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Marine Safety Center Technical Note

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MARINE SAFETY CENTER TECHNICAL NOTE (MTN) NO. 1-08, CH-2

Subj: Marine Safety Center Review of Rigid Hull Inflatable and Rigid Hull Foam Collar Vessels

Ref:
(a) Title 46 CFR Subchapter T - Small Passenger Vessels (Under 100 Gross Tons)
(b) Title 46 CFR Subchapter S - Subdivision and Stability
(c) Marine Safety Center Technical Note 04-95, CH-2 "Lightship Change Determination; Weight-Moment Calculation vs. Deadweight Survey vs. Full Stability Test," dated January 11, 2016
(d) Marine Safety Manual (MSM), Vol IV
(e) Navigation and Inspection Circular No. 14-81, CH-1, "Stability Tests; Waiving of for 'Sister Vessels,'" dated December 2, 1981
(f) ASTM Standard F1321 "Standard Guide for Conducting a Stability Test (Lightweight Survey and Inclining Experiment) to Determine the Lightship Displacement and Centers of Gravity of a Vessel."
(g) ASTM Standard F3052-14 "Standard Guide for Conducting Small Boat Stability Test (Deadweight Survey and Air Inclining Experiment) to Determine the Lightcraft Weight and Center of Gravity of Small Craft."
(h) Navigation and Inspection Circular No. 17-91, CH-1, "Guidelines for Conducting Stability Test," dated November 4, 1991
(i) MSC Guidelines for Submission of Stability Test Procedures, PRG GEN-05
(j) American Boat & Yacht Council, Inc. Hull Division Standard ABYC H-4 "Cockpit Drainage Systems," July 2008

1. Purpose: This Marine Technical Note (MTN) provides an alternative design standard equivalent to certain regulatory requirements in references (a) and (b) for Rigid Hull Inflatables (RHI) and Rigid Hull Foam Collar (RHFC) vessels. Unless stated otherwise, the acronym "RHI" will be used in this MTN to describe both Rigid Hull Inflatable and Rigid Hull Foam Collar vessels. This MTN is not the only means of demonstrating compliance, and MSC will consider other comprehensive engineering-based alternative design standards which provide an equivalent level of safety to the requirements of references (a) and (b).

2. Summary of Changes: Change 2 of this MTN clarifies acceptable drainage criteria, adjusts the minimum collar material properties, and clarifies stability criteria.

3. Applicability: This MTN applies to RHIs which:

   a. are constructed of a rigid hull;
   b. are less than 65 feet in length;
   c. carry 49 or fewer passengers in domestic service on any route;
   d. have collar volume of at least 60% of the full-load displaced volume; and
   e. have collars constructed with air-filled chambers or buoyant foam.

4. Discussion: The alternative design standard presented in this MTN provides consideration of the unique stability and structural characteristics of RHIs. These guidelines do not preclude the Officer in Charge, Marine Inspection (OCMI) from approving RHI structures and stability or applying alternative requirements or restrictions. Specifically, the OCMI retains authority regarding structures and stability as follows:

   a. Hull Structure: Satisfactory service per 46 CFR 177.310, or OCMI judgement per 46 CFR 177.315; and
   b. Stability: Simplified Stability Test (SST) per 46 CFR 178.320, or operational tests per 46 CFR 178.320(c). If an SST is performed, the RHI should be considered an open boat.

5. Action: Submitters should clearly state that the vessel satisfies the alternative design standard of this MTN and request MSC review. In addition, submissions should:

   a. follow the design and calculation guidelines presented in Enclosure (1); and
   b. include the submission checklist, Enclosure (2).

6. Disclaimer: While the guidance contained in this document and Enclosure (1) may assist the industry, the public, the Coast Guard, and other Federal and State agencies in applying statutory and regulatory requirements, this guidance is not a substitute for the applicable legal requirements, nor is it in itself a regulation. It is not intended to, nor does it impose legally binding requirements on any party, including the Coast Guard, other Federal agencies, the States, or the regulated community.

