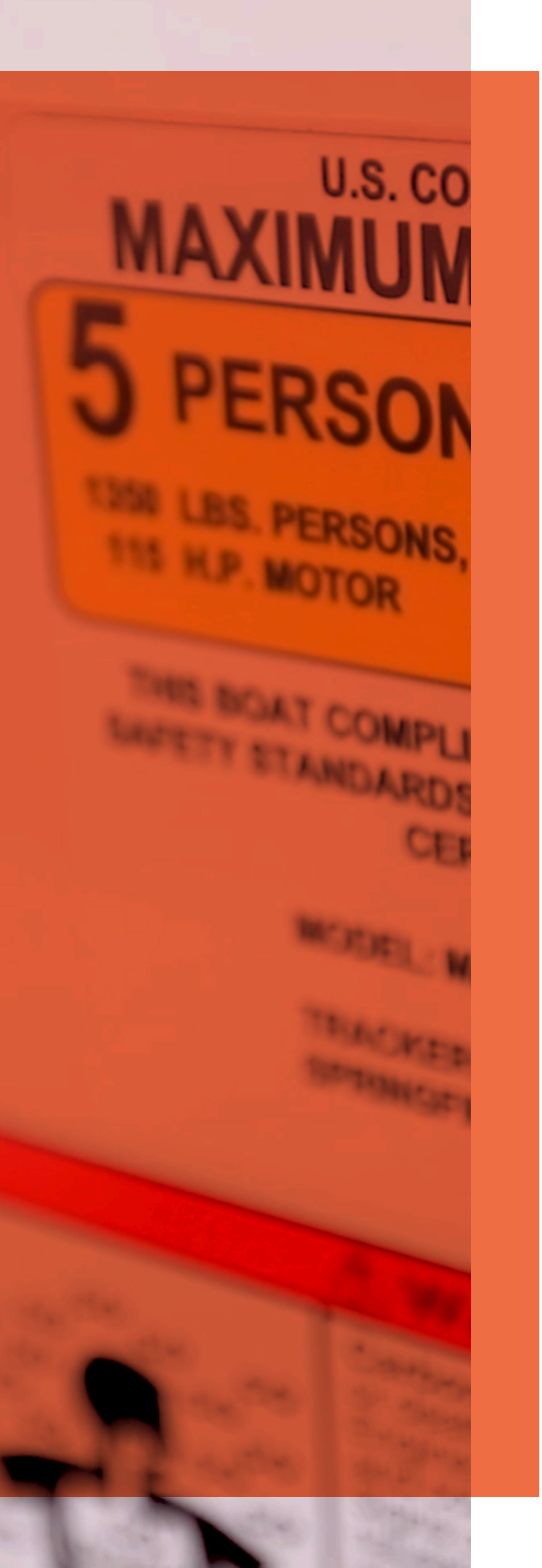


BOAT BUILDER'S HANDBOOK

2021 Edition

SAFE LOADING

SAFE LOADING

33 CFR 183 SUBPART C

Produced under a grant from the Sport Fish Restoration and Boating Trust Fund Administered by the U.S. Coast Guard.

Title 33 CFR, Sections 183.31 – 183. 43

CONTENTS

INTRODUCTION

Boat builders are responsible to determine the capacity figures placed on their monohull boats of less than 20 feet in length. The previous guideline (Display of Capacity Information) has covered the manner in which the capacity and powering figures are to be shown on the USCG capacity label. The 'Powering' guideline covers the manner to establish an upper powering limit. This 'Safe Loading' guideline covers the maximum capacity and persons capacity lines on the USCG capacity label. It discusses the methods for a boat builder to test for or calculate the upper limit for weight capacity and persons capacity, both in terms of pounds and in a whole number of persons.

The format for this guideline is to present the CFR requirements plain language statements, followed by a discussion. The full text of the safe loading CFR subpart is provided as an appendix.

Subpart C divides boats that must comply with this regulation into three categories:

- Inboard and sterndrive boats;
- Outboard boats rated for engines of greater than two horsepower;
- Boats rated for manual propulsion and boats rated for engines of two horsepower or less.

Two of the concepts that are part of the requirements and calculations in this subpart are common to all three categories of boats. These are the establishment of a static float-plane and the determination of maximum displacement. Those two topics are covered first. The manner to determine a boat hull maximum displacement by both tank testing and by mathematical means (aka Simpson's Rule) is covered. An example mathematical calculation follows.

Then the three steps in determining the capacities –

1. Establishing an upper limit for weight capacity - (from boat displacement).
2. Establishing an upper limit for maximum persons capacity - (from the maximum weight capacity).
3. Establishing an upper limit on the number of whole persons - (from the persons capacity in pounds).

- are discussed for the three categories of boat types – and step by step examples are given.

Engine weight Table 183.75 is used in this process of determining the capacities. That table is covered in this Boatbuilder's Handbook in the guideline for engine weights per 33 CFR 183 Subpart E.

TAKE HEED: Boat builder compliance means fully meeting all applicable regulations. The Boatbuilder's Handbook provides a basic introduction and summary of the regulations. Builders need to refer to the actual regulations for the complete text of the regulation to ensure full compliance. It is the boat manufacturer's responsibility to review, understand, and comply with all applicable regulations.

TO SEE A BOAT BEING TESTING FOR COMPLIANCE WITH THE SAFE LOADING (AND FLOTATION) REGULATIONS AT THE USCG BOAT TEST FACILITY – SEE THE VIDEO ON safeafloat.org

1.0 APPLICABILITY

> Per 33 CFR 183.31 – The safe loading regulation applies to monohull boats less than 20 feet in length – except sailboats, canoes, kayaks, and inflatable boats.

A discussion of the meaning of 'sailboat', 'canoe', 'kayak', 'inflatable boats' has been given in the previous 'Display of Capacity Information' guideline.

The three categories of monohull boat less than 20 feet in length subject to safe loading are:

- Inboard/Sterndrive
- Outboard powered boat with engine of over 2 HP
- Manually propelled boats and outboard powered boats of 2 HP or less

2.0 DEFINITIONS

The following definitions apply to this safe loading regulation. Some terms (such as maximum displacement) may mean something else in another context (such as ship load carrying capacity).

Calculation Beam: The broadest part of the boat at each station measured below the static float- plane. This distance is in inches between the outer sides of the hull, excluding rub rails, fenders, or other extensions.

In the majority of cases, this beam will be the widest when measured at the static float-plane, since most hulls have a "flair" between the chine and the sheer. However, in the case of a boat with a "tumblehome" section aft, the broadest point, where the beam must be measured, will be below the static float-plane. Figure 3-A in section 4.0 shows only half of a hull mold (for the sake of simplicity). When completing the Simpson's Rule calculations – the calculation beam is the full width of the boat at each station.

Calculation Length: The horizontal length from the most forward part of the boat below the static float-plane to the vertical midpoint of the transom below the static float-plane (See Figure 1.1 below and Figure 3 in section 4.0).

The calculation length determination relates to the Simpson's Rule mathematical determination of a boat hull maximum displacement – as discussed in Section 4.0. The reason for figuring the length to the vertical midpoint of the transom is that, since the transom is at an angle, the mid-point intersection (as opposed to the intersection at the top of the float plane) will eliminate the need to add the volume of any space aft of that intersection, and also to subtract the volume forward of the intersection. Assuming that the volumes of these two triangular spaces are equal, and they cancel each other out. Calculation length will be less than overall length.

Gear Weight: Applies to all weight that is not considered for persons (for all type boats), or for engines, controls, battery, and fuel tank (for outboard powered boats only). See Section 6.0.

Horizontal Boat: A boat is horizontal when it is transversely level and when the lowest points at 40 % and 75% of the boat's length behind the forward most point of the boat are level (See Figure 1 and Figure 2).

Level Boat: A boat is level when it is transversely level and when either of the two following conditions is met:

The forward point where the sheer intersects the vertical centerline plane and the aft point where the sheer intersects the upper boundary of the transom (stern) are equidistant above the water surface, or are equidistant below the water surface.

The forward most point of the boat is level with or above the lowest point of water ingress.

Maximum Displacement: The weight of the volume of water displaced by the boat at its maximum level of immersion in calm water without water coming aboard.

Monohull boat: A boat on which the line of intersection of the water surface and the boat at any operating draft forms a single closed curve. For example, a catamaran, trimaran, or a pontoon boat is not a monohull boat.

Some boats, e.g., power catamarans, may be considered to be monohull boats for the purpose of this regulation if the line of intersection of the surface of the water with the hull forms a single closed curve, or "footprint", when the boat is carrying its maximum rated horsepower and maximum weight capacity.

Static Float-Plane: The plane below all points of major leakage and the most forward point of the boat below which the maximum displacement of the boat exists (See Figure 1 below).

Determination of the static float-plane is the heart of the method for calculating capacity. The easiest way to understand the concept is to consider that all points of minor leaks have been sealed, while points of major leaks (like water coming over the side) remain above this plane.

