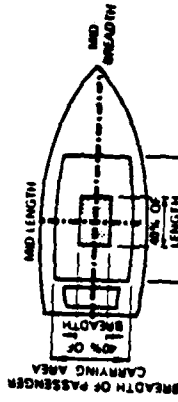


FIGURE 4 MID LENGTH

FIGURE 5 PASSENGER CARRYING AREA LOCATION OF CENTER OF GRAVITY OF WEIGHTS

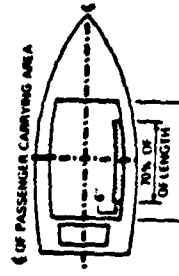


FIGURE 6 STABILITY TEST LOCATION OF CENTER OF GRAVITY OF WEIGHTS STARBOARD SIDE

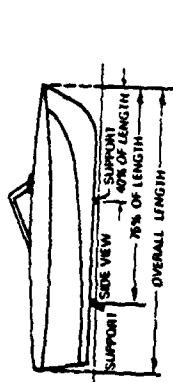


FIGURE 7 LOCATION OF SUPPORTS FOR LEVEL BOAT



FIGURE 8 BOAT WITH DECK



FIGURE 9 BOAT WITH CENTER CONSOLE

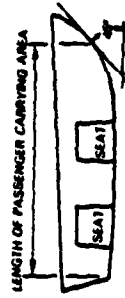


FIGURE 10 OPEN BOAT WITH CURVED STEM

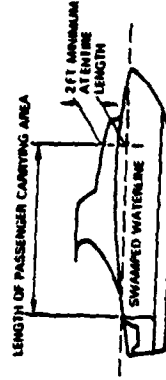


FIGURE 11 BOAT WITH CABIN

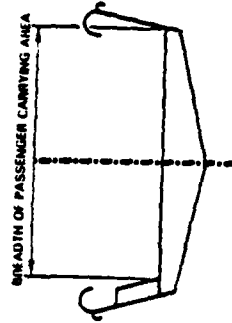


FIGURE 12

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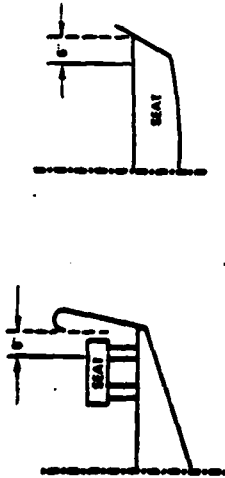


FIGURE 13. LOCATION OF CENTER OF GRAVITY OF WEIGHT ON SEATS

(c) *Placement of quantity of weight starboard side.* Place the quantity of weight required by paragraph (b) of this section in the boat so that—

(1) The quantity of weight required by § 183.320(b)(2) is positioned in accordance with § 183.320(c); and

(2) One-half the quantity of weight required by § 183.320(b)(1) is uniformly distributed over a distance along the outboard perimeter of the starboard side of the passenger carrying area that is equal to at least 30 percent of the length of the passenger carrying area so that the center of gravity of the quantity of weight is located within the shaded area illustrated in Figure 10, the center of gravity of each weight placed on the floor of the boat is at least 4 inches above the floor and the center of gravity of each weight placed on a seat is at least 4 inches above the seat. The location and dimensions of the shaded area are as follows:

(i) The shaded area is centered at the mid-length of the passenger carrying area;

(ii) The length of the shaded area is equal to 70 percent of the length of the passenger carrying area; and

(iii) The breadth of the shaded area is 6 inches from—

(A) For weights placed on the floor, the outboard perimeter of the passenger carrying area; and

(B) For weights placed on a seat, a vertical line inside the passenger carrying area as illustrated in Figure 13.

(d) *Placement of quantity of weight: port side.* The quantity of weight required by paragraph (b)(1) of this section is placed along the port side of the passenger carrying area in accordance with the conditions prescribed in paragraph (c)(2) of this section.

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183.335 Level flotation test without weights for persons capacity.

When the conditions prescribed in § 183.320(a), (d) through (g) are met, the boat must float in fresh, calm water as follows:

(a) The angle of the heel does not exceed 10 degrees from the horizontal.

(b) Any point on either the forward or aft reference area is above the surface of the water.

(c) The reference depth at the reference area that is opposite the reference area that is above the surface of the water is 6 inches or less.

Dated: April 21, 1976.

D. F. Lauth,

Rear Admiral, U.S. Coast Guard,
Chief, Office of Boating Safety.

[FR Doc. 76-12114 Filed 4-29-76; 8:45 am]