S. J. KELLY

Encl: (1) Alternative Design Standards for Certain Rigid Hull Inflatable and Rigid Hull Foam Collar Vessels Certificated under 46 CFR Subchapter T
(2) Marine Safety Center Review of Rigid Hull Inflatable and Rigid Hull Foam Collar Vessels - Submission Checklist

Copy: Commandant (CG-ENG), Office of Design and Engineering Standards
Commandant (CG-CVC), Office of Commercial Vessel Compliance
Commandant (CG-5P-TI), Office of Quality Assurance and Traveling Inspections

Alternative Design Standards
for Certain Rigid Hull Inflatable and Rigid Hull Foam Collar Vessels
Certificated under 46 CFR Subchapter T

Contact Information:

If you have any questions or comments concerning this document, please contact the Marine Safety Center by e-mail or phone. Please refer to Marine Safety Center Technical Note 1-08.

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Encl: (1)

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1.0 Definitions

Breadth
The extreme width of the vessel measured between the outer surfaces of the inflated collar.

Collar Volume
The volume of the collar (when inflated to the design pressure) measured in cubic feet. See Section 4.1 and Section 4.3 for minimum collar volume and subdivision requirements, respectively.

Displaced Volume
The volume of water displaced by the vessel measured in cubic feet. This is equal to 35 times the vessel's displacement in long tons or the vessel's displacement in pounds divided by 64.

Hull Confines
The internal portions of the vessel bounded by the molded lines of the rigid hull and the inboard surfaces of the buoyant collar, extending vertically upward to the top of the collar.

Hull Internal Buoyant Volume
The volume, measured in cubic feet, provided by inherently buoyant compartments as defined below. Compartments linked by piping, pipe chases, and conduit will be considered as one larger compartment. This may be mitigated by installation of appropriate devices which provide watertight integrity between bulkheads and bulkhead penetrations. The collar and any tanks with consumable liquids (e.g. fuel, water) are not included in the hull internal buoyant volume. See Section 4.1 for the required hull internal buoyant volume.

Inherently Buoyant Compartments
Hull compartments that are sealed and unvented. Compartment access hatches should be watertight. In some cases, compartment vents and a bilge system may be fitted if compartment vents have non-return devices and the bilge system has positive-shutoff and non-return valves.

Flotation foam and independent air tanks installed in vented compartments may be counted towards the required hull internal buoyant volume.

Least Freeboard
The minimum vertical distance measured from the waterline to the top of the collar or transom (whichever is lower). The location of the least freeboard may shift longitudinally as the vessel trims. Note that the location of the top of the collar will change as the vessel heels.

Length
The overall distance measured from the forward outboard surface of the inflated collar to the after end of the collar, including any portions of the collar forward of the rigid stem and aft of the transom.

Swamping
A condition where seawater spills over the collar top or transom into the hull confines. Inherently buoyant compartments are not subject to swamping.

Swamped Condition
An equilibrium condition calculated after swamping the hull confines until seawater spills out of the RHI over the transom or top of the collar. Equilibrium is achieved by allowing RHIs to freely trim and heel. Any deck scuppers or drains are considered to be closed or plugged in this condition.

2.0 OCMI Consideration

2.1 Allowable Route
The allowable route, and any associated operating restrictions, must be established by the OCMI and communicated to MSC prior to review.

2.2 Seated Passengers
Proposals and requests to assume, in design calculations, that passengers will remain seated at all times should be directed to the OCMI. Any passenger seating restrictions should be included on the vessel's COI.

3.0 Construction

3.1 Structures
MSC accepts the following rule sets for the structural design of RHIs:

a. ABS High Speed Craft Guide;
b. ABS Rules for Fiber Reinforced Plastic Vessels;
c. DNV GL High Speed Light Craft;
d. Lloyds Special Service Craft.

Requests to use other rule sets should be addressed to the Chief, Small Vessel Branch.

