



Marine Safety Center Technical Note

Date: 11 May 1995

SSIC: 16703/MSM Vol. IV Sec. 6.D.4/
46 CFR 170.175

MTN: 04-95

Subj: LIGHTSHIP CHANGE DETERMINATION; WEIGHT-MOMENT CALCULATION
VS. DEADWEIGHT SURVEY VS. FULL STABILITY TEST

Ref: (a) Marine Safety Manual, Volume IV, section 6.D.4
(b) Navigation and Inspection Circular (NVIC) 17-91 dated 4 November 1991
(c) ASTM Standard Guide F 1321-90, "Standard Guide for Conducting a Stability Test (Inclining and Lightweight Survey) to Determine the Light Ship Displacement and Centers of Gravity of a Vessel."

1. PURPOSE: The purpose of this Marine Technical Note (MTN) is to publish the Coast Guard's long-standing policy for determining when weight changes to a vessel are significant enough to warrant requiring a new deadweight survey or a full stability test (deadweight survey and inclining), in order to reestablish accurate lightship characteristics, which includes vessel displacement and the location of the center of gravity.

2. DISCUSSION:

a. Lightship Characteristic Changes. A vessel's lightship characteristics form the basis for performing the calculations necessary to demonstrate a vessel complies with applicable stability requirements. Accordingly, the accuracy of these characteristics is of paramount importance, both at the time of construction and throughout the vessel's service life. Changes to a vessel, through the addition, removal, or relocation of items which are included as a part of the vessel's lightship, could jeopardize the accuracy of the lightship characteristics. It is incumbent upon vessel owners and their naval architects to minimize the possible adverse affects of the weight changes.

In accordance with reference (a), a complete stability test is usually required after work is completed unless weight changes are minor and do not adversely affect the vessel's stability. However, the Marine Safety Center (MSC) is given the authority to determine whether calculations alone are sufficient, based on the accuracy of the information available or based on applying acceptable penalties. Therefore, an evaluation must be made as to whether or not a vessel needs to undergo a deadweight survey or a full stability test following any change to the lightship characteristics. In making this determination, the MSC will consider the total aggregate of all weight changes that have been made since the last stability test (not just the net change).

This total aggregate weight change (W_{total}) is determined by summing the magnitudes of all weights added (W_a), all weights relocated (W_{rl}) and all weights removed (W_r) as follows:

$$W_{total} = |W_a| + |W_r| + |W_{rl}|$$

In applying the above formula, those items whose weight and center of gravity are known exactly through actual measurement may be excluded from the total aggregate weight change; however, such items are subject to review and approval of the MSC and acceptance and verification by the cognizant Officer in Charge, Marine Inspection (OCMI).

b. **Weight-moment Calculations Only Required.** When the total aggregate weight change does not exceed 2% of the currently approved lightship displacement and the LCG does not shift by more than 1% of the vessel's length between perpendiculars (LBP), weight-moment calculations will generally suffice in lieu of a deadweight survey. However, if the amounts or locations of items being added or removed cannot be determined with a reasonable accuracy, then a deadweight survey will be required in order to confirm the new calculated lightship VCG. If weight-moment calculations only are used, then any future weight changes evaluated must include the total aggregate weight changes from the last stability test, not just from the approved lightship characteristics determined by these calculations.

c. **Deadweight Survey Only Required.** In accordance with 46 CFR 170.175 and the guidelines established in reference (a), a deadweight survey only will generally be required when a vessel has undergone a total aggregate weight change since the last stability test of between two and ten percent (2-10%) of its displacement, or when its lightship LCG shifts by more than 1% of the vessel's LBP.

If however, upon completion of a required deadweight survey, the results show that, when compared to the vessel's calculated lightship characteristics (anticipated based on the weight-moment calculations), there is a difference of less than 1% for the displacement or a shift in the LCG of less than 1% of the vessel's LBP, then the vessel's lightship VCG can be assumed as being the one determined by the weight-moment calculations. If on the other hand, the displacement or LCG fall outside the above tolerances, then the vessel must either undergo a full stability test or, apply an indisputably conservative penalty to the calculated lightship VCG.

d. **Full Stability Test Required.** When the total aggregate weight changes exceed 10% of a vessel's currently approved lightship displacement, a full stability test will be required. Vessels undergoing a full stability test shall comply with the requirements and recommendations of references (b) and (c) and the guidance of paragraph (e) below.

e. **Stability Test Preparations.** Prior to any deadweight survey or full stability test, the vessel's condition shall be as close to lightship as practicable. Total weights to add or subtract which are necessary to convert from the condition of the vessel during the test to the lightship condition should be limited to a maximum of 2% of the vessel's anticipated lightship displacement.

Liquids which are to remain on board shall be listed in the approved inclining procedure and should be consolidated so that the number of tanks involved is minimized. Tanks which contain liquids must comply with the conditions of paragraph 5.2 of reference (c). Specifically, they must either be pressed full or the shape of the tank must be such that the free surface effect can be accurately determined.

3. ACTION:

a. The owner of a vessel which requires approved lightship characteristics to show compliance with Coast Guard stability requirements must advise the cognizant OCMI or Load Line assigning authority of any changes to the vessel's lightship characteristics. Detailed lists of the items to be added or removed, including weight estimates and calculations showing their effect on the vessel's lightship characteristics, must be submitted to the MSC (or ABS using the NVIC 3-84 process) for review. The owner should include documentation of the last approved lightship characteristics that were based upon a stability test as well as any previous weight-moment calculation adjustments.

b. The MSC or ABS will then examine the information in accordance with the above policy and determine if a deadweight survey or full stability test is required. In making this determination, the MSC will consider the types of weight involved, the error inherent in the changes, and their effect on stability. Also included in these considerations will be the sizes and locations of the individual items being changed and the accuracy with which the weights and centers of gravity can be determined. Accordingly, a small number of large items with well defined centers of gravity will generally receive more favorable consideration than a large number of small items or items such as extensive piping systems where the accuracy and level of detail is questionable.



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