ANNEX 6

RESOLUTION MSC.137(76)
(adopted on 4 December 2002)

STANDARDS FOR SHIP MANOEUVRABILITY

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

RECALLING ALSO that by resolution A.751(18) the Assembly approved Interim Standards for ship manoeuvrability (the Interim standards), whereby Governments were recommended to encourage those responsible for the design, construction, repair and operation of ships to apply the Interim Standards and invited to collect data obtained by the application of the Interim Standards and report them to the Organization,

RECALLING FURTHER that by circular MSC/Circ.1053 the Committee approved Explanatory notes to the Standards for ship manoeuvrability, to provide Administrations with specific guidance so that adequate data may be collected by the Organization on the manoeuvrability of ships,

RECOGNIZING the manoeuvring capability of ships to be an important contribution to the safety of navigation,

BELIEVING that the development and implementation of standards for ship manoeuvrability, particularly for large ships and ships carrying dangerous goods in bulk, will improve maritime safety and enhance marine environmental protection,

HAVING CONSIDERED the recommendation made by the Sub-Committee on Ship Design and Equipment at its forty-fifth session,

1. ADOPTS the Standards for ship manoeuvrability, the text of which is set out in the Annex to the present resolution;

2. INVITES Governments to encourage those responsible for the design, construction, repair and operation of ships to apply the Standards to ships constructed on or after 1 January 2004;

3. RESOLVES that the provisions annexed to the present resolution supersede the provisions annexed to resolution A.751(18).

ANNEX

STANDARDS FOR SHIP MANOEUVRABILITY

1 PRINCIPLES

1.1 The Standards for ship manoeuvrability (the Standards) should be used to evaluate the manoeuvring performance of ships and to assist those responsible for the design, construction, repair and operation of ships.

1.2 It should be noted that the Standards were developed for ships with traditional propulsion and steering systems (e.g. shaft driven ships with conventional rudders). Therefore, the Standards and methods for establishing compliance may be periodically reviewed and updated by the Organization, as appropriate, taking into account new technologies, research and development, and the results of experience with the present Standards.

2 GENERAL

2.1 The Standards contained in this document are based on the understanding that the manoeuvrability of ships can be evaluated from the characteristics of conventional trial manoeuvres. The following two methods can be used to demonstrate compliance with these Standards:

.1 scale model tests and/or computer predictions using mathematical models can be performed to predict compliance at the design stage. In this case full-scale trials should be conducted to validate these results. The ship should then be considered to meet these Standards regardless of full-scale trial results, except where the Administration determines that the prediction efforts were substandard and/or the ship performance is in substantial disagreement with these Standards; and

.2 the compliance with the Standards can be demonstrated based on the results of the full-scale trials conducted in accordance with the Standards. If a ship is found in substantial disagreement with the Standards, then the Administration should take remedial action, as appropriate.

3 APPLICATION

3.1 Notwithstanding the points raised in paragraph 1.2 above, the Standards should be applied to ships of all rudder and propulsion types, of 100 m in length and over, and chemical tankers and gas carriers regardless of the length.

3.2 In the event that the ships referred to in paragraph 3.1 above undergo repairs, alterations or modifications, which, in the opinion of the Administration, may influence their manoeuvrability characteristics, the continued compliance with the Standards should be verified.

3.3 Whenever other ships, originally not subject to the Standards, undergo repairs, alterations or modifications, which, in the opinion of the Administration, are of such an extent that the ship may be considered to be a new ship, then that ship should comply with these Standards. Otherwise, if the repairs, alterations and modifications, in the opinion of the Administration, may influence the manoeuvrability characteristics, it should be demonstrated that these characteristics do not lead to any deterioration of the manoeuvrability of the ship.

3.4 The Standards should not be applied to high-speed craft as defined in the relevant Code.

4 DEFINITIONS

4.1 Geometry of the ship

4.1.1 *Length (L)* is the length measured between the aft and forward perpendiculars.

4.1.2 *Midship point* is the point on the centreline of a ship midway between the aft and forward perpendiculars.

4.1.3 *Draught (T_a)* is the draught at the aft perpendicular.

4.1.4 *Draught (T_f)* is the draught at the forward perpendicular.

4.1.5 *Mean draught* (T_m) is defined as $T_m = (T_a + T_f)/2$.

4.1.6 *Trim* (τ) is defined as $\tau = (T_a - T_f)$.

4.1.7 Δ is the full load displacement of the ship (tonnes).

4.2 Standard manoeuvres and associated terminology

Standard manoeuvres and associated terminology are as defined below:

.1 The test speed (V) used in the Standards is a speed of at least 90% of the ship's speed corresponding to 85% of the maximum engine output.