FIGURE 1 Static Float Plane

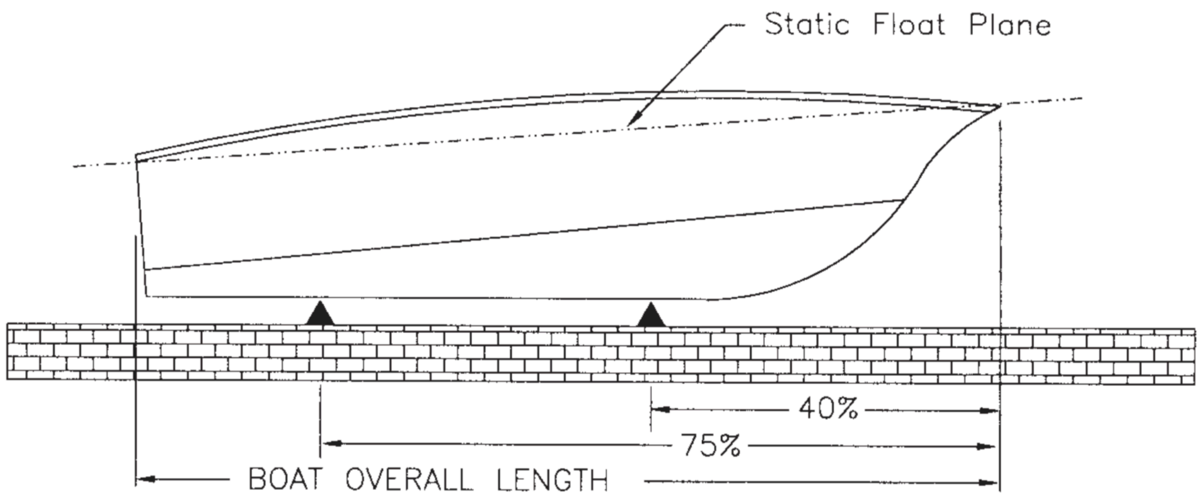


FIGURE 1.1 Static Float Plane — Alternate

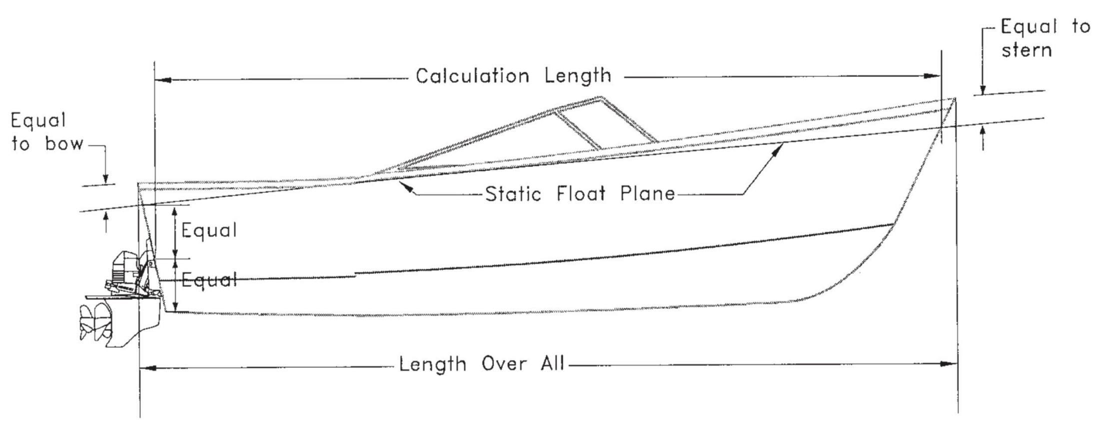
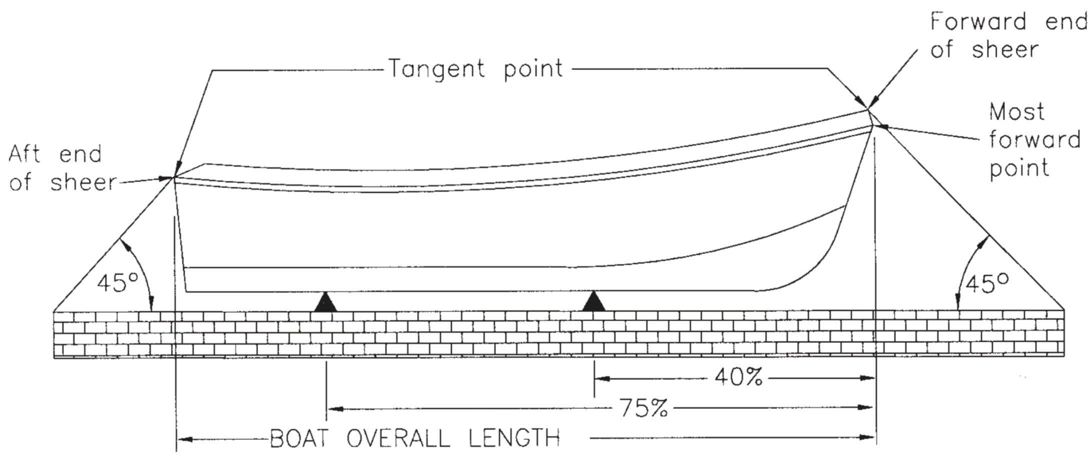


FIGURE 2 Intersections Determination and Horizontal Boat



3.0 DETERMINATION OF THE STATIC FLOAT-PLANE

The volume of the boat hull below the static float-plane will give the boat builder the largest displacement. In simple terms, for a boat placed in a tank (or body of water) the boat may be oriented in whatever fore and aft angle gives the largest load up to the point that water is just about to enter the boat (the point of down-flooding).

To complete in the water testing, the following sources of minor flooding will be sealed.

1. All scuppers or freeing ports, with or without flaps or back-flow devices and regardless of size;
2. Drain holes in the bow;
3. Bait, fish and anchor-well fill/drain holes;
4. Holes in the engine well with boots, in addition to the 3-inch hole already allowed by the regulations;
5. The hull-to-deck joint;
6. Hull doors if able to be closed.

Anything not on this list is considered to be a major source of flooding.

Some transom openings, drain holes or scuppers that may flood the boat during operation must be reviewed by the Coast Guard, and may be considered major down-flooding or water-ingress points. When in doubt about what may or may not be allowed, consult the Coast Guard.

The static float-plane may be established, following its definition, by either of two methods:

1. Starting on the most forward point of the boat below which the maximum displacement exists. This may be above the deck-to-hull joint, on deck, or established on the deck-to-hull joint if the displacement is to ignore the superstructure. The plane intersects the upper boundary of the stern at or below the points of down-flooding (See Figure 1).

2. In some instances, and to maximize the capacity or maximum displacement, the static float-plane may be established as follows:

A line in contact with the lowest point of the sheer that intersects the stem and stern below the intersection of the sheer and the stem at the bow and the intersection of the sheer and the transom at the stern. This line must be located so that the distance between this line and those two intersection points is the same. (See Figure 1.1). In both cases, the plane shall be below the lowest point of down flooding.

4.0 CALCULATION OF MAXIMUM DISPLACEMENT

It is important to note that all three categories of boats in 33 CFR Subpart C covered by this regulation require that the maximum displacement be found (by any of the three methods described here). This is the most involved step in the whole process of meeting safe loading requirements. Once the maximum displacement is determined, the maximum weight capacity (MWC) and the maximum persons capacity (MPC) are established by simple calculations unique to each category of boat.

Archimedes (a Greek scientist of 287–212 BC) discovered that, "any body completely or partially submerged in a fluid is buoyed up by a force equal to the weight of the fluid displaced by the body." Consequently, if we push a boat down into the water to the point before water enters the boat while the bow and the stern are at the same distance from the water's surface, the weight of the volume of water displaced by the boat will represent the force keeping the boat buoyant and afloat. The weight of this water represents the "displacement" of this boat.

The three methods discussed to determine boat displacement are a 'high tech' figure it out with a special computer program method, a 'low tech' immersion method - with the boat placed into the water with weights added up until water is about to enter the boat, and a mathematical method (Simpson's Rule).

4.1 CAD System (Computer Aided Design):

In a CAD software program that determines a boat displacement as a function of hull immersion, the boat hull lines would be entered into the computer. The key analysis result would be to establish the float-plane and corresponding hull volume.

4.2 Boat Immersion:

The boat immersion method requires significant infrastructure (dedicated building space, a pool, an overhead crane or other lifting system, and plenty of weights). Boat immersion is the method used by the USCG at the Boat Test Facility to test recreational boats for compliance with the maximum capacity and flotation & stability regulations. It is the method used by other professional organizations that offer boat testing.

The system, as its name implies, consists of placing the boat in a tank or pool of fresh water while it is suspended level from above by a pair of hoists that permit lowering it into the water, and then adding weights distributed evenly so the boat immerses with the float-plane parallel to the surface of the water. All points of minor leaks are sealed, such as deck-to-hull joints, bilge pump discharges other scuppers or drains and a three inch hole in the engine well as described in CFR 183.35 (b) (1) in the case of an outboard. The maximum displacement is reached just before water begins to come into the boat.

The added weight is a 'test weight'. In the case of boat immersion, it is important to understand that the maximum displacement is the test weight added to immerse the boat to its static float-plane plus the weight of the boat. That is, when the boat is first placed in the water, it displaces its own weight before any additional weight is added.

If you don't have expensive test tanks, cranes, and plenty of test weights you can still perform a cruder form of immersion test by loading the boat with known weights in a calm body of fresh water. The known weights could be people, solid objects, or full capped barrels without any remaining air. Simply flooding the boat with water is not recommended as it is difficult to measure the exact amount of water introduced into the boat, one cannot control where to distribute the weight, and the boat may not be designed to withstand the internal pressure of the water.

4.3 Mathematical - Simpson's Rule:

Simpson's Rule is a mathematical method to determine the area of an odd shape (like a boat cross section). Applying the rule a second time can be used to determine the volume of an odd shape (like a boat hull). For Simpson's Rule, special equations have been developed to turn a series of boat dimension readings into an estimate of boat hull volume (and thus displacement).

Simpson's Rule is based on dividing the object into stations, finding some specific dimensions – and applying a series of multiplier factor to come up with the areas of the stations. The second step is to take the station areas – and apply a new set of multipliers to come up with the volume of the object.

This section explains how to use this mathematical manipulation to determine the volume of a boat hull (in cubic feet) – and thus the displacement (in pounds of water) of the hull. Then an example calculation is presented.

