C.12.8 Criteria for Assessing the Intact Stability of Large Sailing Vessels and Sailing Auxiliaries

C.12.8.1 These criteria are applicable to all vessels not meeting the criteria for small sailing vessels.

C.12.8.2 Each vessel in this category shall be inclined.

C.12.8.3 Stability Requirements

Vessels of usual form, proportion and rig should meet the following intact stability requirements. In the case of unusual vessels, or where because of other considerations such as size, application of these standards is impractical, other calculations may be required by the Authority.

1. The vessel should have a range of positive stability, throughout her range of operating drafts, from the upright to at least 70° for service on smooth or partially smooth waters and 90° in open waters.
2. The vessel under bare poles, shall meet Weather Criteria of C.1.3.3.2.
3. In addition to complying with provision 1, the adequacy of the vessel's righting arm curve as related to the sail area should be verified by application of the following procedures and criteria.
   (a) Plot the righting arm curve for the most severe operating condition to:
      1. 90°, if the angle of vanishing positive stability is equal to or less than 90°.
      2. The angle of vanishing positive stability if that angle exceeds 90° but is less than 120°.
      3. 120°, if the angle of vanishing positive stability exceeds that value.

   If the angle at which the maximum righting arm occurs is less than 35°, the curve is truncated so that the maximum is no more than the value at 35°. This is shown in Figure 5.

   (b) Assume a wind heeling arm curve of the form $HZ_\theta = HZ \cos^2\theta$ where HZ equals the heeling arm in metres at zero degrees. Compute the following values of HZ for static or dynamic balance, as indicated by subscripts A, B and C below:

      1. HZ_A. Static balance at deck edge immersion, see Figure 16.

$$HZ_A = \frac{HZ_\theta}{\cos^2\theta}$$ where θ equals angle to deck edge immersion

