



REVIEW OF GAS CARRIER/BARGE STRUCTURES

Procedure Number: C1-32

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A handwritten signature in blue ink that reads "E. J. Newton".

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Purpose

To establish a process for requesting structural plan review approval for a gas carriers/independent pressure tank barges regulated under 46 CFR, Subchapters O, I, and/or D.

Contact Information

If you have any questions or comments concerning this document, please contact the Marine Safety Center (MSC) by e-mail or phone. Please refer to Procedure Number C1-32.

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1. Applicability

This Plan Review Guideline (PRG) is applicable to gas carriers and tank barges carrying liquefied gases in independent pressure tanks.

2. Instructions

Using applicable portions of references (a) through (k), the submitter shall provide sufficient documentation and plans to indicate compliance with the applicable requirements. The submission shall be made electronically to the above email address or, if paper, in triplicate to the MSC's address found on the above website. To facilitate plan review and project management, all plans and information specified in these guidelines should be submitted as one complete package through a single point of contact for the project.

3. References

- a. 46 CFR Subchapter D
- b. 46 CFR Subchapter I
- c. 46 CFR Subchapter O
- d. IGC Code, International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk
- e. [ABS Rules for Building and Classing Steel Vessels, 2010, Part 5C](#)
- f. International Convention for the Safety of Life at Sea, 1974, and its Protocol of 1998 (SOLAS), as amended
- g. [ABS Rules for Building and Classing Steel Barges](#)
- h. [ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways](#)
- i. [Ship Structure Committee \(SSC\) report SSC-205, "Structural Design Review of Longitudinal, Cylindrical, Liquid-filled Independent Cargo Tank Barges", 1970](#)
- j. [Navigation and Vessel Inspection Circular \(NVIC\) No. 1-98, Loading Considerations for Existing Inland Tank Barges](#)
- k. [Navigation and Vessel Inspection Circular \(NVIC\) No. 7-68, Notes on Inspection and Repair of Steel Hulls](#)

4. Content

- a. If the vessel is new and not a sister vessel, has the Application for Inspection been submitted? In general, no plan review will occur until receipt of a copy of the Application.
- b. Is it clearly stated what is desired from the MSC? Are all plans requiring Coast Guard review and/or approval submitted in triplicate? Are there any special or unusual requests involved?
- c. Is the vessel being reviewed under NVIC 10-82 or 2-95? If Yes, a full review is not required and appropriate oversight may be conducted of the structures submittal approved by the authorized classification society. If vessel was reviewed by SAFEHULL, the ADC may choose to accept ABS approval without further review.
- d. Is the vessel being classed by ABS? If Yes, the submitter should provide the MSC with a copy of the ABS approval letter and approved drawings. Per references (a) (b) and (c), the USCG considers ABS structural review for class as acceptable for demonstrating compliance with US regulations.
- e. The majority of gas carrier reviews involve unmanned tank barges and independent pressure vessel barges regulated under a dual Subchapter O/D certification, for domestic routes only. Determine applicability of regulations per 46 CFR 151.01-10, as follows:
 - (1) For **unmanned** barges only, if cargo is listed in 46 CFR Table 151.05 and **has** flammability or combustibility characteristics as indicated by a fire protection requirement in the table, then Subchapters O and D apply.
 - (2) For **unmanned** barges only, if cargo is listed in 46 CFR Table 151.05 and **does not have** flammability or combustibility characteristics as indicated by a fire protection requirement in the table, then Subchapters O and D or O and I apply. The option for applying D or I, in addition to O, should be indicated by the owner on the Application for Inspection.
 - (3) For a barge carrying only cargoes listed in 46 CFR 30.25-1 the vessel should be reviewed to the requirements of Subchapter D only.
 - (4) Per 46 CFR 151.01-10(e), **manned** barges which carry a cargo listed in Table 151.05 will be considered individually by Commandant for applicable regulations and design requirements.
- f. If the vessel is a self-propelled tankship, consult 46 CFR, Subchapter O, Parts 153 and 154. Ensure compliance with references (j), (k), and (l), as applicable for international routes.
- g. The International Code for the Construction and Equipment of Ships Carrying Liquefied Gases in Bulk (reference (d)) does not apply to non-self propelled vessels

and that international routes will not be permitted unless the owner has prior agreement with a foreign port state. All tripartite agreements should be processed through COMDT (CG-5223).