The actual station dimensions used in this formula can be obtained from:

- Hull lines drawings;
- Measuring a hull mold;
- or measuring a boat.

Hull Lines Drawings: You can establish the static float-plane and all the sections as required by Simpson's Rule on the hull lines drawings, and then figure the section areas; or you can measure the vertical dimensions at the proper stations directly from the drawings, and compute the volume as per the worksheet below.

Measuring a Hull Mold: Using a boat hull mold works well as there are no structural impediments and the measurements taken to the inside of the mold surface (and thus the outside of the boat hull) will give the hull displacement directly (without additional mathematical manipulations. The process is to establishing the float-plane, install a string along the centerline, establish all the sections, measure the vertical stations at each section, and enter all measurements on the work sheet.

Measuring the Boat: There may be cases in which it is impractical to measure a mold, so an alternative method is to measure an existing boat. The figures needed for using Simpson's Rule are the same as in Figure 3 below, except that the method may be more difficult than that of measuring the mold. Measuring the station dimensions inside the boat is made more difficult due to the internal structure of the boat. Measurements to the inside of the hull will need to account for the thickness of the hull to get the full hull displacement.

An alternative is to measure the distances from the floor to each station – and to then make the mathematical manipulation to the inside station measurements. After establishing a float-plane, establishing the calculation length, and establishing the stations (or sections), the measurements are taken by drawing a line on the floor as the projection of each station, from the centerline to the projected calculation beam at each station location. Then divide the half-beam line into five equal spaces and measure from the floor to the projected points a, b, c, d, e, and f, where these intersect with the bottom of the boat. Subtract these measurements from the calculated distance between the float-plane and the floor. This will result in the values to be entered on the work sheet.

FIGURE 3. Determination of Boat Displacement

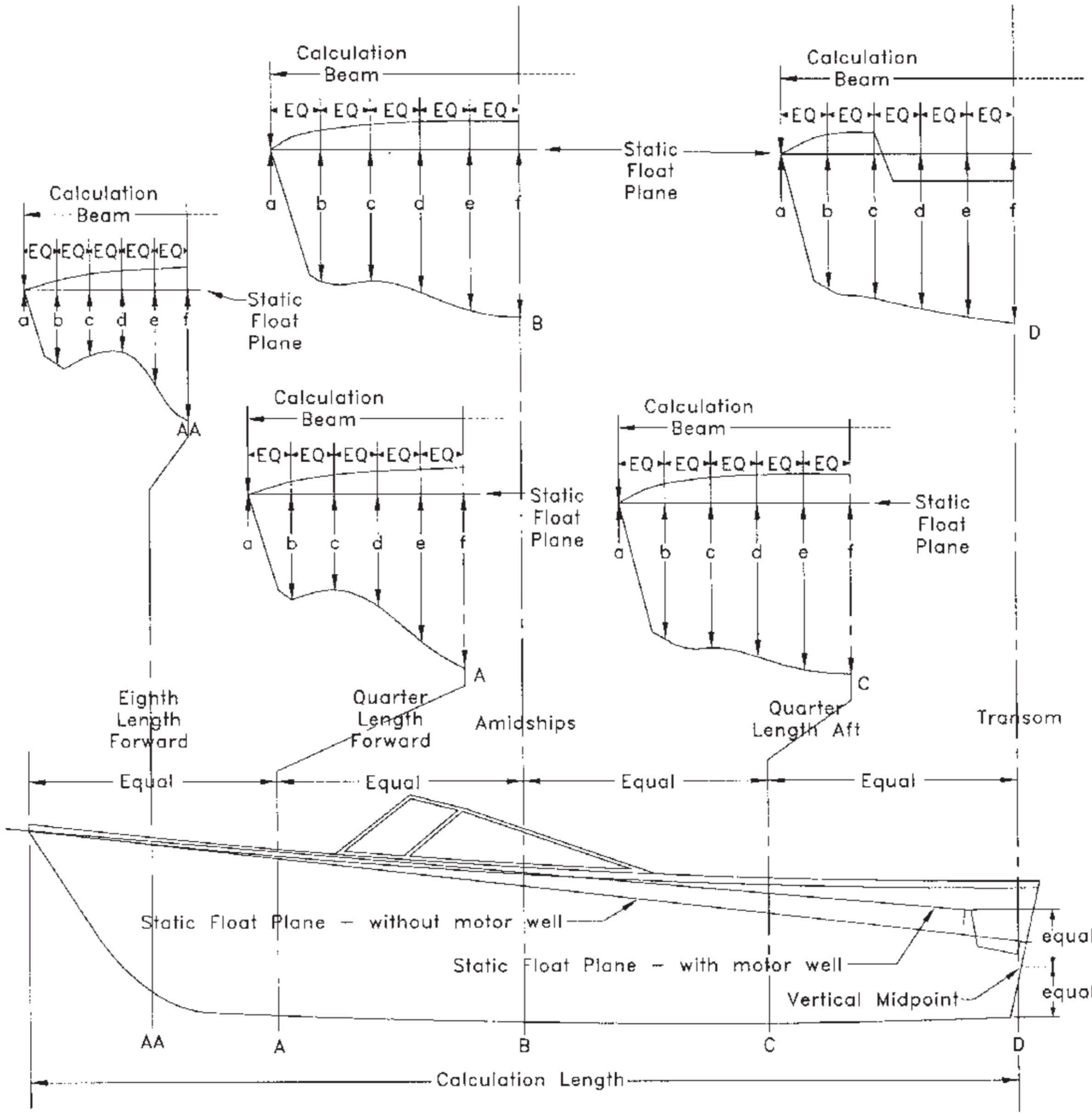
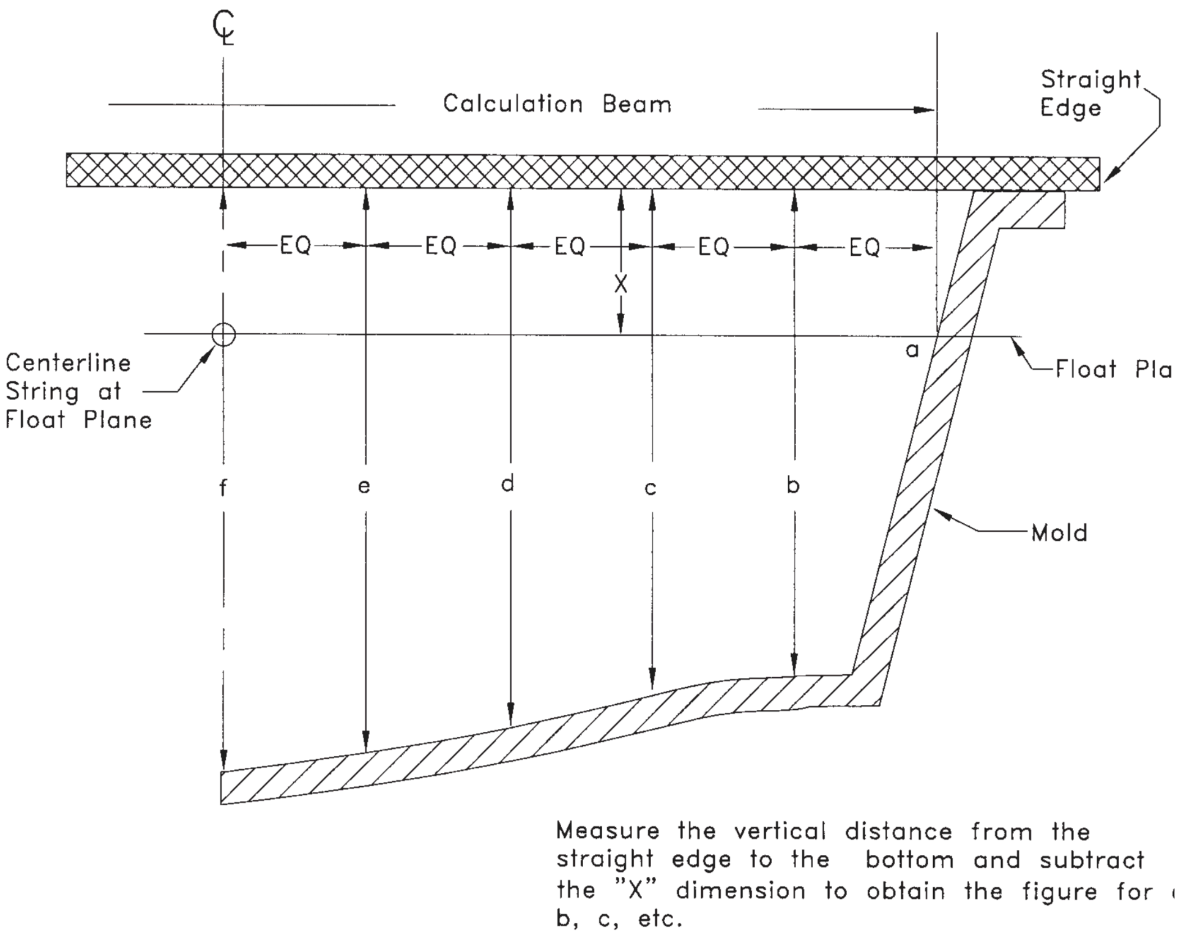


