

## **D 4 Guidelines concerning stability measuring installations**

### **Scope of application**

In the case of ships equipped with an approved stability measuring system, the IMO Resolution A.749 (18) "Code on Intact Stability for all Types of Ships Covered by IMO Instruments" as amended by the resolution MSC.75(69) of 14 May 1998, an approval of adequate stability according to section 4.9 of the Code is not required.

This rule applies without limitation, i.e. the determination of sufficient stability of ships with stability measurement system during ship's operation installations in service is also permitted if a stability measurement cannot be made in individual cases because of unsuitable measuring conditions, for example.

The ship's command is requested to document continually the results of the stability measurements before each departure. If an approved stability measuring system has been installed later, the approved stability documents and loading computers have to be updated and approved again. This includes:

- Change of the  $KG_C$  and  $GM_C$  limit value tables or curves (including the weather criterion, section 3.2 of the Code);
- Changing the limit values stored in the loading computer;
- On container ships, at least one additional loading case where the ship is loaded with the maximum permitted number of 20 foot containers with a height of 8.5 feet and a weight of 14 tons. The position of the center of gravity is to be assumed at half the container height.

The corresponding documents must be submitted for approval.

If the number of containers changes due to the installation of an approved stability measuring system the approved container stowage and lashing plan has to be updated and also to be submitted for approval.

## 1. General information

A stability measuring installation, also called inclination experiment installation, is used as an aid to determine the current  $GM_C$  and therefore the height center of gravity  $GK_C$  of the laden ship at the time of measurement. In this case, the measurement with a stability measuring installation is largely automated.

The following terms are used in connection with these requirements:

- "Angle of heel" is the inclination of the ship around its longitudinal axis measured from the upright position.
- "Test inclination" is the change in the angle of heel brought about by the shifting of the test mass.

## 2. Inclination test

The  $GM_C$  is determined from the results of an inclination test. It is based on the following input data or measuring data:

- Mass: A defined mass is moved from one side of the ship to the other;
- Distance: The distance of the mass displacement in the athwartships direction is recorded;
- Displacement: This is determined from form data and from draughts to be measured;
- Test inclination: The test inclination is determined as the algebraic difference between the angle of heel after and before the shifting of the mass.

The  $GM_C$  is calculated from these data according to the following equation:

$$GM_C = \frac{\text{Mass} \cdot \text{Distance}}{\tan(\text{testinclination}) \cdot \text{Displacement}}$$

This  $GM_C$  describes the current initial stability of the ship, including the effect of all free surfaces.

To obtain reliable information on the present  $GM_C$ , several measurements are made where the test inclination achieved should not be less than  $2^\circ$  and the angle of heel that occurs should not be greater than  $4^\circ$ .

### **3. Requirements concerning a stability measuring installation**

#### **3.1 System conditions**

The stability measuring installation must be approved by the See-BG. In order to get approval, the installation must satisfy the relevant technical specifications of a recognized classification society.

#### **3.2 Requirements for making a measurement**

The term “measurement” means the process from starting the installation until printing out the report (cf. 2).

- .1 The installation must be designed so that at the time of the measurement, the ship can be heeled by an angle of 2° minimum, but not more than 4°, to both sides of the ship.
- .2 The stability measuring installation must be designed so that the measurement process runs automatically. The results of the measurement are recorded in a report.
- .3 The arrangement and fitting of the stability measuring installation must guarantee that the person making the measurement not only checks the measurement, but permanently monitors the measuring-relevant state of the ship, e.g. its free position at the pier, no loading activity, no transferring of tanks (unless part of the measurement).
- .4 The installation must be designed so that the automated measurement process is completed in 15 minutes if possible, but no later than 20 minutes. In this case, the  $GM_C$  must be assumed as  $GM_{Cmin} + 0.4 \text{ m}$  (from limit curve), and the displacement as corresponding to a draught of 80% of the permitted summer freeboard draught.

#### **3.3 Measuring accuracy required**

Stability measuring installations must be prototype tested by a recognized classification society. The prototype test includes all components that are necessary for determining the  $GM_C$ .

- .1 The angle of heel is determined by means of two independent angle-measuring devices. The processing of the measured values must be able to offset periodic fluctuations in the inclination of the ship through mathematical smoothing so that the fluctuations of the value determined do not drop to more than 10% of the periodic heeling fluctuations within 1 minute. It should be possible to make the stability measurement with a test heeling of at least 2° to each side of the ship, respectively. The maximum admissible error when measuring the angle of heel must not exceed 0.02° (corresponding to 1% of the minimum test inclination).
- .2 The maximum admissible error of installations for automatic draught measurement is  $\pm 2 \text{ cm}$ .
- .3 The equipment used to determine the heeling moment must ensure that the total error of the heeling moment does not exceed  $\pm 2\%$ .
- .4 Density measurements of the water must be made within an accuracy of  $\pm 0.025 \text{ t/m}^3$ .

Prototype testing of the draught measuring installations used in connection with the stability measurement must be proved by a recognized classification society.

### **3.4 Evaluation of the measurement**

- .1 The displacement and KM value are determined from the draughts identified, taking into account the trim and also the hogging/sagging of the ship.
- .2 The measurement must be made to both sides and supplies at least four  $GM_C$  values as a result, e.g.:

Starting position  $\rightarrow$  Bb  $\Rightarrow$   $GM_1$ , Bb  $\rightarrow$  starting position  $\Rightarrow$   $GM_2$ ,

Starting position  $\rightarrow$  Stb  $\Rightarrow$   $GM_3$ , STb  $\rightarrow$  starting position  $\Rightarrow$   $GM_4$

The starting position should lie in the vicinity of the upright position of the ship. For automated processing of the results, the smallest measured individual result is in principle used.

- .3 The loading computer must be able to include the result of the stability measurement in the continuing stability calculation in a suitable manner.

### **3.5 Error recognition and impairment of the measuring process**

- .1 An approved stability measuring installation recognizes failure of individual components and thereupon terminates the measurement or triggers an alarm. If necessary, redundant components, e.g. angle measuring devices, must be provided.
- .2 The ship's management must check the individual results of the measurement for plausibility. If there are extraordinary differences, the test conditions must be checked and the measurement must be repeated if necessary.

### **3.6 Reference tests**

After fitting a stability measuring installation or after completing the ship, the function of the installation is demonstrated. During the process, the angles of heel, draughts and displaced masses are recorded with additional measuring devices independent of the stability measuring installation. If a yard inclination test is carried out with the ship, the stability measuring installation should be tested immediately before or afterwards. In each case, the external conditions are subject to the same requirements as a yard inclination test. The measurement evaluation is submitted to the See-BG for examination.

### **3.7 Re-calibration**

The measuring components installed must be re-calibrated at regular intervals. Draught measuring devices should also be checked by regular comparative readings by the crew to ensure that it is functioning correctly.

**Note:**

In principle, stability measurements are not permitted when the ship is in operation, unless the installation is expressly licensed for this purpose. The essential precondition for this license is the aptitude of the equipment to record reliably average angles of heel with small rolling oscillations and to end the measuring process with a warning if certain limits of these rolling oscillations are exceeded.

If stability measurements are made with a licensed installation when the ship is in operation, the maximum admissible speed through the water in kn is at  $L_{pp}/15$  with  $L_{pp}$  in m, but 8 kn maximum. In this case, the water depth should be at least 1.3 times to 1.5 times the draught. There must be no course changes or bigger rudder positions during the measurement. Automatic steering with small rudder amplitudes has no effect.

**4. Enter into force**

This guideline enters into force on 01 January 2002