In addition, the collar and its connection to the hull must be shown to have adequate strength as prescribed in Section 3.2.

3.2 Collars
MSC will accept collars meeting the following criteria.

3.2.1 Inflatable Collars

3.2.1.1 Materials and Material Properties
Inflatable collars should be fabricated from commercial marine grade polyurethane, polyvinyl chloride (PVC), or rubber. Depending upon the material, the seams should be glued or thermo-bonded to make the collars airtight.

The collar's material properties should be measured by an independent laboratory according to the test procedures of ASTM D751-06. The minimum properties are as follows:

a. Breaking/Tensile Strength: 500 lbs/in (warp and fill directions) [Procedure B];
b. Adhesion Strength: 15 lbs/in;
c. Tearing Strength: 50 lbs (warp and fill directions) [Procedure B];
d. Puncture Resistance: Screwdriver 180 lbs.

3.2.1.2 Relief Valves

Each collar compartment should be fitted with one or more relief valves. The relief valve pressure setting and the minimum strength in the collar are related through the hoop stress equation detailed below. This relationship provides a minimum safety factor of 10. Since most woven fabrics have different properties in the warp and fill directions, the breaking or tensile stress used below should reflect the fabric layout of the collar.

$$\sigma_{crit,min} \geq 10 \times \left(\frac{P_r \times D}{2 \times t}\right)$$

Where:

$\sigma_{crit,min}$ = Breaking/tensile stress in the warp or fill direction (as described above) in psi
P_r = Relief valve setting in psi
D = Collar diameter in inches
t = Collar fabric thickness in inches

3.2.2 Foam Collars

Foam collars must be constructed of marine grade closed-cell foam that is durable, abrasion resistant, impact resistant, non-absorbing, and UV resistant. The requirement for UV resistant foam may be dispensed with if the foam is covered in a fabric meeting the material properties of Section 3.2.1.1.

3.2.3 Collar to Hull Connection

Common commercial collar-hull connection methods include chemical adhesion (glued) and mechanically fastened (such as bolt ropes and fastener/flat bar clamps). These connection methods typically require local reinforcement of the collar material and the hull in way of the connection. Calculations must be submitted to demonstrate that the collar connections and breaking/tensile strength of the collar material have a safety factor of at least 3.33 based upon the design collar loading. Collar loading should be computed using the following equation:

$$F_{Crit} \geq 3.33 \times P_D \times W_S$$

Where:

F_{Crit} = breaking strength (glued) or yield strength (mechanical) of the collar connection in pounds / inch
P_D = greatest design hull bottom plating pressure (including slamming pressure) in psi.

W_S = horizontal distance that the collar extends outboard from the rigid hull in inches

3.3 Fire Protection
All subchapter T vessels must meet the structural fire protection standards of 46 CFR Part 177 Subpart D.

3.3.1. Fiberglass (FRP) Hulls
Internal gasoline fuel tanks may only be fitted on RHIs constructed using fire retardant resin in accordance with 46 CFR 177.410(d)(2).

3.3.2 Collar Materials
Inflatable and cellular foam collars may be constructed of combustible materials provided that they are not in close proximity to a source of ignition.

4.0 Compartmentation and Buoyancy

4.1 Minimum Collar Volume and Required Hull Internal Buoyant Volume
The following volume requirements apply to the collars and inherently buoyant compartments:

$$V_C \geq 21 \times \Delta_{FL}$$

$$V_{IB} \geq V_{IB,min} = 40.25 \times \Delta_{FL} - 0.7 \times V_C$$

Where:

V_C = collar volume in cubic feet
Δ_{FL} = full-load displacement of the vessel in long tons
V_{IB} = actual hull internal buoyant volume in cubic feet
$V_{IB,min}$ = minimum hull internal buoyant volume in cubic feet

The above formulas reflect the following limits:

a. The hull internal buoyant volume must exceed 73% of the full-load displaced volume.
b. The collar volume must exceed 60% of the full-load displaced volume.