- h. Per 46 CFR 38.05-1 and 46 CFR 151.15-3(d)), a minimum of hull type II is required for gas barges. A type I hull may be required depending on appropriate hazard of cargo. The required protective voids are as follows:

- (1) Type I:

- (i) 4.0 feet inboard from side and box end void
 - (ii) 25.0 feet aft of the head log
 - (iii) 15.0 inches bottom inspection clearance

- (2) Type II:

- (i) 3.0 feet inboard from side and box end void
 - (ii) 25.0 feet aft of the head log
 - (iii) 15.0 inches bottom inspection clearance

- i. Verify independent cargo tanks, containment system, and piping, per 46 CFR 38.05-1, 2, and 3. These regulations require minimum notch toughness in materials, dynamic loading analysis for all but river routes, and other 46 CFR, Subchapter F requirements. The review of cargo tank design requires information on the maximum amount of bending/deflection in the tank. Pressure vessel tanks have other requirements under Subchapter F in addition to the allowable stresses stipulated in 32.63-25(c). Note, 46 CFR 151.50-5(b) requires design and testing of at least 8 foot head above the top of the tank using the specific gravity of the product to be carried. Review of independent pressure tanks are conducted by the MSC Machinery Branch, E1.
- j. Per 46 CFR 31.10-32, 42.15-1(a) or 45.105, a loading manual is required if length greater than 300 feet and oceans service, or if dual certificated Subchapter O/I and carrying a cargo listed in table 151.05, per 151.01-10(c-1). The loading manual must indicate loading conditions, which meet both stability and longitudinal strength/stress requirements.
- k. Determine anticipated cargoes and consult 46 CFR 151.50 for cargoes, which require special structural design requirements under this section (e.g. 151.50-12 requires design of at least 75 psi and no welding to the tank, among other requirements, for ethylene oxide).
- l. Evaluate compliance with ABS structural rules for the primary hull structure (references (e), (g) and (h), as appropriate), as follows:

- (1) For vessels, over 190 m (623 feet), receiving a loadline, only:

- (i) Calculate the vessel definitions: Part 3, Section 1.
 - (ii) Verify the information in Introduction: Part 5, Section 2A.1.
 - (iii) Calculate the scantlings for the bottom shell: Part 5, Section 2A.4.3.2.
 - (iv) Calculate and check long. and trans. bulkheads: Part 5, Section 2A.4.5.

- (v) Verify the scantlings of main supporting members: Part 5, Section 2A.4.5.5.
- (vi) Verify buckling and ultimate strength calculations: Part 5, Section 2A.5.2.2.

(2) For vessels, 190 m (623 feet) or under, receiving a loadline, only:

- (i) Calculate the vessel definitions: Part 3, Section 1.
- (ii) Validate the gen. information: Part 5, Section 2 Part B.1-.15.
- (iii) Verify shell plating scantlings: Part 5, Section 2B.19.
- (iv) Calculate and check bulkhead plating: Part 5, Section 2B.23.
- (v) Calculate the scantlings for bottom structure: Part 5, Section 2B.26.
- (vi) Verify the scantlings of supporting members: Part 5, Section 2B.27.
- (vii) Verify the scantlings of frames, beams, and bulkhead stiffeners: Part 5, Section 2B.29.

(3) For unclassified, non-loadline vessels over 190 m (623 feet):

- (i) Calculate the vessel definitions: Section 1.
- (ii) Validate the information in Introduction: Part 5, Section 2A.1.
- (iii) Calculate and check the design considerations: Part 5, Section 2A.2.
- (iv) Calculate and check load criteria calcs.: Part 5, Section 2A.3
- (v) Calculate the scantlings for bottom structure: Part 5, Section 2A.4.3.
- (vi) Calculate and check side shell and deck plating: Part 5, Section 2A.4.4.
- (vii) Calculate and check long. and trans. bulkheads: Part 5, Section 2A.4.5.1.
- (viii) Validate corrugated bulkhead scantling, as applicable: Part 5, Section 2A.4.5.4.
- (ix) Verify the scantlings of main supporting members: Part 5, Section 2A.4.5.5.
- (x) Calculate/verify total strength assessment: Part 5, Section 2A.5.