FIGURE 3-A Determination of Boat Displacement — Detailed

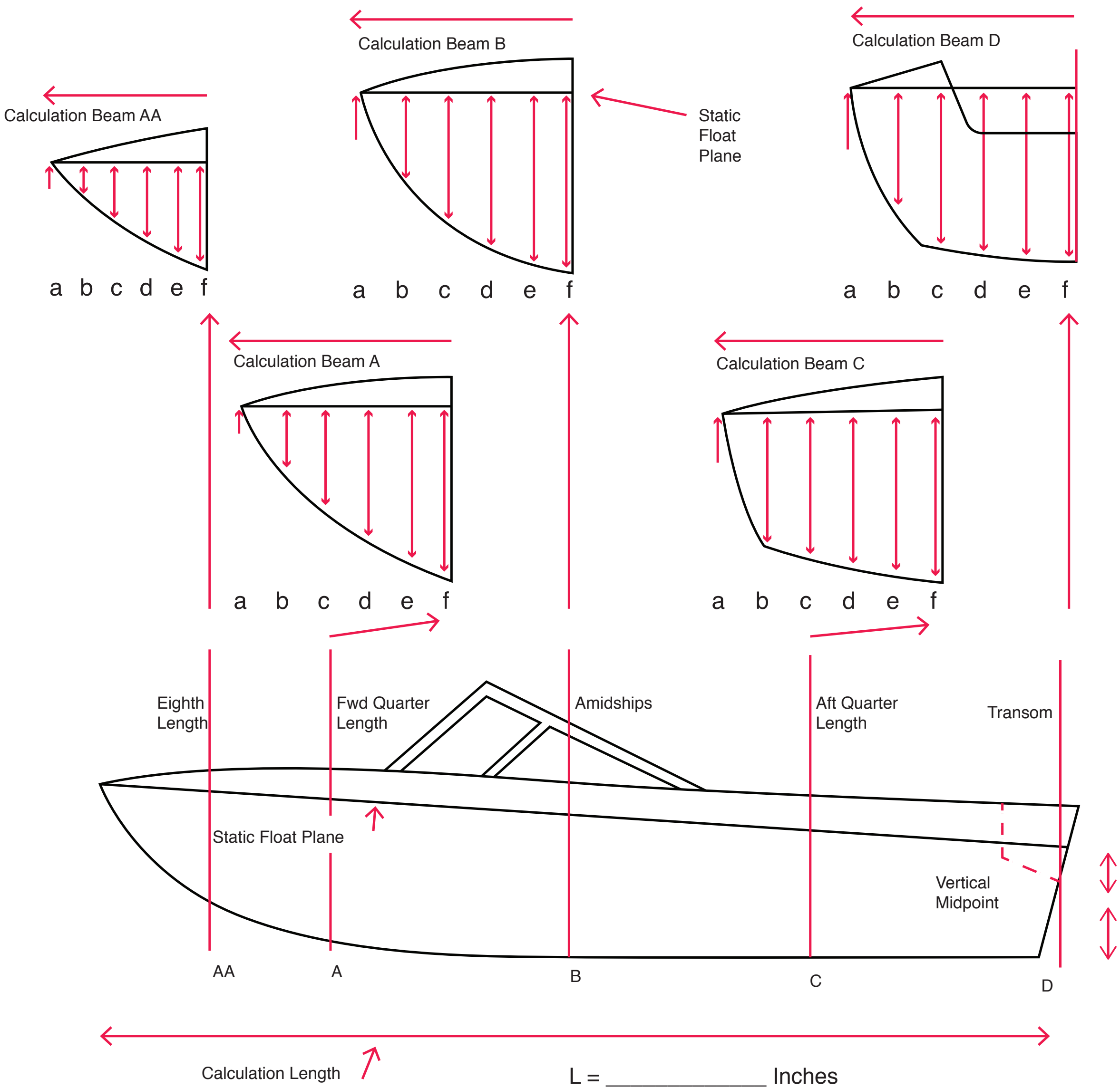


Note: The "X" dimension could be 0 if the float plane coincides with the hull sheer or top of the mold.

Figure 4 is a worksheet to record the readings needed to compute the boat hull displacement. The process is to enter the calculation beam and vertical dimensions a, b, c, d, e and f, on each of the sections (stations). The calculation beam changes from station to station – and – is the full beam side to side, not just from the centerline to the side. The calculation length (L) remains the same for all stations.

Enter the dimensions as inches in decimal form – to one decimal place.

FIGURE 4 Boat Displacement



[Station vertical measurements (a to f) from outside bottom of boat up to static float plane]

STATION	a	b	c	d	e	f	beam
AA							
A							
B							
C							
D							

4.3.1 Simpson's Rule Measurements

Using the mold measurement option:

1. Mold Preparation: Set the hull mold on the floor so that the keel line is level as described under the definition of "Horizontal Boat".

2. Determine where the float-plane will intersect the transom. Look for the lowest point of water ingress on the hull. Drains, scuppers, bilge-pump discharge fittings, deck-to-hull joint, and other sources of minor leaks may be below the float-plane.

3. Attach a string to the bow of the mold on the centerline, and to the point on the transom or transom plane where all points of major leaks are now above the string. This is the static float-plane.

4. Look at Figure 3 and notice that the calculation length (L) dimension used for Simpson's Rule is not the same as the LOA, or length-over-all, of the boat. Rather, it is the dimension taken from the most forward point of the interior of the mold below the static float-plane to a point on the transom which is the mid-point between the static float-plane and the keel line or its projection. Mark, with a piece of tape on the string, the vertical projection of this mid-point on the transom. The calculation length (L) will be the horizontal distance from this tape to the most forward point on the interior of the mold. (The placement of section D on a boat with a classic slanted flat transom is easy – dealing with a myriad of other transom designs is more of a challenge.)

5. Divide the length of the string into four equal spaces, and then divide the most forward of these into two equal spaces. This establishes Sections: AA, A, B, C, and D.

6. The next step is to mark, on the topside flange of the mold, the places where the beam of each section will intersect the hull sheer or perimeter of the mold. The easiest method is to attach a piece of masking tape to the top of the mold approximately in the area where this intersection will be, and then, with a straight edge across the top of the mold, mark the outboard point of intersection when both ends of the straight edge are equidistant from the transom (or perpendicular to the centerline string). Now you have marked the place where the calculation beam used in the formula will be measured. The float-plane may very well be below the top flange of the mold where the straight edge has been placed, so a measure of the distance between the straight edge and the string marking the float-plane is 'dimension x' (see figure 3A), this number must be subtracted from the measurements in the next step.

7. Divide the half-beam distance on each station (or section) into five equal spaces. Measure the vertical distance from the straight edge to the bottom of the mold at each of the points marked a, b, c, etc. Then subtract dimension x from these measurements to arrive at the net dimension between the static float-plane and the mold bottom (outside skin of the boat), to be entered on the blank spaces provided in Figure 4, for a, b, c, etc.

8. Using the blank form from section 4.1, enter the measurements of the net dimension between the float-plane and the boat on each of the vertical lines at each station. Then enter the beam at each station. Remember this is the full calculation beam and not the half-beam. Enter the calculation length (L). Figure 4 shows a detailed look at the manner in which the stations AA, A, B, C and D are laid out and measured.

The Simpson's Rule calculations determine the hull volume below the static float plane – which is converted to the boat hull displacement in pounds based on the weight of water – which is then used to calculate the boat's maximum weight capacity based on the boat weight.

4.3.2 Simpson's Rule Calculations

Once all the measurements are made, the calculation of boat displacement is a straight forward mathematical exercise – using the special Simpson's Rule formulas given below in Step 1 (section area) and Step 2 (boat volume). (A builder with several models may find the time to set up a spread sheet to complete the calculations directly with section measurement data entry.)

Step 1: Compute the area at each station

Area = [(beam @ station / 15)] [a + 4b + 2c + 4d + 2e + 2f]

- Complete the calculation of area at each station AA / A / B / C / D.
- Calculation gives section area in square inches.
- As the measurements are taken to one decimal number, complete the calculations to one decimal number.

Step 2: Compute cubic capacity of boat hull.

$$\text{Cubic capacity of hull} = \frac{L}{174{,}600}\,[16AA + 13A + 27B + 27C + 9D] + [*]$$

- The calculation takes the section area in square inches and gives cubic capacity of hull in cubic feet. The factor 174,600 accounts for the change in units – and – allows for a 5% safety margin

- About that [*]. The volume of any feature aft of the transom and below the float-plane contributing to the displacement of the boat will be added to the calculated cubic capacity. At the same time, if there is any volume not contributing to the displacement, such as the motor-well volume below the float-plane, it will be subtracted. For example – with the boat shown in Figure 4. There is an area of the motor well that is below the float-plane. Assuming this volume to be one cubic foot, that quantity will be subtracted from the calculated value.

Step 3: Compute the maximum displacement below the static float-plane.

Formula: Displacement = cubic capacity x 62.4 lb / cu ft

- This calculation gives displacement in pounds. Water weights 62.4 pounds per cubic foot.