4.2 Compartmentation of Hull Internal Buoyant Volume
To maintain hull internal buoyant volume in the event of damage, each inherently buoyant compartment should be no more than 15% of the hull internal buoyant volume (V_{IB}) calculated in Section 4.1 above. This relationship is demonstrated in the following equation:

$$V_{comp} \geq 0.15 \times V_{IB,min}$$

Where:

V_{comp} = volume of any single inherently buoyant compartment, or linked inherently buoyant compartments in cubic feet
$V_{IB,min}$ = minimum hull internal buoyant volume in cubic feet

The volume of inherently buoyant compartments may be reduced by foam flotation, independent air tanks, or similar means. Foam floatation material shall meet the requirements of 46 CFR 179.240. In accordance with 46 CFR 179.240(b)(8), and to account for the porosity of the foam, the "effective volume" of any foam floatation materials shall be 86% of the actual volume as demonstrated in the following equation:

$$V_{Eff} = 0.86 \times V_{Foam}$$

Where:

V_{Eff} = effective volume of foam flotation in cubic feet
V_{Foam} = actual volume of foam flotation in cubic feet

4.3 Compartmentation of Collar Volume

Inflatable collars should be subdivided with the minimum total number of collar compartments as follows:

Vessel Length in Feet	Minimum Number of Collar Compartments
$L \leq 30$	4
$30 < L \leq 40$	6
$40 < L \leq 50$	8
$50 < L \leq 65$	10

The vessel may have an even or odd number of collar compartments. Each collar compartment must be approximately the same volume in accordance with the equation below:

$$\text{Compartment Volume} = \frac{V_C}{N} \pm 20\%$$

Where:

V_C = collar volume in cubic feet
N = actual number of collar compartments

Collar compartments should not be less than 6 feet in length.

4.4 Bilge System

Sealed and unvented hull compartments used to satisfy the swamped condition stability requirements, specified in Section 5.4.1 below, are exempt from the fixed bilge pumping requirements in accordance with 46 CFR 182.500(c).

Vented void hull compartments fitted with internal buoyancy components which occupy more than 90 percent of the compartment volume can similarly be exempted from fixed bilge system requirements. The effective volume of foam should be calculated in accordance with 46 CFR 179.240(b)(8) as described in Section 4.2.

Although bilge pumping systems are not required on certain RHIs, these systems may be fitted provided that they comply with the guidance in this MTN and 46 CFR 182 Subpart E – Bilge and Ballast Systems. If bilge system piping passes through a watertight bulkhead needed for compliance with the compartmentation requirements of Section 4.2 of this MTN, bulkhead penetrations should provide the same level of watertight integrity as the watertight bulkhead. Bulkheads needed for internal buoyancy should be clearly identified on all bilge system plans.

Both vented and sealed hull compartments must have openings, fitted with watertight covers, which permit internal inspection and provide access for a portable bilge pump suction hose.

5.0 Stability

The vessel's stability must comply with all of the stability requirements of this section. When applying these criteria, the vessel should be free to trim as it heels unless noted otherwise in this section. In addition, the righting arm analysis should be computed at frequent heel intervals (2 degrees or less) to capture the effects of an RHI's unique waterplane and potential for swamping.

5.1 Stability Test Procedure

In accordance with 46 CFR 170.085, a written stability test procedure must be sent to MSC at least two weeks before the stability test. Reference (f) and reference (i) provide guidance on the required elements for this procedure. If a deadweight survey is to be conducted, a conservative VCG should be indicated in the procedure and approved prior to the test. In all cases, the procedure shall be approved by MSC prior to conducting the test. Vessel owners or representatives shall make arrangements with the OCMI for a Coast Guard representative to witness the stability test in accordance with 46 CFR 170.175(b).

