

# Do-it-yourself stability tests

By LCDR Mark Prescott

You don't have to be a naval architect or an engineer to perform a simplified stability test on your small passenger vessel. The vessel is subjected to a heeling force, equal to the maximum it would normally experience in service. If sufficient stability is indicated, the vessel passes. It is that simple.

Stability requirements for vessels carrying passengers are in 46 CFR part 171. Subpart B deals with small passenger vessels and describes the simplified stability test.

## Vessels

The simplified stability test may be used on vessels under 100 gross tons, not more than 65 feet in length and carrying between seven and 150 passengers. Such vessels are commonly known as T-S boats (small subchapter T boats).

For T-S boats carrying more than six, but less than 50 passengers, the test is required when the vessel's stability is questioned by the Officer in Charge, Marine Inspection (OCMI).

T-S boats with more than 49 passengers must perform the simplified stability test or complete an inclining experiment, which requires the services of a naval architect. Usually, an owner is advised of test requirements when he or she applies for a Certificate of Inspection, or during the vessel's construction.

If a vessel is required to pass this test, the owner should be able to conduct it with the help of a straight-forward form, CG-4006, available at local Coast Guard inspection offices. A marine inspector will observe the test and answer any questions.

## Conducting the test

A vessel can heel when passengers move to one side or when wind blows against its side. These actions create what is known as a "heeling moment," which simply is a force applied at a certain distance. (It is something like a lever moving a heavy object. The moment is the force applied at the end of the lever times the distance to the pivot point.)

Other forces, due to flooding, shifting cargo, waves, loads being lifted by crane or free surface effect, may also cause heeling moments. However, wind and passengers are all that

should concern a T-S vessel owner. If it gets more complex, there would be a need for an inclining experiment and a naval architect.

Basically, the simplified stability test consists of fully loading a vessel in its worst case condition, moving weights across the deck, and checking to see if a mark placed on the hull is submerged.

First, the following must be determined:

- 1) **basic dimensions, including overall length, beam, freeboards and heights of the deckhouse or any enclosed areas;**
- 2) **number of passengers and amount of cargo; and**
- 3) **vessel's intended route.**

With this knowledge, the owner can determine how much weight is needed and how much will have to be moved to create the required force. The necessary weight is determined by multiplying the number of passengers times their weight. This weight is generally assumed to be 160 pounds, unless there is a mix of women and children, reducing it to 140 pounds.

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*Inspector measures deckhouse height to figure wind area.*





*Inspector measures distance test weights have moved across the deck. Total weight times distance must be at least equal to the greater of the passenger or wind heel moments.*

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Add in the weight of any cargo, and the total weight needed to be loaded on the vessel will be known. This weight must be distributed realistically. The cargo will be in its normal location and the passengers will be distributed evenly. If a vessel has more than one deck, the form has a formula to determine the amount of weight to place on the upper deck.

The basic dimensions required are clearly marked on the form. They will indicate the distance passengers can move across the deck, help calculate the total area subjected to pressure from the wind and determine the height of the maximum immersion mark to be placed on the side of the hull. An accurate set of plans is helpful, but not necessary. The dimensions can be determined with a tape measure directly from the vessel. Once the weight and dimensions have been determined, the required heeling moment can be calculated.

The greater of the passenger or wind heel moments now must be imposed by moving some

of the added weights across the vessel. Test weights can be anything that can be accurately weighed, including sand bags, barrels of water, steel shafts or plates. The center of gravity should be about 2.5 feet above the deck.

To simulate the maximum moment, a known weight or weights are moved a known distance. The moment created is equal to the weight multiplied by the distance. A convenient table is provided on form CG-4006 to record and calculate the actual imposed moment.

Before the weights are moved, a mark is placed on the side of the hull. For flush deck vessels, the mark is placed at one half the freeboard. CG-4006 has a section to help the owner determine the height of the mark above the waterline. After the vessel is heeled by moving the appropriate amount of weight, the mark is checked. If it is not submerged, the vessel passes.

Following the successful completion of a simplified stability test, the OCMI may issue a stability letter. However, since the issuance of this letter is not required for T-S boats, the owner should keep a copy of the test in case the vessel's stability is ever questioned.

## Conclusion

If you have or are building a T-S vessel, you may be required to conduct a simplified stability test. Don't panic! Ask for a test form (CG-4006) from your local Coast Guard inspection office and look it over. If you have any questions, the inspectors you normally deal with will be glad to answer them for you. The test is not difficult to conduct and generally takes less than half a day.

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*For this flush deck vessel, the maximum immersion mark is placed at one half the freeboard after weights are added.*