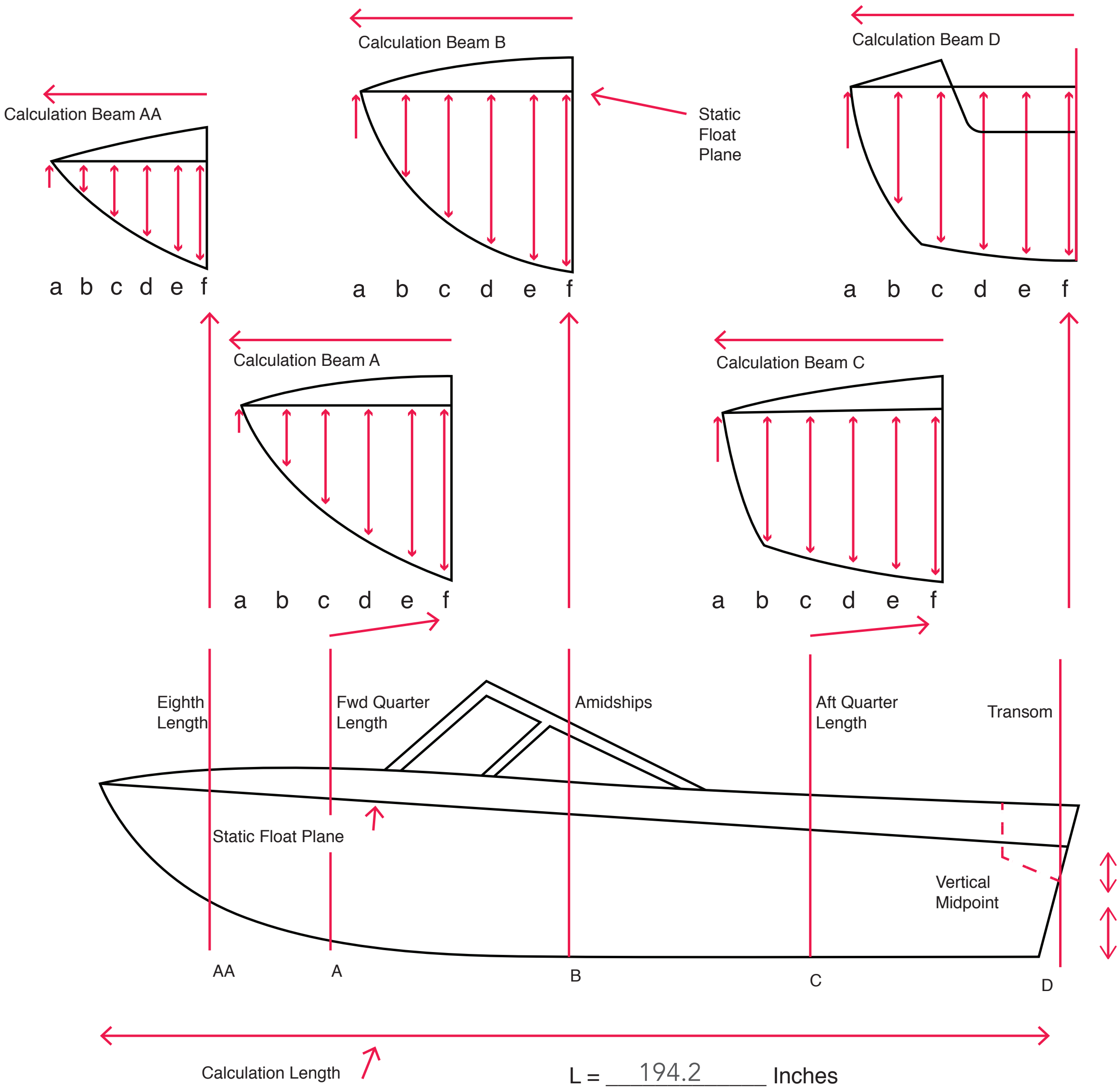
4.3.3 Simpson's Rule Example Calculation

The maximum displacement of an outboard powered boat is to be calculated by Simpson's Rule. Boat mold measurements have been completed.

Boat type	Outboard runabout
Length over all (LOA)	16.5 ft.
Calculation length (L)	16.2 ft. (194.2 in.)
Beam	6.75 ft.
Calculation beam	must be measured at each station
Horsepower rating	120 HP
Transom height	24 inches
Fuel tank	permanent
Boat weight	700 lb.
Displacement	to be determined

The values on the forms have been taken from measuring a boat hull mold as described in section 4.0 and entered on the blank form – see Figure 4-1. Note that the calculation length and the various station calculation beams are less than the overall dimensions of the boat.

Figure 4.1 Simpson's Rule Measurements Filled In



[Station vertical measurements (a to f) from outside bottom of boat up to static float plane]

STATION	a	b	c	d	e	f	beam
AA	0.0	6.6	11.3	16.5	19.0	25.6	47.5
A	0.0	8.5	18.9	25.8	29.6	36.6	70.0
B	0.0	26.3	29.0	32.1	35.5	38.4	78.8
C	0.0	26.0	28.4	30.8	35.4	35.6	77.5
D	0.0	24.9	27.4	29.6	32.1	33.2	76.3

Step 1: Compute area.

$$\text{Area} = \frac{\text{beam}}{15}(a + 4b + 2c + 4d + 2e + 2f)$$

Area AA ______ Section eighth-length forward:

$$AA = \frac{47.5}{15}\,[\underset{a}{0} + \underset{b}{4(6.6)} + \underset{c}{2(11.3)} + \underset{d}{4(16.5)} + \underset{e}{2(19.0)} + \underset{f}{2(25.6)}]$$

AA = 646.6 square inches

Area A ______ Section quarter-length forward:

$$A = \frac{70.0}{15}\,[\underset{a}{0} + \underset{b}{4(8.5)} + \underset{c}{2(18.9)} + \underset{d}{4(25.8)} + \underset{e}{2(29.6)} + \underset{f}{2(36.6)}]$$

A = 1434.5 square inches

Area B ______ Section amidships:

$$B = \frac{78.8}{15}\,[\underset{a}{0} + \underset{b}{4(26.3)} + \underset{c}{2(29.0)} + \underset{d}{4(32.1)} + \underset{e}{2(35.5)} + \underset{f}{2(38.4)}]$$

B = 2308.3 square inches

Area C ______ Section quarter-length aft:

$$C = \frac{77.5}{15}\,[\underset{a}{0} + \underset{b}{4(26.0)} + \underset{c}{2(28.4)} + \underset{d}{4(30.8)} + \underset{e}{2(35.6)} + \underset{f}{2(35.6)}]$$

C = 2203.1 square inches

Area D ______ Section aft:

$$D = \frac{76.3}{15}\,[\underset{a}{0} + \underset{b}{4(24.9)} + \underset{c}{2(27.4)} + \underset{d}{4(29.6)} + \underset{e}{2(32.1)} + \underset{f}{2(33.)}]$$

D = 2052.0 square inches

Step 2: Compute cubic capacity.

$$\text{Cubic capacity of hull} = \frac{L}{174600}[16AA + 13A + 27B + 27C + 9D] - 1 \text{ cu ft*}$$

$$\text{Cubic capacity} = \frac{194.2}{174,600}[16(646.6)+13(1434.5)+27(2308.3)+27(2203.1)+9(2052.0)] - 1^*$$

Cubic capacity = 187.2 cubic feet (*including 1 cu.ft. deduction for motor well)

Step 3: Compute maximum displacement below static float-plane.

Displacement = cubic capacity X 62.4 lb./ cu. ft.

Displacement = 187.2 X 62.4 lb./cu.ft.

Displacement = 11,681.3 pounds

The example boat has a displacement of 11, 681.3 pounds. That figure is then used to determine the boat's maximum weight capacity.

5.0 CALCULATION OF MAXIMUM WEIGHT CAPACITY (MWC) / CALCUATION OF MAXIMUM PERSONS CAPACITY (MPC)

The calculation of maximum weight capacity (MWC) is similar – with slight variations – for the three categories of boats covered by the regulations: inboards/sterndrives, outboards over 2 HP, and manually propelled boats/outboards of 2 HP or less. Likewise, the calculation of maximum persons capacity (MPC) varies among these three types of boats. Maximum persons capacity is determined both as a whole number of persons and an upper limit in pounds.

The safe loading regulation shows the way to calculate the upper limit for the capacity figures. Those figures do not have to be posted on the capacity label. On the contrary, down-rating of the calculated figures is highly recommended. As discussed in the 'Flotation' guideline, builders must provide flotation to support the posted capacity and powering figures; down-rating will lower the requirement for expensive flotation material. Down-rating will allow for production variations – and provides a greater margin of safety.

With down-rating, the actual tested or calculated value of weight capacity and persons capacity will be larger than the numbers affixed to the capacity label. Throughout the various guidelines, the figure for the term 'maximum weight capacity (MWC)' is taken as the number the boat builder affixes to the label; the term 'maximum persons capacity (MPC) is taken as the number of pounds the boat builder affixes to the label.

The maximum weight capacity is one factor (along with engine/batter/fuel controls weight) used to calculate the upper limit for maximum persons capacity. It is recommended that builders always post (at least) the required differential between the MWC and MPC figures (as explained below) – and that builders consider further down-rating the MPC figure to allow for gear weight. Example calculations are included below.

5.1 INBOARD/STERNDRIVE MAXIMUM WEIGHT CAPACITY

Per 183.33 - Formulas are given to determine the maximum weight capacity (MWC) for inboards and sterndrives.

The vast majority of inboard and sterndrives determine the maximum weight capacity (MWC) by the following formula:

$$\textbf{MWC} = \frac{\textbf{(maximum displacement – boat weight)}}{\textbf{7}}$$

Maximum displacement has been covered previously in this guideline.

For inboards and sterndrives boat weight includes:

Hull, deck and superstructure weight
Weight of permanent appurtenances – which includes the engine
Weight of permanently installed (full) fuel tank.

Permanent appurtenances means equipment that is installed such that removal would require the use of tools. So such items as seats and center consoles (and inboard engines) are permanent. By CFR definition, outboard engines, batteries, and portable fuel tanks are not permanent appurtenances – even though tools would normally be required for removal.

As discussed, the calculated value of maximum weight capacity is usually down-rated; the MWC figure if taken as the capacity posted on the label.

This CFR section gives another rarely used formula to calculate the MWC. This formula may give a builder of high performance, low profile boats a larger calculated value.

$$\text{MWC} = \frac{\text{maximum displacement}}{5} - \frac{\text{boat weight}}{5} - 4\left(\frac{\text{machinery weight}}{5}\right)$$

where machinery weight includes the engine(s), sterndrives, controls, and batteries.

When testing a boat of this category, the USCG will use the immersion method for finding the test weight and then use the calculation: MWC = (test weight / 7).

5.2 INBOARD/ STERNDRIVE MAXIMUM PERSONS CAPACITY (MPC)

Per 183.39 – The persons capacity on an inboard / sterndrive is determined in relation to the maximum weight capacity.