5.2 Stability Test

Lightship characteristics are to be determined using one of the following methods:

a. Sister to a vessel with known characteristics (Section 6.D.2 of reference (d) and reference (e));
b. Deadweight survey combined with an indisputably conservative assumed vertical center of gravity (VCG) height approved prior to the test (references (f) through (h)); or
c. Inclining (full stability test) (references (f) through (h)).

Many RHIs have a relatively narrow rigid hull, and the maximum passenger count is sensitive to the lightship vertical center of gravity (VCG). Since an inclining experiment (in-water or in-air) measures a vessel's VCG, these experiments are recommended for RHIs in lieu of conducting a deadweight survey and assuming an indisputably-conservative (high) VCG.

The submission of deadweight survey or inclining results should be submitted in accordance with reference (i). Ensure that any transverse center of gravity (TCG) and associated list is included in the lightship characteristics.

5.2.1 In-Water Inclining

To prevent large changes in the RHI's waterplane (due to collar or chine submergence or emergence), it may be necessary to limit the maximum heel angle during an inclining. In these instances, the pendulum length must be proportionally increased to ensure that the required 6 inch pendulum deflection, to each side, is obtained. Trimming weights may be placed at the start of the in-water inclining if necessary to prevent large changes to the vessel's waterplane. Ensure that the stability test procedure adequately addresses management of the vessel's waterplane and the use of any trimming weights.

5.2.2 Air Inclining

To eliminate the waterplane issues discussed above, an air inclining experiment in accordance with references (g) and (i) may be conducted. As these experiments are highly sensitive to the test configuration, strict compliance with the guidance of references (g) and (i) is necessary.

5.3 Passenger and Crew Weight and Vertical Center of Gravity

5.3.1 Weight

The current assumed average weight per person in 46 CFR 170.090(d)(i) shall be used as a minimum value. As of the publication date on this MTN, the assumed average weight per person (passenger and crew) shall be no less than 185 pounds.

5.3.2 Vertical Center of Gravity

Passengers and crew should be assumed to be standing with a vertical center of gravity (VCG) of at least 39 inches above the deck unless the OCMI approves operational restrictions specifying that passengers must remain seated at all times while underway.

The VCG for all passengers assumed to be seated in design calculations (see Section 2.2), must be at least 12 inches above the seat or collar.

5.4 RHI Specific Criteria

In addition to the criteria of 46 CFR 170.170, 170.173, and 171.050, as modified in Sections 5.5 through 5.7 below, calculations must demonstrate that the vessel complies with the following provisions.

5.4.1 Swamping Criteria

The following must be satisfied when an intact RHI becomes swamped, or partially swamped, in any condition of loading.

a. The point of least freeboard must not submerge in the static condition;
b. There should be no appreciable change in vessel heel;

c. The range of positive stability beyond equilibrium must be at least 5 degrees for protected waters, 10 degrees for partially protected waters, and 15 degrees for exposed waters;
d. There must be at least 2.82 foot degrees of righting energy from the equilibrium heel angle to the angle of vanishing stability; and
e. The maximum righting arm must be at least 0.33 feet.

5.4.2 Collar Puncture Criteria (Inflatable Collars Only)
Calculations must demonstrate that the vessel satisfies items 5.4.1 c. through e. above with any one collar compartment deflated (non-buoyant). The collar top may be submerged at any point when a collar compartment is deflated, but the equilibrium heel angle cannot exceed 10 degrees.

5.4.3 Passenger Crowding
a. Apply a passenger crowding heeling moment as follows:

i. For vessels equipped with a suitable railing, distribute the total number of passengers along the railing, at one side of the vessel, with a distribution of 2.0 square feet per person;
ii. If suitable passenger railings are not installed, the passenger weight should first be distributed by modeling passengers seated with a TCG along the extreme breadth of the collar, on one side of the vessel, at a width of 18 inches per person and a VCG of 12 inches above the collar;
iii. Remaining passengers must be crowded, and considered standing, up to the inboard side of the collar with a distribution of 2.0 square feet per person; and
iv. Analyze any condition where fewer passengers creates a worst-case heeling condition.

b. For each condition of loading and operation the vessel must exhibit the following stability characteristics in the heeled condition:

i. GM of 1.0 foot or greater;
ii. A range of positive stability of at least 10 degrees beyond the equilibrium heel angle.

