Australian Government
Australian Maritime Safety Authority

Domestic Commercial Vessel
INSTRUCTIONS TO SURVEYORS

DCV-ITS-01 (05/2019)

Subject: Verifying ISO derived EU conformity assessment ***first of type*** righting moment curve *(GES 2014/03 refers).*

General: This instruction provides a consistent method of verifying that the stability of a vessel using GES 2014/03 is adequately described by the righting moment curve of the ***first of type*** used in *ISO12217:2013 Small Craft – Stability and Buoyancy assessment and categorization Parts 1 and 2*.

A vessels initial ***first of type*** GZ curve and stability information requires verification and, if necessary, correction where it has been prepared by a third party (who is not an attested surveyor under the National Law) and has been assessed against:

- *ISO 12217-1:2013: Small craft - Stability and buoyancy assessment and categorization - Part 1: Non-sailing boats of hull length greater than or equal to 6 m*, or
- *ISO 12217-2:2013: Small craft - Stability and buoyancy assessment and categorization Part 2: Sailing boats of hull length greater than or equal to 6 m*.

The stability verification test in this instruction is **not** be used where a vessel has been modified from the original design, particularly if the freeboard has been significantly reduced or the modification has caused the position of the vertical centre-of-gravity (VCG) to be situated at a higher level than that originally intended by the designer. Examples of this include the addition of:

- a mast-furled main sail;
- a roller-reefing headsail;
- a radar antenna; or
- any other item of equipment.

Where modifications of this nature have occurred, a full stability analysis of the vessel is to be conducted.

Instruction: *ISO 12217* normally requires the stability to be assessed in the minimum operating condition (m_{MO}) and the loaded arrival condition (m_{LA}) unless otherwise noted within the standard. Data may also be made available for the maximum load condition (m_{LDC}). For the purposes of this verification test, the vessel is to be loaded according to the heaviest load condition specified in the stability documentation.

Should the GZ curve require correction (as per *Step 4* below), the vessel will require full stability reassessment against the criteria of *ISO 12217* utilizing the corrected GZ curve.

Step 1 – Preparations for test

- The test is to be conducted under normal vessel inclining conditions with a pendulum set up to record heel angles of the vessel.
- The surveyor should inspect the vessel immediately prior to undertaking the test to satisfy themselves that the vessel is loaded as per the heaviest load condition found in the stability documentation. Particular regard is to be paid to the:
    - **Pendulum** - location and length
    - **Condition of tanks and approximate trim** - tanks shall be filled to represent that of the heaviest load condition.
    - **Movable weights** - are to be positioned as close as practicable to those represented in the loaded condition found in the stability documentation.
    - **Draughts** - are to be recorded.

- The weights that are to be used to induce the heel lever must reflect those that are part of the loaded condition of the vessel. Additional weights are not to be added and weights are not to be removed.

Step 2 – **Heeling of the Vessel**

The vessel shall be heeled to both port and starboard by the application of a heeling moment using the weights designated in *Step 1*. Movement of these weights must be sufficient to produce two heel angles:

- at least three degrees, port and then starboard, and
- at least five degrees, port and then starboard

Four heel angles are to be produced. Both the heeling moments and angles of heel are to be recorded.

Step 3 – **Calculation of GZ**

The heeling moments are to be created by moving the weights (that are part of the loaded condition of the vessel) by known amounts. The righting lever deduced for that angle of heel is given by:

$$GZ = \frac{w.h.cos\emptyset}{\Delta}$$

where:

GZ	righting lever (m)
w	mass moved to produce the heel angle (kg)
h	distance parallel to design waterline mass was moved through to produce heeling moment (m)
θ	angle of heel produced (degrees)
Δ	displacement of vessel as used to derive the GZ curve in the respective loading condition (kg)

Step 4 – **Correction of GZ to reflect vertical moment of weights used to induce heel**

Where the weights used to create the heeling moment have to be moved vertically from their normal location in order to generate the required heeling moment, the resulting measured righting moment should be corrected for the change in the VCG of the craft.