(4) For unclassified, non-loadline vessels 190 m (623 feet) or under:

- (i) Calculate the vessel definitions: Section 1.
- (ii) Validate the introduction information: Part 5, Section 2B.1-.15.
- (iii) Calculate/check hull-girder strength: Part 5, Section 2B.17.
- (iv) Calculate and check the shell plating: Part 5, Section 2B.19.
- (v) Calculate and check deck plating: Part 5, Section 2B.21.
- (vi) Calculate and check bulkhead plating: Part 5, Section 2B.23.
- (vii) Calculate the scantlings for bottom structure: Part 5, Section 2B.26.
- (viii) Verify the scantlings of supporting members: Part 5, Section 2B.27.
- (ix) Verify the scantlings of frames, beams, and bulkhead stiffeners: Part 5, Section 2B.29.

m. Verify that a structural review of the hull and tanks is complete, including stress analyses as indicated by the attached matrix for structural requirements. In particular note the following:

- (1) Pinnacle grounding stresses in accordance with 46 CFR 32.63-20 and 151.10-20(b)(2)(ii). Note that pressure tanks supported by three or more saddles interact with the hull and may share some of the hull bending moment. This shared hull bending moment also results in added tank bending moment and must always be considered in the tank design, per 46 CFR 32.63-25(a) and (c).
- (2) Lakes, Bays and Sounds and oceans routes require dynamic loading analysis per 46 CFR 38.05-2(d) and 151.10-20(b)(3)(iii). Hog, sag and stillwater bending also required for oceans routes in accordance with 151.10-20(b)(3). See reference (j) for more details. As further stated in 46 CFR 38.05-10, each tank shall be so supported as to prevent the concentration of excessive loads on the supporting portions of the shell or head, and cargo tank resonance and tank vessel vibrations must be considered in the design of foundations and stays.
- (3) Collision chocks and saddle designs per 46 CFR 38.05-2(e) and 32.63-25, include the following:
 - (i) Saddle and hold-downs must be designed so that barge deflections and the resulting induced tank loads from pinnacle grounding or dynamic loading do not result in tank failure.
 - (ii) Collision protection requires collision chocks, typically a length of plate fastened to the tank longitudinally, which will dissipate the energy of a collision. Since no standard is given, the standard listed in 151.15-3(d)(1)(ii) is acceptable.
- n. Aluminum materials are unacceptable for hatch covers and ullage openings.
- o. Hull girder cannot butt against an independent tank, and 46 CFR 151.15-1(6) discourages attachment of hull structure to tank as well.
- p. Doubler plates and backing bars should be per NVIC 7-68.
- q. Evaluate saddle reactions and hull stress in grounded conditions using a HECSALV model. Independent tanks supported and strapped in by three or more saddles contribute to hull stiffness but are not an integral part of section modulus. Apply these saddle reactions in the grounded condition on HECSALV and determine the stresses. Stress must be less than the limits indicated in 46 CFR 151.10-20(b).
- r. Evaluate welding schedule details. If welding schedule plan is not provided, the MSC may either request copies from submitter or specify welding compliance issues in comments on the return correspondence letter. No strength welding shall be employed in the attachment of supports, lugs, etc., to tanks that require and have been stress relieved. Lap welds should be per NVIC 7-68 (reference (k)).

- s. Verify the barge's compressive deck stresses and collapse strength, according to the guidance of reference (g). This will be of particular interest if the L/D ratio exceeds 16 for oceans service or 20 for inland service.
- t. Under normal review procedures, the MSC will conduct independent calculations to verify submitter accuracy by evaluating saddle reactions and hull stress in grounded conditions using a computer model. Independent tanks supported by three or more saddles contribute to hull stiffness but are not an integral part of SM.
- u. Under normal review procedures, the MSC will compare the hull section modulus to that developed from a computer model of the ship's hull.

5. Disclaimer

This guidance is not a substitute for applicable legal requirements, nor is it itself a rule. It is not intended to nor does it impose legally-binding requirements on any party. It represents the Coast Guard's current thinking on this topic and may assist industry, mariners, the general public, and the Coast Guard, as well as other federal and state regulators, in applying statutory and regulatory requirements. You can use an alternative approach for complying with these requirements if the approach satisfies the requirements of the applicable statutes and regulations. If you want to discuss an alternative, you may contact MSC, the unit responsible for implementing this guidance.