

MSC Guidelines for Review of OSV Stability

Procedure Number: T1-6

Revision Date: 01/21/00

References

- a. 46 CFR 170, Subpart F, Determination of Lightweight Displacement and Centers of Gravity
- b. NVIC 17-91, Guidelines for Conducting Stability Tests
- c. ASTM F 1321-92, Standard Guide for Conducting a Stability Test (Inclining and Lightweight Survey) to Determine the Light Ship Displacement and Centers of Gravity of a Vessel
- d. Marine Technical Note 04-95, LightShip Change Determination
- e. 46 CFR 170, Subpart E, Weather Criteria
- f. 46 CFR 174, Subpart G, Special Rules Pertaining to Offshore Supply Vessels
- g. International Convention for the Safety of Life at Sea, 1974, and its Protocol of 1978 (SOLAS)
- h. IMO Resolution A.469 (XII), Guidelines for the Design and Construction of Offshore Supply Vessels
- i. Meyer, Richard and Feeney, Kevin. "A Simplified Stability Letter for Offshore Supply Vessels." Marine Technology, January 1981. The Society of Naval Architects and Marine Engineers.
- j. NVIC 3-89, Guidelines for the Presentation of Stability Information for Operating Personnel

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

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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?
- ❑ OSV stability reviews generally fall into one of three categories, depending on the method used to establish the acceptable range of loading conditions. The greater this range, the greater the operational flexibility, and the greater complexity required in the stability review/guidance. The three most common methods are listed as follows, in order of increasing complexity:
 - ❑ stability letter with a limited number of specific authorized loading conditions
 - ❑ simplified stability letter with approved loading diagram(s)
 - ❑ approved T&S Book, with or without an accompanying stability letter
- ❑ The simplified stability letter with approved loading diagrams is the most common form of OSV stability review, as it provides a good balance of operational flexibility and simplified stability guidance for the operator (see reference (i)). Regardless of the type of stability review encountered, however, the basic requirement is that the submitter must clearly demonstrate that each possible loading condition meets the required stability criteria of 46 CFR, Subchapter S. In order to establish a range of acceptable loading conditions, a common technique involves generation of a maximum KG or minimum GM curve. These curves typically plot the maximum KG or minimum GM value on the ordinate axis (y-axis), against the range of operational drafts on the abscissa (x-axis). Acceptable curves incorporate values derived from the most stringent governing stability criteria, along with trim considerations.
- ❑ A satisfactory stability review results in operational guidance in the form of a stability letter, and approved vessel loading conditions as indicated above. If the T&S book includes sufficient operational restrictions, instructions, and guidance that would normally be included in a stability letter (see reference (j)), then the MSC may return correspondence approving the T&S book in lieu of a stability letter, noting that the operational instructions in the T&S book must be strictly followed.
- ❑ In addition, stability reviews may be preliminary or final, depending on the basis of the light ship values. Preliminary stability calculations are not required, but at the option of the owner/naval architect they may be submitted before the incline of the vessel, using assumed light ship values or a range of displacements including assumed values. This is often done to facilitate expedited final stability reviews.

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Preliminary stability reviews are conducted in the same manner as final stability reviews, except that a stability letter is not generated and all returned items are marked "Examined". Following the incline of the vessel and calculated results indicating the true light ship of the vessel, a final stability review may be accomplished and a stability letter generated. A new set of stability calculations is not required if the submitter demonstrates that the assumed light ship values closely match those resulting from the incline experiment (see reference (d) for further guidance and acceptable ranges).

- Verify applicability of Regulations. See 46 CFR 90.05 (Subchapter I), 46 CFR 125.100 (Subchapter L), and SOLAS I/2, I/3, and II-1/1.
- Ensure the following items have been submitted (* as applicable):
 - General Arrangements
 - Lightship values based on calculated results of stability test data
 - Lines, offsets, or computer disk with hull model
 - Hydrostatic Tables
 - Tank Capacity Tables\Plan
 - Ullage & Sounding Tables
 - Maximum KG, or Minimum GM curves
 - Intact calculations
 - Damage Stability calculations*
 - Lifting calculations*
 - Towing calculations*
 - Trim and Stability (T&S) Booklet, Loading Diagrams, or summary loading conditions*
- Verify light ship characteristics utilizing one of the following methods:
 - 1) Does a sister vessel, with known characteristics, exist?
 - 2) Has an approved procedure and subsequent stability test been performed in accordance with references (a), (b), and (c)?
- For each OSV on domestic voyages, the following stability criteria apply for each condition of loading:
 - Weather stability criteria of 46 CFR 170, Subpart E
 - Intact stability criteria of either 46 CFR 170.173(b) or (c) {unusual proportion and form}, **or** 174.185 {Rahola}
 - the submitter may freely choose one of the two intact criteria but may not mix/match to suit depending on loading conditions or ranges in the vessels righting energy curve— the full requirements of the chosen criteria must be consistently used throughout the entire set of stability calculations