5.4.4 Drainage
Each RHI must be equipped with efficient means of pumping or draining water from the deck and well while at rest. Due to the additional buoyancy and swamping standards in this MTN, drainage does not need to meet the requirements of 46 CFR 178.450. Instead, calculations must demonstrate that the fully loaded vessel in the swamped condition will drain and/or can be mechanically pumped such that 75% of the entrained water is removed from the vessel within 90 seconds. These calculations are based on the criteria used to assess the proof test outlined in reference (j).

When demonstrating compliance with this section, consideration should be given to the following:

a. If the drains are below the waterline at any point throughout the draining process, the external sea pressure acting against the drainage must be considered; and
b. If the vessel trims by the bow at any point throughout the draining process, any reduction in the drainage rate must be considered.

Any drainage openings in the transom should be fitted with non-return devices.

5.5 Subchapter S 170.170 Weather Criteria

5.5.1 Projected Lateral Area

The projected lateral area for 46 CFR 170.170 calculations shall include all areas under, or enclosed by, railings and canopies. In addition, a rectangular profile should be included to represent standing passengers. The length of the rectangular profile should extend to the extents of the decks accessible to passengers and crew and the height should be 6 feet above the deck for standing passengers and 4 feet 6 inches above the deck for seated passengers. The height of the projected lateral area for any seated passengers (see Section 2.2) may be modified depending on the vessel's seating arrangement. Any overlapping areas of rectangles need only be counted once. Rectangles or silhouettes representing individual persons will not be accepted.

5.5.2 Application – General

The value of the angle "T" is to be the smaller of 14 degrees or the heel angle resulting from submerging 3/8 of the least freeboard (instead of 1/2 of the least freeboard). For the above calculations, vessel trim should remain fixed at the initial value as the vessel heels.

5.5.3 Application – Alternative

Apply the wind heeling moment of 46 CFR 170.170, calculated as follows:

$$\text{Heeling Moment} = P \times A \times H$$

Where: P, A, and H are defined in 46 CFR 170.170.

In each condition of loading, the vessel's equilibrium heel angle resulting from the application of this moment must be less than the angle of T defined in Section 5.5.2.

5.6 Subchapter S 170.173 Criteria

When demonstrating compliance with 46 CFR 170.173, the calculations must consider the possibility of swamping as the vessel heels. The calculations must show that the vessel satisfies the criteria.

5.7 Subchapter S 171.050 Passenger Heel

5.7.1 Passenger Freedom of Movement

Unless railings are installed at the inboard sides of the collars, the collars should be included when calculating the geometric center of the passenger deck of 46 CFR 171.050.

5.7.2 Application - General
The value of the angle "T" is to be the smaller of 14 degrees or the heel angle resulting from submerging 3/4 of the least freeboard (instead of the least freeboard). For these calculations, vessel trim should remain fixed at the initial value as the vessel heels.

5.7.3 Application – Alternative
Apply the passenger heeling moment of 46 CFR 171.050, calculated as follows:

$$\text{Heeling Moment} = \frac{2}{3} \times W \times b$$

Where: W and b are defined in 46 CFR 171.050.

For these calculations, the vessel should be free to trim. In each condition of loading, the vessel's equilibrium heel angle resulting from the application of this moment must be less than the angle of T defined in Section 5.7.2.

5.8 Changes in the Vessel's Lightship Characteristics
Minor changes to a vessel's lightship characteristics may have major implications for compliance with the alternative design standards of this MTN. Changes to the vessel after MSC approval should be documented in accordance with reference (c). When indicated, calculations should be submitted demonstrating that the RHI satisfies the hull internal buoyancy, collar buoyancy requirements, and any other affected criteria of this MTN.

