MSC Guidelines for Review of Gas Carrier PRIS

Procedure Number: T1-28 Revision Date: 01/18/00

References

a. 46 CFR, Subchapter D

b. 46 CFR, Subchapter I

c. 46 CFR, Subchapter O

d. 46 CFR, Subchapter S

e. ABS Rules for Building and Classing Steel Barges, 1991

f. ABS Rules for Building and Classing Steel Vessels for Service on Rivers and Intracoastal Waterways, 1995

g. Navigation and Vessel Inspection Circular (NVIC) No. 1-98, Loading Considerations for Existing Inland Tank Barges

h. Ship Structure Committee (SSC) report SSC-205, "Structural Design Review of Longitudinal, Cylindrical, Liquid-filled Independent Cargo Tank Barges", 1970

i. Matheson Gas Data Book

j. Coast Guard Publication CG-478, "Liquified Natural Gas, Views & Practices, Policy and Safety", 2/1/76

Disclaimer

These guidelines were developed by the Marine Safety Center staff as an aid in the preparation and review of vessel plans and submissions. They were developed to supplement existing guidance. They are not intended to substitute or replace laws, regulations, or other official Coast Guard policy documents. The responsibility to demonstrate compliance with all applicable laws and regulations still rests with the plan submitter. The Coast Guard and the U. S. Department of Transportation expressly disclaim liability resulting from the use of this document.

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 the Procedure Number: **T1-28**

E-mail: customerservicemsc@msc.uscg.mil
Phone: 202-366-6480.

General Review Guidance

- 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.

- 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?

- Verify the applicability of regulations. Most vessels will fall under a dual Subchapter O/D classification, although O/I is also possible. Unlike ordinary tank barges, an inland barge carrying LFGs regulated only under Subchapter D must still have a PRIS. Ensure that the Hull Type is correct (I or II) and in accordance with the list of desired authorized cargoes. See 46 CFR 30.01, 90.05, and 150.110.

- If the vessel is a self-propelled tankship, consult 46 CFR, Subchapter O, Parts 153 and 154. Also consult with MSC for other potential compliance and plan review issues. Tankships carrying LFG or other pressurized cargoes will generally require review of a comprehensive loading and stability manual, rather than generation of a PRIS document.

- Ensure that the vessel's general arrangements are in compliance with the applicable regulations. Take particular note of the following:

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

  - Type I: 4'side and box end void
    25'rake bulkhead for lead barges
    15" bottom inspection clearance

  - Type II: 3'side and box end void
    25'rake bulkhead for lead barges
    15" bottom inspection clearance

- Per 38.05-1(d) & 32.60-10:
  - cargo tank spaces must be isolated from the remainder of the vessel by cofferdams in accordance with 32.60-10
  - no access from cargo tanks to enclosed spaces, 32.60-10(c)(2)
  - ventilation required for stowage purposes in enclosed spaces, 32.60-10(d)

- Per 38.05-10(e), clearances of 24 inches from the side and 15 inches from the bottom around independent containment systems (in addition to the required protective voids)

- For pressure vessel designs, distance between tanks and between the hull and tanks must allow inspection of all hull and tank surfaces

- For non-pressure vessel type containment systems, access shall be arranged to permit inspection of one side of each of the primary tank and secondary barrier

- Weathertightness of the deck must be maintained for designs with protruding tanks, except for vessel on restricted/protected routes, and open hopper type barges of acceptable design

- Ensure that the structure of the hull and tanks is in compliance, including stress analyses, with the attached matrix for structural requirements. In particular, note the following:

  - Adequacy of plating thicknesses and scantlings according to applicable ABS structural rules (ref. e or f), dependent upon route.

  - 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).

  - LBS and oceans routes require dynamic loading analysis per 46 CFR 38.05-2(d) and 151.10-20(b)(3)(iii). Analysis of hogging, sagging, and stillwater bending conditions also required for oceans routes in accordance with 151.10-20(b)(3). See reference (h) 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.

  - Collision chocks and saddle designs per 46 CFR 38.05-2(e) and 32.63-25, include the following:

    - 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

    - Collision protection requires collision chocks, typically a length of plate fastened to the tank longitudinally which will dissipate the energy of a collision. For these chocks, the design loads are specified as a factor times the cargo plus tank weight. Since no standard is given, the standard listed

in 151.15-3(d)(1)(ii) is acceptable. As shown in 151.15-3(d)(1)(ii), the stress limits shall be greater than yield and ultimate tensile strength such that the energy is dissipated by the chocks.

- Ensure that the cargo tanks, containment system, and piping meet the requirements of 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. Pressure vessel tanks have other requirements under Subchapter F in addition to the allowable stresses stipulated in 32.63-25(c).

- Ensure the barge has met applicable intact and damaged stability requirements. In general, use the attached stability matrix to determine which criteria apply. Note the following comments:

  - Per 46 CFR 31.10-32, 42.15-1(a) or 45.105, a loading manual is required if length greater than 300' 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).

  - In these types of vessels, with longitudinal cylindrical tanks in the hoppers, longitudinal free surface has a significant effect on trim & stability.

  - Barges must meet 46 CFR 173, Subpart B if equipped to lift; and 46 CFR 174, Subpart B if cargo is carried above the weather deck (as in most Subchapter O/I barges)

  - Hull type I damaged stability is a 2 compartment standard, side and bottom damage, while hull type II is a modified 1 compartment standard. The deck edge must not submerge to survive. If the barge has coaming (which most do) then the limit is the minimum of the intersection of the deck and coaming, or the height of the quantity "f_a" above the deck edge.

  - Hull type I & II intact requirements are generally the same, from 46 CFR 172, Subpart E (righting energy (5/10/15), GM_L, and GM_T requirements.