As seen in the discussion of the label format in the 'Display of Capacity Information' guideline – the persons capacity must be displayed in both a whole number and in pounds. Whichever number is reached first establishes the limit. Many low weight passengers will reach the number of persons limit first; heavy weight riders will reach the total pounds first.

The maximum persons capacity cannot exceed the maximum weight capacity:

MPC less than or equal to MWC

On the capacity label the MWC line reads "XX POUNDS, PERSONS, GEAR". Thus, if a builder has the MPC figure the same as the MWC figure there is no allowance for gear. Boat builders are encouraged to allow for gear weight (for fishing/hunting/ tubing/picnicking). Thus, builders are encouraged to down-rate the MPC figure to something less that the MWC. Gear weight is discussed in greater detail in Section 6.0.

The regulations do require a check of 'dry stability' for boats with a maximum persons capacity of less than 550 pounds. First, this low a persons capacity is not likely on inboards and sterndrives. Second, the dry stability test would only be the controlling factor for a very narrow beam boat – and through many years of USCG testing has not been found to be a determining factor. Still, boat builders should be aware of the requirement – the test procedures are given in the CFR text.

The maximum persons capacity in a whole number is determined by the following formula:

$$\#\ \text{Persons} = \frac{\text{MPC} + 32}{141}$$

If the fraction is less than one-half, round down to the next lower whole integer; if the fraction is equal to or greater than one-half, round up to the next higher whole integer. For example: 7.3 must be rounded down to 7; 7.5 may be rounded up to 8. In all cases boat manufacturers may down-rate the persons capacity from the calculated figure.

5.3 EXAMPLE OF CALCULATIONS FOR MAXIMUM WEIGHT CAPACITY AND PERSONS CAPACITY OF INBOARD AND STERNDRIVE BOATS

Let's use the hypothetical outboard boat described in section 4.2 above, but converting the boat to a sterndrive. The specifications will read as follows:

Boat type	Sterndrive runabout
Length over all (LOA)	16.5 ft.
Beam 6.75 ft.	
Horsepower engine	120 HP (factory-installed)
Hull weight (dry)	700 lb.
Full, permanent fuel tank	150 lb.
Engine & drive weight	845 lb.
Boat weight (hull + engine + fuel)	1695 lb.
Displacement (*without motor well)	188.2 cubic feet or 11,743.7 lb.

Step 1: Compute maximum displacement - as was done in previous example.

11,743.7 pounds – from Simpson's Rule

• Had this boat been tested by the immersion method to determine displacement, the boat weighing 1695 pounds would have displaced this weight when placed in the tank. The extra 'test weight' added up to the point water was about to enter the boat (with the boat's static float plane parallel to the water surface) would be in the vicinity of [11,743.7 – 1695 = 10048.7 pounds].

Step 2: Compute maximum weight capacity.

$$MWC = \frac{(\text{maximum displacement} - \text{boat weight})}{7}$$

$$MWC = \frac{11,743.7 - 1695}{7}$$

MWC = 1436 pounds (calculated value to nearest pound)

(Builder opts to down-rate: "MWC = 1400 POUNDS, PERSONS, GEAR")

Step 3: Compute persons capacity in pounds.

MPC = MWC

MWC = MPC = 1400 POUNDS

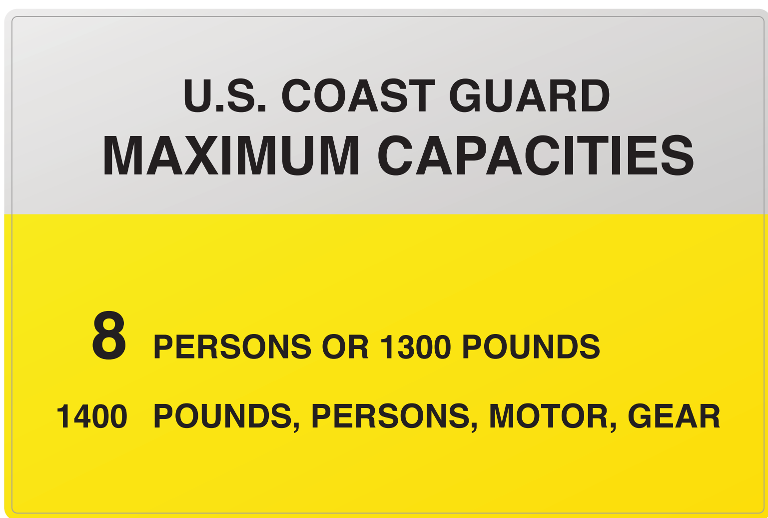
(Boat builder opts to down-rate MPC to 1300 POUNDS to allow for 100 pounds of gear weight - which will also help the builder meet the flotation requirement.)

Step 4: Compute persons capacity in whole numbers

$$\text{Persons} = \frac{32 + \text{persons capacity (lb.)}}{141}$$

$$\text{Persons} = \frac{32 + 1300}{141} = 9.4 \text{ rounded down to } 9$$

(Boat builder opts to down-rate the number of persons in a whole number to 8.) So the resulting boat capacity label will read.



A manufacturer has ample freedom to rate the boat as he/she sees fit, as long as it does not exceed the maximum weight capacity. The parameters to be considered in the decision-making process are:

- How many intended occupant positions does the boat have?
- What is a reasonable number of persons to load in this boat?
- How much gear should we consider?
- How much added flotation will be required?
- Has the boat been performance-tested with heavy loads?
- Expected variations in production?

5.4 MAXIMUM WEIGHT CAPACITY - OUTBOARD BOATS WITH ENGINES OVER 2 HP

Since many outboard boats leave the manufacturing plant without engines, the method of calculating weight and persons capacity varies slightly from the inboard category. Weights for engines, controls, batteries, etc., must be worked into the formulas. The process is the same: figure the location of the static float-plane, calculate the maximum displacement, and then apply the formulas to arrive at the capacities.

The other difference is in the calculation of the displacement, where we acknowledge that a 3-inch diameter hole is permitted in the engine-well area to provide access for the control cables and fuel lines. This hole will be sealed during immersion tests, or considered acceptable if displacement is calculated by another method.

The Coast Guard has been given authority to randomly check boats for compliance with the flotation requirements. When this check is conducted, simulated outboard engine weights are used rather than an actual outboard engine. The weight used during this check is obtained from the outboard engine weight table included in 33 CFR 183 Subpart E (Weights of Gasoline Outboard Engines and Related Equipment for Various Rated Power (Horsepower) Ranges. This subpart is included herein as a separate guideline in the Boatbuilder's Handbook. This engine weight table accounts for heavier 4-stroke engines and was adopted from the ABYC Standard S-30 and became effective on June 1, 2018.

> Per 183.35 – the maximum weight capacity for outboard powered boats with engines over 2 horsepower is determined by a given formula with respect to the boat displacement.

The maximum weight capacity for an outboard powered boat is determined in a similar manner to inboards and sterndrives – just the denominator changes from 7 to 5.

$$\text{MWC} = \frac{\text{maximum displacement} - \text{boat weight}}{5}$$

The boat weight for inboards/sterndrives does include the engine weight; the boat weight for an outboard powered boat does not include the engine weight.

5.5 MAXIMUM PERSONS CAPACITY FOR OUTBOARD BOATS OVER 2 HP

> Per 183.41 – the persons capacity for an outboard powered boat of more than 2 horsepower is determined as a function of the maximum weight capacity and the engine/control/battery/fuel weight.

As before for inboards & sterndrives, the outboard over 2 HP regulation also calls for a dry stability test if the MPC is less than 550 pounds. This has not been shown to be an issue with USCG boat testing but boat builders should be aware of the requirement as detailed in the CFR.

The boat builder does not need to weigh the installed engine/controls/battery/fuel weights – but rather must refer to the Subpart E Table 183.75. The various weights are given for the range of HP ratings; column 9 gives the total engine/control/battery/fuel weight to be used in the following calculation.

$$\text{MPC} = \text{MWC} - (\text{Table 183.75, column 9})$$

Technically the MPC figure can be based on the tested/calculated figure for weight capacity (before down-rating). As stated, this guideline takes the posted figure as the MWC and determines the upper limit for persons capacity as that based on the posted value of MWC. Boat builders are encouraged to always show at least the proper differential between the posted MWC and MPC based on the required differential from Table 183.75, column 9. Beyond that, boat builders are also encouraged to further down-rate the posted MPC to allow for gear weight.

Gear weight is the calculated value of the MWC minus the MPC minus the Table 183.75, column 9 figure. Thus, if a builder posts MWC and MPC figures with a differential that matches the Table 183.75 figures, there is no allowance for gear weight. Builder down-rating of the persons capacity allows for gear weight.

As discussed in the flotation guideline, for outboard powered boats builders must provide flotation material to support 50% of the first 550 pounds of persons weight (and 1/8 of persons weight over 550 pounds) – but only 25 % of any gear weight.

The selection of capacity (and powering) figures – and the resulting flotation requirements - all come into play in the boat design process.

As before the persons capacity in a whole number is determined by the formula:

$$\#\ \text{Persons} = \frac{\text{MPC} + 32}{141}$$

5.6 EXAMPLE OF CALCULATIONS FOR MAXIMUM WEIGHT CAPACITY AND PERSONS CAPACITY: OUTBOARD BOATS WITH ENGINES OVER 2 HP

In section 4.2 we have an example of the calculations for maximum displacement for an outboard powered boat. The only difference from the sterndrive boat noted in example in section 5.3 as an example for the capacity calculations is that the outboard boat has a small volume of the engine well, below the float-plane and forward of the transom, which must be deducted when figuring cubic capacity; hence the displacement for the sterndrive boat was [188.2 x 62.4 = 11,743.7 lb]. For the present example of an outboard boat the displacement is [187.2 x 62.4 = 11,681.3 lb].