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- if the unusual proportion and form criteria is chosen, the angle of maximum righting arm determines the specific requirements:
 - if above 30 degrees, 170.173(b) applies
 - if less than or equal to 30 degrees, then 170.173(b) or (c) may be used
- If the unusual proportion and form intact stability criteria is used, ensure that the calculations incorporate the zero trimming moment method, per 46 CFR, 170.173(d)
- if the Rahola criteria is used, the stability letter will specify a maximum freeboard at the stern in accordance with Table 174.185
- Damaged stability criteria of 46 CFR 174.200 or 205, if the vessel is regulated under Subchapter L. Note the following:
 - 174.200 applies if 16 or fewer offshore workers are carried (damage is applied only along the sides of the vessel along the length of the engineroom).
 - 174.205 applies if more than 16 offshore workers are carried or if accommodations for crew members or offshore workers are located below the deepest load waterline (46 CFR 127.270(c)(1)). (Damage is applied along the entire sides of the vessel.)
 - verify that correct damaged extents are used, according to Table 174.207(A)
 - verify that the engineroom is protected by longitudinal watertight bulkheads at least 30 inches from the outer shell, otherwise the engineroom must be flooded
 - ensure correct assumptions of space permeability, in accordance with Table 174.207(b).
- If Subchapter L damaged stability criteria applies, check the miscellaneous piping arrangements and progressive flooding assumptions per 46 CFR 174.207(c)(4). Note that engine exhaust piping is not normally considered watertight throughout its length. Therefore, all compartments it passes through including the engineroom must be considered flooded, if the engine exhaust piping passes within damaged extents and lies below the final equilibrium waterline.
- Ensure that the location of downflooding is correctly accounted for in the stability calculations.

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- ❑ Maximum KG or Minimum GM curve:
 - ❑ Verify that the curve is derived from the most stringent governing value among weather, intact, and damaged stability requirements, as applicable.
 - ❑ The curve should also incorporate the most stringent values from different trim assumptions, as OSV hull forms often have trim sensitive stability properties. In any case, the final stability guidance should indicate the range of acceptable trims based on the provided calculations.
- ❑ Loading Conditions
 - ❑ Ensure that correct light ship values are used
 - ❑ Ensure that the final KG (or GM) value in each specified load condition is within allowable parameters established by the final KG or GM curve
 - ❑ Ensure that final KG (or GM) values are corrected for free surface. See 46 CFR 170, Subpart I
 - ❑ Ensure that the freeboard at maximum load is the lesser of stability drafts and Geometry Load Line drafts per 46 CFR, Subpart E
- ❑ Loading Diagrams
 - ❑ Review loading diagrams according to the guidance of reference (i). Noted items to check include the following:
 - ❑ The reference loading conditions used for the loading diagram plot must sequentially place under deck weights into tanks in order of highest to lowest VCG
 - ❑ The corrected GM or KG values from Conditions I, II, and other intermediate conditions, should be plotted on the GM/KG curve, with lines drawn connecting the loading conditions. The lines connecting the assumed loading conditions must fall entirely within the allowed parameters of the governing GM/KG curve.
 - ❑ Ensure that the reference loading conditions incorporate the correct VCG height of the above deck cargo.
 - ❑ A minimum free-surface correction must be incorporated, using the summation of required consumable liquids. Verify the correct usage of the liquid mud free surface values as well, as these values usually dominate the overall correction.
 - ❑ Generally, no more than two curves per diagram (each page) should be used. Larger numbers of curves can lead to confusion and errors. Use