The correction that should be applied when the weights are raised during the heeling test is:

$$GG_1 sin\varphi + \text{the measured } GZ$$

where:

GG_1	is the shift in vessel VCG due to the weights being moved

Step 5 – **Calculate the average deviation of recorded GZ values from righting moment curve**

Using the four values for GZ determined at *step* 3 (& corrected in *Step 4),* the average deviation away from the righting moment curve is to be calculated to assess whether the vessel reflects the stability documentation and assessment. The average deviation is calculated as follows:

- Using the four GZ values calculated in *Step 3* (and corrected in *Step 4*), calculate the difference (deviation) between the calculated values of GZ and the values in the original GZ (of the first of type) for each heel angle recorded. Four deviations should be calculated.
- Add all of the deviations together to produce a total value.
- Divide the sum of all the deviations by four (the number of weight movements) to obtain the average deviation of GZ
- Then calculate the average deviation into a percentage as follows:

  % deviation = (average deviation / average of original GZ values for each heel angle) x 100

Should the values of deviation fall below the righting moment curve (a negative % deviation) as shown in the figure below, the average deviation percentage (calculated above) must be within 5% of the original amounts recorded in the GZ found in the stability documentation.

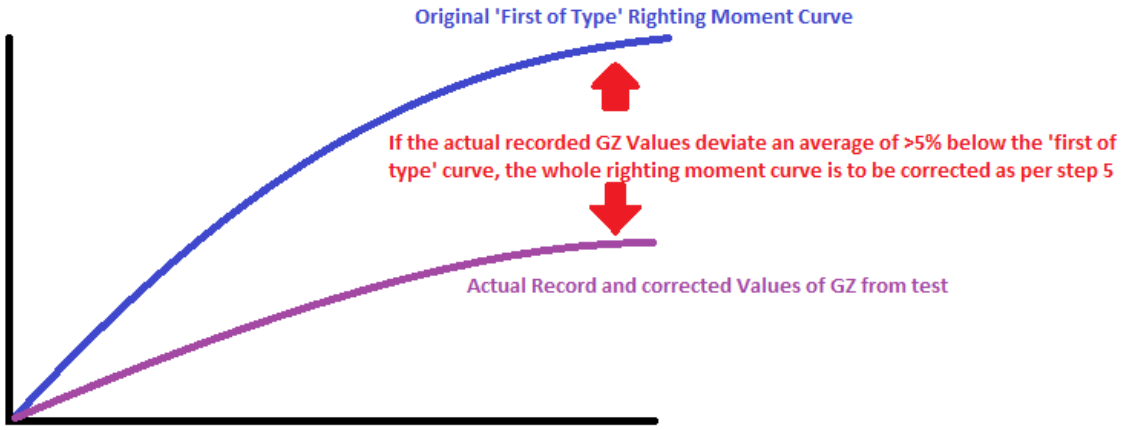

Figure – Showing 'first of type' righting moment curve corrected using 'as built' calculated GZ deviations

It is acceptable for the values of deviation to be above the original curve and when they are, they are not required to be within a certain percentage of the original curve.

Step 6 – Correction of the whole righting moment curve

Where the average deviation is more than 5% below the original righting moment curve, the ***first of type*** righting moment curve is to be corrected throughout the range of heel angles by an amount equal to:

$$GG1\sin\varphi$$

Where:

φ is any heel angle

The value of GG1 is obtained as follows:

$$= \frac{\left\{\left(\frac{\delta}{\sin\emptyset}\right) + \left(\frac{\delta_2}{\sin\emptyset_2}\right) + \left(\frac{\delta_3}{\sin\emptyset_3}\right) + \left(\frac{\delta_4}{\sin\emptyset_4}\right)\right\}}{4}$$

where:

δ_n is the difference in measured GZ from the ***first of type*** GZ curve at angle ∅, for the four values obtained according to *step 2* and calculated according to *step 3* and *step 4* above.

Step 7 – Assessment of "corrected righting moment curve' against ISO 12217 stability criteria

Where the ***first of type*** righting moment curve requires modification at step 6, the corrected righting moment curve is to be reassessed against the applicable requirements of *ISO 12217* to verify compliance of the vessel. A copy of this corrected stability documentation is to be submitted to the National Regulator as well as being provided to the vessel owner.

If following reassessment of the corrected righting moment curve against the respective ISO 12217 stability criteria, the vessel fails the test, the vessel is not fit for purpose for its intended area of operation.

Where a vessel fails the reassessment, the vessel would require a full initial survey as per the requirements of *Marine Order 503 – Certificate of Survey.*

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