Following are the specifications for the hypothetical outboard boat:

Length overall:	16.5 ft.
Boat weight:	1353 lb.
Displacement:	11,681.3 lb.
Outboard engine:	120 HP
Engine weight:	See step 3 below – (also includes battery, controls, fuel tank)
Fuel:	Permanent fuel tank (needed for interpretation of Table 183.75 weights)
Transom height:	24 inches (comes into play in interpretation of Table 183.75 weights).

Step 1: Compute maximum displacement.

11,681.3 lb.

Step 2: Compute maximum weight capacity.

$$MWC = \frac{\text{maximum displacement} - \text{boat weight}}{5}$$

$$MWC = \frac{11{,}681.3 \text{ lb.} - 1353 \text{ lb.}}{5}$$

MWC = 2,066 lb. (to nearest pound)

(Boat builder opts to down-rate the figure to 2000 pounds.)

Step 3: Compute persons capacity in pounds.

This calculation depends on the engine/controls/battery/fuel tanks weight. Go to Table 183.75 where column 9 shows the sum of the engine/controls/battery/fuel tank weights for an engine of 120 HP. The given table gives the weights for a boat with a transom height of over 20 inches and with a portable fuel tank. Per the notes at the end of the table weight deductions are allowed for boats with a transom height of 20 inches or less – and for a permanent fuel tank instead of a portable fuel tank.

For the example boat (with 120 HP engine, transom height over 20 inches, and permanent fuel tank) the (adjusted) Table 183.75, column nine number is 623 pounds. (Subpart E gives bonus sheets where the two allowed weight adjustments have been calculated.)

MPC = MWC – Table 183.75, column 9

MPC = 2000 – 623 = 1377 pounds

(Boat builder opts to down-rate to posted MPC of 1200 pounds to allow for 177 pounds of gear weight.)

Step 4: Compute persons capacity in whole numbers.

$$\text{Persons capacity (no.)} = \frac{32 + \text{persons capacity in lb.}}{141}$$

$$\text{Persons capacity (no.)} = \frac{32 + 1200}{141}$$

Persons capacity (no.) = 8.7 rounded up to 9

(But - boat builder opts to down-rate the number of persons in a whole number to 7.)

The resulting capacity label will show:

A manufacturer has ample freedom to rate the boat as he sees fit, as long as it does not exceed the maximum weight capacity and maximum powering limit. The parameters to be considered in the decision-making process are:

- How many intended occupant positions does the boat have?
- What is a reasonable number of persons to load this boat with?
- How much gear we should consider?
- How much added flotation will be required?
- Has the boat been performance-tested with heavy loads?
- What production variables must be accounted for?

Boat builders should show at least the Table 183.75, column 9 differential between the posted MWC and MPC figures. Further, boat builders are encouraged to allow for gear weight.

5.7 MAXIMUM WEIGHT CAPACITY FOR BOATS RATED FOR MANUAL PROPULSION AND BOATS RATED FOR OUTBOARD ENGINES OF 2 HP OR LESS

Many small boat builders have been mislead to think the capacity and flotation regulation do not apply to their boats. The rules do apply – and the Coast Guard does test such boats.

The boat displacement is determined in the exact same manner as the other two categories of boats. Since these boats do not operate at high speeds, the safe loading regulations allows more of their displacement to be used as maximum weight capacity.

Another point worth mentioning is that there are small "tunnel-hulled" boats sold as catamarans that will fall into this category, because their water-line or foot-print is a single line when loaded. These are most often used as dinghies or tenders. Many people do not consider them to fall under the applicability of this subpart of the law, but they do.
adopted from the ABYC Standard S-30 and became effective on June 1, 2018.

> Per 183.37 – the maximum weight capacity for boats rated for manual propulsion and boats rated for engines of 2 horsepower or less is determined as a function of the boat displacement and boat weight

As with the previous two boat categories, the MWC for this category of boats is calculated in a similar manner – with a lesser dividing number.

To make it simple, all manner of 'manually propelled' boats will be called rowboats.

One difference in this category of boats is that there is no ‘dry stability’ testing required for boats with a persons capacity of less than 550 pounds.

$$MWC = \frac{(\text{displacement} - \text{boat weight})}{3.33}$$

The formula is similar with the dividing number going from 7 for inboards to 5 for outboards over 2 HP and to 3.33 for rowboats and outboard of 2 HP or less.

5.8 MAXIMUM PERSONS CAPACITY: BOATS RATED FOR MANUAL PROPULSION AND BOATS RATED FOR OUTBOARD MOTORS OF 2 HORSEPOWER OR LESS

Per 183.43 – the persons capacity for rowboats and outboard of 2 HP or less is determined as a result of the maximum weight capacity – and whether the boat has that 2 HP engine or not.

The upper limit for persons capacity of a rowboat will be 90% of the MWC.

The upper limit for persons capacity of a 2 HP boat will be 90% of the MWC minus 25 pounds to allow for the engine weight.

MPC = 0.9 (MWC) for a rowboat

MPC – 0.9(MWC) – 25 for a 2 HP boat

As before the persons capacity in a whole number is determined by the formula:

$$\# \text{ Persons} = \frac{MPC + 32}{141}$$

Gear weight is determined by the calculation MWC – MPC – Table 183.75, column 9.   For rowboats there is no Table 183.75 figure – and MPC will always be at least 10% less than MWC – so rowboats will always have at least 10% MWC as gear weight. If the builder down-rates MPC further – the gear weight figure goes up.

[For 2 HP boats, the regulations did not change to refer to Table 183.75, so the 25 pound figure remains in the above formula for a 2 HP powered boats.]

5.9 EXAMPLE OF CALCULATIONS FOR MAXIMUM WEIGHT CAPACITY AND PERSONS CAPACITY: BOATS RATED FOR MANUAL PROPULSION AND BOATS RATED FOR 2 HORSEPOWER OR LESS (CATEGORY THREE)

For the purpose of this example we will assume a 14.5 ft. rowboat that has a transom capable of receiving an engine. The manufacturer has certified the boat for 2 HP.

In section 4.0, we discussed the methods to calculate maximum displacement. The assumed boat has a classic up-turned sheer and is sold as a rowing or low power outboard powered boat. The preferred methods to use in figuring displacement would be the immersion method or measuring a hull or mold and following Simpson's Rule. Following are the specifications:

Length overall:	14.5 ft.
Beam:	5.75 ft.
Boat weight:	600 lb.
Outboard engine:	2 HP
Engine weight:	25 lb.
Displacement	2808 pounds (by Simpson's Rule)

Step 1: Compute maximum displacement.

2808 pounds – found by Simpson's Rule

Step 2: Compute maximum weight capacity (MWC).

MWC = (maximum displacement – boat weight) /3.33

MWC = 3/10 (2808 lb. – 600 lb.) /3.33

MWC = 662pounds

(Boat builder opts to down-rate the MWC to the posted figure of 600 pounds.)

Step 3: Compute the persons capacity in pounds (lb.).

The boat may be used for rowing but it has a transom capable of carrying an outboard motor and the manufacturer has decided to rate the boat for 2 HP on the certification capacity label.

MPC = 90% MWC — 25 lb.

MPC = (.90 X 600) — 25 = 515 pounds

(Boat builder opts to down-rate MPC to 450 pounds to allow for additional gear weight.)

Step 4: Compute the persons capacity in whole numbers.

$$\# \text{ Persons} = \frac{\text{MPC (lb.)} + 32}{141}$$

$$\# \text{ Persons} = \frac{32 + 450}{141} = 3.4 \text{ rounded down to } 3$$

(Boat builder opts to down-rate the two-seat rowboat to 2 persons.)

The resulting capacity label will be:

U.S. COAST GUARD

MAXIMUM CAPACITIES

2 PERSONS OR 450 POUNDS

600 POUNDS, PERSONS, MOTOR, GEAR

2 HORSEPOWER, MOTOR

6.0 GEAR WEIGHT

Gear weight applies to all weight that is not considered for persons (for all boats) or for engines, controls, battery, and permanent fuel tank (for outboard powered boats). Gear weight includes things taken on the boat for fishing, hunting, work, and recreation. Gear weight includes things like anchors, fishing equipment, life jackets, tools, food & drink, and hunting gear. Gear weight does not include such things as trolling motor & battery, engine battery, and permanent attachments.

Although the regulation uses the term 'dead weight' for inboards/sterndrives, it has the same meaning as 'gear weight'. The term 'gear weight' is clearly more appropriate for recreational boats – and is used throughout the Boatbuilder's Handbook.

Gear weight is particularly important with respect to monohull boats under 20 feet in length as the flotation regulation requires that boat builders provide flotation material to support 25% of the gear weight.

6.1 Gear Weight Calculations

[For outboard powered boats]

Gear Weight is a quantity equal to the posted maximum weight capacity (MWC) minus the Table 183.75, Column 9 allowance for the weight of engine/controls/battery/fuel tank minus the posted maximum persons capacity (MPC).

MWC – Table 183.75 – MPC

[For inboard/sterndrive powered boats]

Gear Weight (as Table 183.75 does not apply) is a quantity equal to the MWC minus the MPC.

MWC – MPC

[For rowboats]:

Gear weight is the quantity equal to the posted MWC minus the posted MPC.

MWC – MPC

6.2 Gear Weight Considerations and Recommendations

Given the list of common items that are considered to be gear weight, good sense would dictate that any recreational boat should have some gear weight allowance. However, the current safety regulations permit an outboard or inboard/sterndrive boat manufacturer to display capacities that do not account for gear weight.

As the regulations specify that MPC = [0.9 x MWC – 25] for outboards powered by engines of 2 HP or less and MPC = [0.9 x MPC] for rowboats, these type boats will always have a gear weight of at least 10% of the MWC.