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- of the loading diagrams should require no more calculation than simple addition.
- The label on the abscissa axis (x-axis) of the loading diagram should read as “Total Below Deck Tonnage (fuel oil, lube oil, cargo, ballast, etc.)”. It may not be labeled as “Below Deck Cargo”, as this incorrectly indicates the allowed below deck weight and may lead to errors and unsafe loading conditions.
 - Trim and Stability Books (see reference (j) for additional guidance)
 - If approval of the T&S book is requested in lieu of a stability letter, ensure that the T&S book includes a section listing operating/stability instructions of equal or greater detail and clarity, as compared to a typical stability letter. Stability instructions and operating guidance must have a satisfactory level of technical detail, sufficiency, clarity, and ease of use, in accordance with reference (j).
 - The T&S book should contain only that information necessary to ensure the vessel has adequate stability for the route and service intended. It should not contain extraneous information or information that might confuse operating personnel. If an owner wishes to present background information to operating personnel (such as stability test calculations or righting energy curves) then it should be provided as a separate, supplemental booklet.
 - Tank sounding tables should normally be included in the T&S booklet in those cases where their use is necessary to perform the required calculations. However, the tables need not be a part of the T&S booklet when they are bulky.
 - Sample loading conditions should be provided to serve as a reference for operating personnel. They should be worked out fully so that operating personnel can follow through them if necessary. A minimum of three sample conditions is recommended; they should normally include conditions at the load line draft, conditions with 100, 50, and 10 percent of consumable liquids and stores, and any other important or typical conditions. All sample conditions should be accurate and shown to comply with the applicable stability criteria.
 - For each OSV on international voyages, the following stability criteria applies for each condition of loading:
 - If 12 or fewer offshore workers are carried and the vessel length is less than 328 feet (100 m), then the applicable domestic stability criteria, or the criteria in reference (h) is acceptable for use.

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- If 12 or fewer offshore workers are carried and the vessel length is greater than 328 feet (100 m), then the criteria of SOLAS II-1/25-1 applies.
- If more than 12 offshore workers are carried and the vessel length is less than 328 feet (100 m), then the criteria of SOLAS II-1/8 applies (Passenger vessel rules).
- Note: The SOLAS regulations require calculation of indices and factors instead of the righting arm and energy criteria traditionally applied in domestic regulations.

- The following items will be included in the return correspondence (with copies provided to the cognizant MSO and ABS (loadline/stability group)):
 - Number of offshore workers on domestic voyages (for Sub. L OSVs, 16 or fewer, or 36 or fewer, depending on damaged stability criteria used), and on international voyages (usually 12 or fewer)
 - Maximum density of allowable cargo, if greater than 8.54 lb/gal (SG = 1.025), and the specific tanks permitted to carry the cargo
 - Approved light ship weight and location (VCG and LCG)
 - Comment to ABS noting the maximum allowed draft (specify molded and extreme)
 - Comment to ABS to include a statement in the Load Line certificate requiring compliance with the stability letter and approved stability guidance (T&S book, loading diagrams, etc.)
 - If a stability letter is generated, it will contain the appropriate standard phrases and stability instructions (bilges, hull openings, watertight doors, weight changes, slack tank restrictions, etc.). See reference (j) for additional information.

- If the vessel is carrying a crane, ensure compliance with 46 CFR 173, Subpart B (for more information, see work instruction for review of Crane Lifting calculations).

- If the owner requests towing authorization on the stability letter, review the required calculations to the towline pull criteria of 46 CFR 173, Subpart E

- At respective drafts, compare the displacement and KM values listed in the hydrostatic tables to the values used in corresponding loading conditions.

- The following items are indicative of normal MSC plan review:
 - Independently generate the required KM or GM curve, using all applicable stability criteria.

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- Construct an outer hull model in HECSALV or GHS and generate hydrostatics. In general, submitted values should be close to those independently generated; KM should be within 0.2 feet and displacement within 2%.
- Perform independent calculations to verify values used for free-surface corrections
- Independently calculate tank capacities. Compare 100% capacities, and weight loading values and locations to those used in the submitted calculations.
- Construct a full HECSALV or GHS model including compartmentation.
- Analyze different loading conditions of the vessel and compare stability results using the computer model and the criteria.

Definitions

Downflooding Point: The lowest opening on a vessel that allows the entry of seawater into the hull or superstructure of an undamaged vessel due to heel, trim, or submergence of the vessel.