.2 Turning circle manoeuvre is the manoeuvre to be performed to both starboard and port with 35° rudder angle or the maximum rudder angle permissible at the test speed, following a steady approach with zero yaw rate.

.3 Advance is the distance travelled in the direction of the original course by the midship point of a ship from the position at which the rudder order is given to the position at which the heading has changed 90° from the original course.

.4 Tactical diameter is the distance travelled by the midship point of a ship from the position at which the rudder order is given to the position at which the heading has changed 180° from the original course. It is measured in a direction perpendicular to the original heading of the ship.

.5 Zig-zag test is the manoeuvre where a known amount of helm is applied alternately to either side when a known heading deviation from the original heading is reached.

.6 The 10°/10° zig-zag test is performed by turning the rudder alternately by 10° to either side following a heading deviation of 10° from the original heading in accordance with the following procedure:

.1 after a steady approach with zero yaw rate, the rudder is put over to 10° to starboard or port (first execute);

.2 when the heading has changed to 10° off the original heading, the rudder is reversed to 10° to port or starboard (second execute); and

.3 after the rudder has been turned to port/starboard, the ship will continue turning in the original direction with decreasing turning rate. In response to the rudder, the ship should then turn to port/starboard. When the ship has reached a heading of 10° to port/starboard of the original course the rudder is again reversed to 10° to starboard/port (third execute).

.7 The first overshoot angle is the additional heading deviation experienced in the zig-zag test following the second execute.

.8 The second overshoot angle is the additional heading deviation experienced in the zig-zag test following the third execute.

.9 The 20°/20° zig-zag test is performed using the procedure given in paragraph 4.2.6 above using 20° rudder angles and 20° change of heading, instead of 10° rudder angles and 10° change of heading, respectively.

.10 Full astern stopping test determines the track reach of a ship from the time an order for full astern is given until the ship stops in the water.

.11 Track reach is the distance along the path described by the midship point of a ship measured from the position at which an order for full astern is given to the position at which the ship stops in the water.

5 STANDARDS

5.1 The standard manoeuvres should be performed without the use of any manoeuvring aids which are not continuously and readily available in normal operation.

5.2 Conditions at which the standards apply

In order to evaluate the performance of a ship, manoeuvring trials should be conducted to both port and starboard and at conditions specified below:

.1 deep, unrestricted water;

.2 calm environment;

.3 full load (summer load line draught), even keel condition; and

.4 steady approach at the test speed.

5.3 **Criteria**[*]

The manoeuvrability of the ship is considered satisfactory if the following criteria are complied with:

.1 Turning ability

The advance should not exceed 4.5 ship lengths (L) and the tactical diameter should not exceed 5 ship lengths in the turning circle manoeuvre.

.2 Initial turning ability

With the application of 10° rudder angle to port/starboard, the ship should not have travelled more than 2.5 ship lengths by the time the heading has changed by 10° from the original heading.

.3 Yaw-checking and course-keeping abilities

.1 The value of the first overshoot angle in the 10°/10° zig-zag test should not exceed:

.1 10° if L/V is less than 10 s;

.2 20° if L/V is 30 s or more; and

.3 (5 + 1/2(L/V)) degrees if L/V is 10 s or more, but less than 30 s,

where L and V are expressed in m and m/s, respectively.

.2 The value of the second overshoot angle in the 10°/10° zig-zag test should not exceed:

.1 25°, if L/V is less than 10 s;

.2 40°, if L/V is 30 s or more; and

.3 (17.5 + 0.75(L/V))°, if L/V is 10 s or more, but less than 30 s.

.3 The value of the first overshoot angle in the 20°/20° zig-zag test should not exceed 25°.

.4 Stopping ability

The track reach in the full astern stopping test should not exceed 15 ship lengths. However, this value may be modified by the Administration where ships of large displacement make this criterion impracticable, but should in no case exceed 20 ship lengths.

[*] For ships with non-conventional steering and propulsion systems, the Administration may permit the use of comparative steering angles to the rudder angles specified by this Standard.

6 ADDITIONAL CONSIDERATIONS

6.1 In case the standard trials are conducted at a condition different from those specified in paragraph 5.2.3, necessary corrections should be made in accordance with the guidelines contained in the Explanatory notes to the Standards for ship manoeuvrability, developed by the Organization.*

6.2 Where standard manoeuvres indicate dynamic instability, alternative tests may be conducted to define the degree of instability. Guidelines for alternative tests such as a spiral test or pull-out manoeuvre are included in the Explanatory notes to the Standards for ship manoeuvrability, referred to in paragraph 6.1 above.*

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* Refer to MSC/Circ.1053 on Explanatory notes to the Standards for ship manoeuvrability.