For outboard powered boats over 2 HP the USCG recommends that the posted capacity figures show at least the minimum differential required between the MWC and the MPC (as per Table 183.75, column 9). But - showing the exact differential means zero gear weight.

So, with respect to both outboards and inboards/sterndrives, the USCG strongly recommends that the posted capacity figures show at least some gear weight. A safety minded manufacturer will include an amount of gear weight appropriate for the boat type and likely usage.

Some boats even have a negative gear weight, when the calculation of MWC – Table 183.75 – MPC results in a negative number. This may be a result of the June 1, 2018 switch from old CFR Table 4 to new CFR Table 183.75 with higher engine weights contributing to a higher column 9 minimum MWC/MPC differential – but with no adjustments of the previously posted capacity figures.   When a USCG inspection finds such a case, a notice of noncompliance will be issued and the manufacturer must then prove through testing or calculations that the boat can be rated for a higher 'test' maximum weight capacity than the posted MWC figure.

6.3 Example Gear Weight Calculations

[Using the previous examples from this chapter for the three boat types:]

[Outboard]

The example outboard had a MWC of 2000 pounds / MPC of 1200 pounds / 120 HP limit / > 20 inch transom height / permanent fuel tank.

The Table 183.75, column 9 figure is 623 pounds.

Gear weight = MWC – Table 183.75 – MPC = 2000 – 623 – 1200 = 177 pounds.

[Inboard/sterndrive]

The example sterndrive had a posted MWC of 1400 pounds and a down-rated MPC of 1300 pounds.

Gear weight = MWC – MPC = 1400 – 1300 = 100 pounds.

[Rowboat}

Given a rowboat with a posted MWC of 600 pounds and 540 pounds.

Gear weight = MWC – MPC = 600 – 540 = 60 pounds.

{As noted, for rowboats, gear weight will always be at least 10% of the posted MWC.}

Appendix 1. 33 CFR 183 Subpart C – Safe Loading

§ 183.31 Applicability.

This subpart applies to monohull boats less than 20 feet in length except sailboats, canoes, kayaks, and inflatable boats.

§ 183.33 Maximum weight capacity: Inboard and inboard-outdrive boats.

(a) The maximum weight capacity (W) marked on a boat that has one or more inboard or inboard-outdrive units for propulsion must not exceed the greater value of W obtained from either of the following formulas:

W=(maximum displacement)5−boat weight5−4(machinery weight)5orW=(maximum displacement−boat weight)7W=(maximum displacement)5−boat weight5−4(machinery weight)5orW=(maximum displacement−boat weight)7

(b) For the purposes of paragraph (a) of this section:

(1) "Maximum displacement" is the weight of the volume of water displaced by the boat at its maximum level immersion in calm water without water coming aboard. For the purpose of this paragraph, a boat is level when it is transversely level and when either of the two following conditions are met:

(i) The forward point where the sheer intersects the vertical centerline plane and the aft point where the sheer intersects the upper boundary of the transom (stern) are equidistant above the water surface or are equidistant below the water surface.

(ii) The most forward point of the boat is level with or above the lowest point of water ingress.

(2) "Boat weight" is the combination of:

(i) Hull weight;

(ii) Deck and superstructure weight;

(iii) Weight of permanent appurtenances; and

(iv) Weight of full permanent fuel tanks.

(3) "Machinery weight" is the combined weight of installed engines or motors, control equipment, drive units, and batteries.

§ 183.35 Maximum weight capacity: Outboard boats.

(a) The maximum weight capacity marked on a boat that is designed or intended to use one or more outboard motors for propulsion must be a number that does not exceed one-fifth of the difference between its maximum displacement and boat weight.

(b) For the purposes of paragraph (a) of this section:

(1) "Maximum displacement" is the weight of the volume of water displaced by the boat at its maximum level immersion in calm water without water coming aboard except for water coming through one opening in the motor well with its greatest dimension not over 3 inches for outboard motor controls or fuel lines. For the purpose of this paragraph, a boat is level when it is transversely level and when either of the two following conditions are met:

(i) The forward point where the sheer intersects the vertical centerline plane and the aft point where the sheer intersects the upper boundary of the transom (stern) are equidistant above the water surface or are equidistant below the water surface.

(ii) The most forward point of the boat is level with or above the lowest point of water ingress.

(2) "Boat weight" is the combination of:

(i) Hull weight;

(ii) Deck and superstructure weight;

(iii) Weight of permanent appurtenances; and

(iv) Weight of full permanent fuel tanks.

§ 183.37 Maximum weight capacity: Boats rated for manual propulsion and boats rated for outboard motors of 2 horsepower or less.

(a) The maximum weight capacity marked on a boat that is rated for manual propulsion or for motors of 2 horsepower or less must not exceed 3/10 of the difference between the boat's maximum displacement and the boat's weight in pounds.

(b) For the purposes of paragraph (a) of this section:

(1) "Maximum displacement" is the weight of the volume of water displaced by the boat at its maximum level immersion in calm water without water coming aboard. For the purpose of this paragraph, a boat is level when it is transversely level and when either of the two following conditions are met:

(i) The forward point where the sheer intersects the vertical centerline plane and the aft point where the sheer intersects the upper boundary of the transom (stern) are equidistant above the water surface or are equidistant below the water surface.

(ii) The most forward point of the boat is level with or above the lowest point of water ingress.

(2) "Boat weight" is the combination of:

(i) Hull weight;

(ii) Deck and superstructure weight; and

(iii) Weight of permanent appurtenances.

§ 183.39 Persons capacity: Inboard and inboard-outdrive boats.

(a) The persons capacity in pounds marked on a boat that is designed to use one or more inboard engines or inboard-outdrive units for propulsion must not exceed the lesser of:

(1) The maximum weight capacity determined under § 183.33 for the boat; or

(2) For boats with a maximum persons capacity less than 550 pounds, the maximum persons capacity determined in the following manner:

(i) Float the boat in calm water with all its permanent appurtenances, including installed engines, full fuel system and tanks, control equipment, drive units and batteries.

(ii) Gradually add weights along one outboard extremity of each passenger carrying area, at the height of the seat nearest the center of that area, but no higher than the height of the gunwale and distributed equally forward and aft of that center in a plane parallel to the floorboards, until the boat assumes the maximum list or trim or both, without water coming aboard.

(iii) Compute the persons capacity in pounds in the following formula: Persons capacity = A/0.6 where A is the total of the weights added in paragraph (a)(2)(ii) of this section.

(b) The maximum persons capacity in whole numbers of persons marked on a boat that is designed or intended to use one or more inboard engines or inboard-outboard units must not exceed the value obtained by adding 32 pounds to the value determined in paragraph (a)(2)(iii), dividing the sum by 141 and rounding off the result to the nearest whole number. If the fraction is less than one-half, round down to the next whole integer and if the fraction is equal to or greater than one-half, round up to the next higher whole integer.

§ 183.41 Persons capacity: Outboard boats.

(a) The persons capacity in pounds marked on a boat that is designed to use one or more outboard motors for propulsion must not exceed the lesser of:

(1) The maximum weight capacity determined under § 183.35 for the boat minus the motor and control weight, battery weight (dry), and full portable fuel tank weight required by § 183.75; or

(2) For boats with a maximum persons capacity less than 550 pounds, the maximum persons capacity determined in the following manner:

(i) Float the boat with all its permanent appurtenances.

(ii) Add, in normal operating positions, the dry motor and control weight, battery weight, and full portable fuel tank weight, if any, required by § 183.75 for the maximum horsepower capacity marked on the boat. Permanently installed fuel tanks shall be full of fuel.

(iii) Gradually add weights along one outboard extremity of each passenger carrying area, at the height of the seat nearest the center of that area, but no higher than the height of the gunwale, and distributed equally forward and aft of that center in a plane parallel to the floorboards until the boat assumes the maximum list or trim, or both without water coming aboard.

(iv) Compute the persons capacity in pounds using the following formula: Persons capacity = A/0.6 where A is the total of the weights added in paragraph (a)(2)(iii) of this section.

(b) The maximum persons capacity in whole numbers of persons marked on a boat designed or intended to use one or more outboard motors for propulsion must not exceed the value obtained by adding 32 pounds to the lesser of the values determined in paragraph (a)(1) or (a)(2)(iv), dividing the sum by 141, and rounding off the result to the nearest whole number. If the fraction is less than one-half, round down to the next lower whole integer and if the fraction is equal to or greater than one-half, round up to the next higher whole integer.

§ 183.43 Persons capacity: Boats rated for manual propulsion and boats rated for outboard motors of 2 horsepower or less.

(a) The persons capacity in pounds marked on a boat that is rated for manual propulsion or for motors of 2 horsepower or less must not exceed:

(1) For boats rated for manual propulsion, 90 percent of the maximum weight capacity in pounds; and

(2) For boats rated for motors of 2 horsepower or less, 90 percent of the maximum weight capacity in pounds, less 25 pounds.

(b) The maximum persons capacity, in whole numbers of persons marked on a boat that is rated for manual propulsion must not exceed the value obtained by adding 32 pounds to the value determined in paragraph (a)(1), dividing the sum by 141, and rounding off the result to the nearest whole number. If the fraction is less than one-half, round down to the next lower integer and if the fraction is equal to or greater than one-half, round up to the next higher whole integer.

(c) The maximum persons capacity in whole numbers of persons marked on a boat rated for motors of 2 horsepower or less must not exceed the value obtained by adding 32 pounds to the value determined in paragraph (a)(2), dividing the sum by 141, and rounding off the result to the nearest whole number. If the fraction is less than one-half, round down to the next lower whole integer and if the fraction is equal to or greater than one-half, round up to the next higher whole integer.