6.0 Submissions to MSC

Detailed documentation, plans, and calculations allow MSC to efficiently verify compliance with the guidelines of this MTN. Submitters should discuss the intended operations, any restrictions, and requests for special consideration with their OCMI early in the design process, and document such items in submissions to MSC. Construction (Section 3) and Compartmentation and Buoyancy (Section 4) plans and calculations should be submitted prior to construction. If desired, Stability (Section 5), using assumed lightship characteristics and preliminary loading conditions calculations, may be submitted to MSC before the vessel's construction is complete. These calculations should be clearly marked "preliminary." During final review, MSC will consider the totality of the design and verify that the characteristics of the as-built vessel satisfy the requirements of this alternative design standard. MSC recommends using conservative assumptions during the design process and including design margins for compliance with these Alternative Design Standards. In addition, MSC recommends using the submission checklist, Enclosure (2) to this MTN.

Marine Safety Center Review of Rigid Hull Inflatable Vessels Submission Checklist

Plans and calculations for vessels designed to the alternative standards in this MTN require MSC review and approval. The following items should be included in the submittal package:

1. Letter of intent identifying what is included in the submittal and requested actions to be taken by the Marine Safety Center, including a request for MSC to evaluate the design to the alternative design standards of MTN 01-08.

2. Copy of Application for Inspection submitted to the OCMI. If passengers will be seated at all times or seated on the collar, this restriction should be noted on the Application for Inspection.

3. Description of the vessel operating envelope, including route designation and classification, number of passengers, total persons carried, and any operating limits and/or restrictions previously provided (such as maximum draft, trim, wave height, speed, geographical boundaries, passenger restrictions, etc).

4. All plausible loading conditions for each particular operation of the vessel.

5. Computerized hull model (with compartmentation, collars, cockpit, etc.) should be included in the submission. Otherwise, the submitted plans must provide sufficient detail to permit accurate modeling of the collar, rigid hull, and the internal hull and collar compartments.

6. Lines plan of the hull to at least the bulkhead deck.

7. Hydrostatics or curves of form and righting arm curves (tabulated data may be accepted).

8. Tank capacity tables including liquid volume or weight, center of gravity location, and free surface factor for relevant tank filling levels.

9. General arrangement and relevant plans showing:
   a. Outboard Profile;
   b. Compartmentation (at least plan and profile views);
   c. Location and extent of bulkhead deck;
   d. Location and extent of watertight bulkheads including collision bulkhead;
   e. Watertight and weathertight doors, hatches, scuttles, and similar closures;
   f. Weather deck freeing port and/or scupper sizes and locations (as applicable);
   g. Downflooding points and other openings into the hull such as vents or windows;
   h. Locations and reference points of any draft or loading marks. See 46 CFR 185.602(b) and (c), and reference (d), Section 6.B.6.

10. Fixed ballast plan or written ballast description (if applicable): Ensure that fixed ballast shown on ballast plan or written ballast description matches the fixed ballast used in lightship calculation.

11. Approved lightship values or stability test lightship calculation.

Encl: (2)

12. Construction and arrangement plans and design calculations:
    a. Seating arrangement;
    b. Inflatable or rigid collar properties;
    c. Hull internal buoyancy;
    d. Collar volume;
    e. Inflatable collar compartmentalization;
    f. Connection of the collar to the hull.

13. Stability calculations:
    a. Swamping Criteria (Section 5.3.1);
    b. Collar Puncture Criteria (Inflatable Collars Only) (Section 5.3.2);
    c. Passenger Crowding (Section 5.3.3);
    d. 46 CFR 170.170 Weather criteria (Section 5.4);
    e. 46 CFR 170.173 criteria for vessels of unusual proportion and form (Section 5.5);
    f. 46 CFR 171.050 Passenger heel requirements (Section 5.6).

14. Collision bulkhead calculations (if applicable).

15. Foam flotation material information (if applicable).

16. Drainage plan and supporting calculations.

17. Bilge system plan (if applicable)