  - Note the special requirements of 46 CFR 172, Subpart C, which apply if the vessel is certificated under Subchapter D.

- The MSC will generate a PRIS using the attached sample PRIS as a guide. The PRIS is a document which provides the OCMI with the information required by 46 CFR 151.01-20(b), 151.04-1(b) and (c), and 151.10-15(c), to be placed on the tank barge's COI. Included will be a statement per 38.01-1, referencing Title 49 and/or 46 CFR 38.01-2. Also included will be a comment in the cover letter, reminding the OCMI to include a comment per 46 CFR 38.01-5 on the COI. The

following guidance will be used to determine the loading restrictions that will be placed on each tank/cargo combination:

- 46 CFR 38.15-1(b) requires non-refrigerated tanks (most inland tank barges which carry LFGs are not refrigerated) to be filled so that their filling densities shall not exceed the ratios indicated in table 38.15-(1)(b). Filling density is defined as the percent ratio of the weight of the gas in a tank to the weight of water the tank holds at 60 F. However, determination of the maximum filling density should be performed in accordance with 46 CFR 151.45-6, as Table 38.15-1 has been found to be incorrect for butylene, isobutylene, propylene, and butadiene. Cargoes with a specific gravity greater than water require additional scantling design to carry cargo to the tank top, otherwise slack carriage of the higher density cargoes is allowed.

- 46 CFR 151.45-6(a) states that tanks carrying liquids or liquefied gases at ambient temperatures (non-refrigerated) regulated by Subchapter O shall be limited in the amount of cargo loaded to that which will avoid the tank being liquid full at 105 F, if insulated, and 115 F if not insulated.

- Refrigerated tanks are governed by 46 CFR 38.15-1(a) and 46 CFR 151.45-6(b). An outage of at least 2% is normally required.

- The following lists typical cargoes and governing regulations (an asterisk * indicates most common cargoes)

46 CFR 38, table 38.15-(1)(b)	46 CFR 151.50-30(e)
Propane*	Ammonia, anhydrous*
butane*	chlorine*
butylene*	methyl chloride*
propylene*	vinyl chloride*
ethane	dichlorodifluoromethane
ethylene	dimethylamine
methane	monochlorodifluoromethane

46 CFR 151, not listed in Table 151.50-30(e)	
butadiene*	argon (refrigerated)
ethyl chloride	acetaldehyde
carbon dioxide, liquid	sulfur dioxide
butadiene / butylene mixtures	methylamine
methyl acetylene prodiene mixture (MAPP)	methyl bromide

- The following cargoes use filling densities listed in the special requirements section:

Cargo	Regulation	filling density
Ethylene oxide	46 CFR 151.50-12(j)	0.83
Propylene oxide	46 CFR 151.50-13(d)	0.80

- The submitter should provide the volume of the independent tanks in ft^3 which carry LFGs or compressed gases.
- Determine maximum cargo weight by one of the following two methods:
  - Table method: obtain the maximum filling density from the tables (as previously noted, do not use this method for butylene, isobutylene, propylene, and butadiene)
    - Convert each tank's 100% volume to equivalent freshwater weight in short tons:

      Freshwater Weight = (volume in ft^3)(7.4805 gal/ft^3)(8.32828 lb/gal)(ST/2000 lbs)

    - Multiply this freshwater tank weight by the listed filling density to get maximum cargo weight in short tons (minus 2% outage):

      Max Cargo Weight = 0.98 * Freshwater Weight * Filling Density

  - Specific volume method: (must be used for all refrigerated cargoes, but also recommended for non-refrigerated cargoes); obtain the specific volume of the cargo at 105 F (if insulated), or at 115 F (if uninsulated)
    - Enter the Matheson Gas Data book and interpolate to obtain the specific volume in ft3/lb at either 105 F or 115 F. Butadiene has properties of 4.8989 lbs/gal (0.0272879 ft^3/lb) at 105 F, and 4.9625 lbs/gal (0.0269382 ft^3/lb) at 115 F.

      Max cargo weight = 0.98 * tank volume (ft^3)/(specific volume (ft^3/lb) * 2000 lb/ST)

- Obtain the total cargo load that corresponds to the limiting drafts in the stability study (total displacement minus light ship weight), for each route and cargo density combination desired. Divide this total load proportionately into the tanks according to total tank volumes (in most cases the LFG tank volumes are identical, so that the total load is simply divided by the number of tanks to obtain the maximum load per tank from stability criteria). Compare these values to the maximum weight/tank determined from one of the filling density methods above.

The MSC will list the lesser of these maximum weights per tank on the PRIS. Usually LFGs are filling density limited, but some compressed gases such as MTC are stability limited.

- The MSC will build an electronic model of the barge and verify hydrostatics and stability calculations, and will also build electronic models of the tanks and verify volume/ullage tables and free-surface calculations (transverse and longitudinal).

- The MSC will compare the submitted hull section modulus and lightship characteristics to that calculated by the MSC computer model.

- The MSC will also evaluate saddle reactions and hull stress in the grounded condition using the computer model, and will compare these to the submitted results. Independent tanks supported by three or more saddles contribute to hull stiffness but are not an integral part of SM. The tank contribution may be determined by using the Laplace Transform method. Results for saddle reactions can be computed based on the hull/tank interaction. Ensure that these saddle reactions and resulting stresses in the grounded condition are less than the limits indicated in 46 CFR 151.10-20(b).

- Ensure that the barge's compressive deck stresses and collapse strength are in accordance with the guidance of reference (g).

Attachments

- Tank Vessel Stability Matrix
- Structural Requirements Matrix