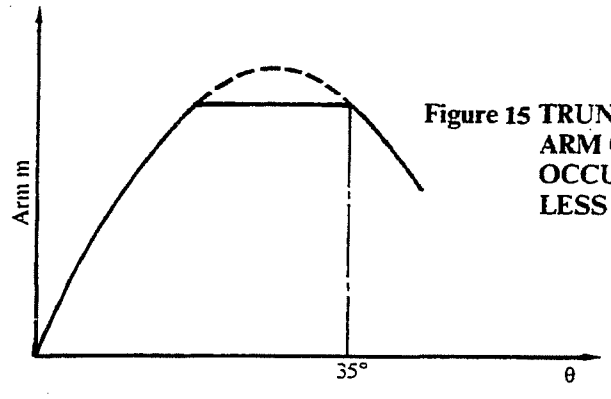

Figure 15 TRUNCATION OF RIGHTING ARM CURVE IF MAXIMUM ARM OCCURS AT AN ANGLE OF LESS THAN 35°

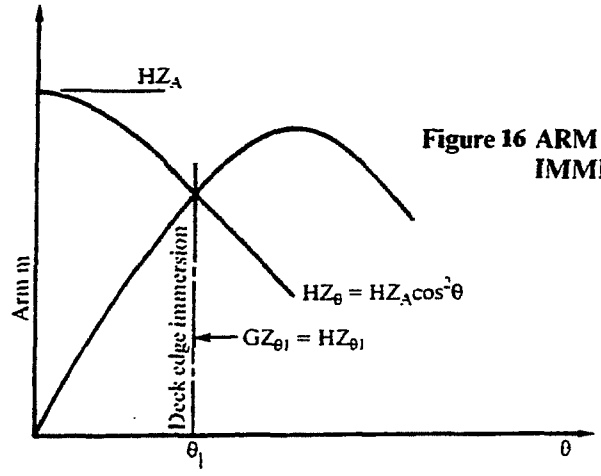

Figure 16 ARM THROUGH DECK EDGE IMMERSION ANGLE θ_1

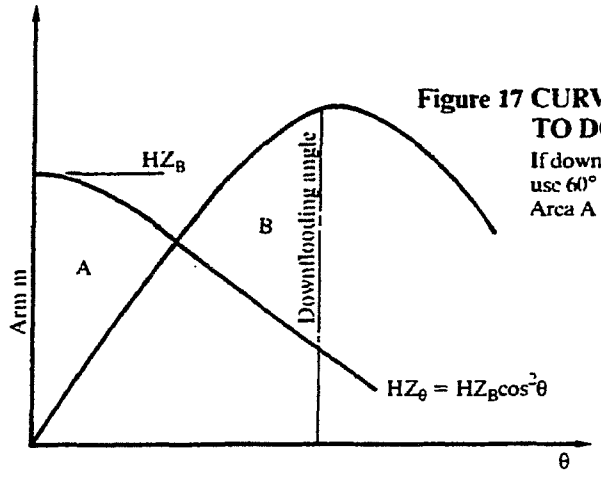

Figure 17 CURVE TO BALANCE AREAS TO DOWNFLOODING ANGLE

If downflooding angle exceeds 60°, use 60° in lieu of angle.
Area A = Area B

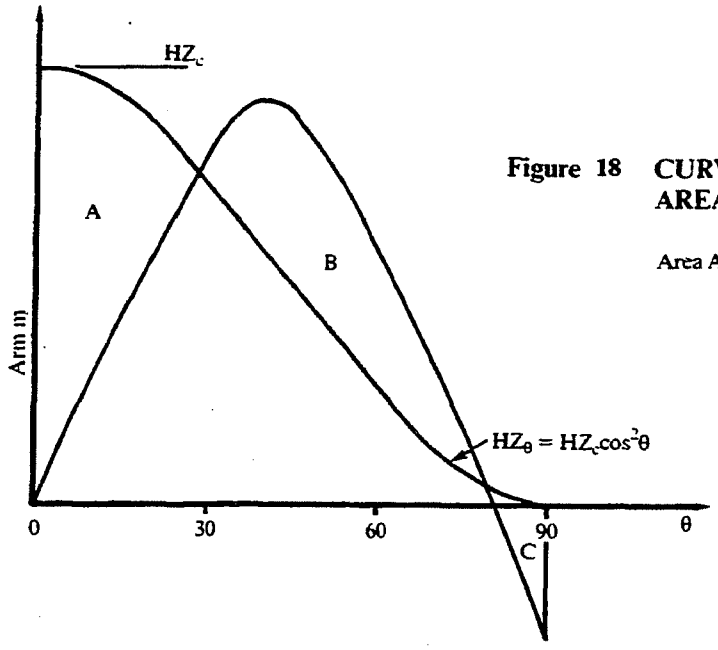

Figure 18 CURVE TO BALANCE AREAS TO 90°

Area A + Area C = Area B

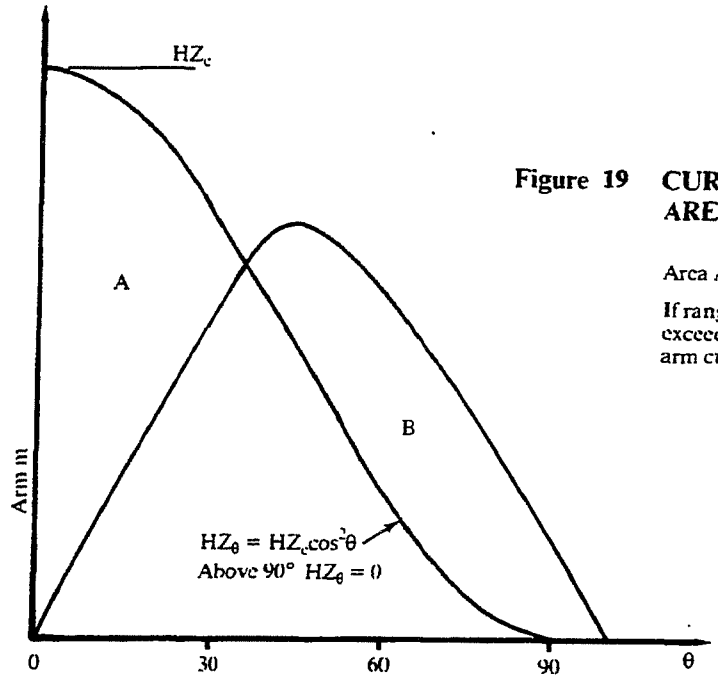

Figure 19 CURVE TO BALANCE AREAS TO CAPSIZE

Area A = Area B

If range of positive stability exceeds 120° cut off righting arm curve at 120°

2. HZ_B. Dynamic balance to downflooding, i.e. angle at which water can enter the hull through hatches, side scuttles, etc. Compute HZ_B so that the area under the righting arm curve equals the area under the heeling arm curve, both taken to the downflooding angle, or as shown in Figure 17 so that area 'A' equals area 'B'. If the angle of flooding exceeds 60°, use 60° in lieu of the downflooding angle.
3. HZ_C. Dynamic balance throughout the range of stability. Compute HZ_C so that the area under the righting arm curve equals the area under the heeling arm curve. If the range is less than 90°, take the areas up to 90°, as shown in Figure 18. If the range is greater than 90°, take the area under the righting arm to the maximum angle of positive stability, but not more than 120° as shown in Figure 19.

Note: HZ_B and HZ_C can be computed from the equation:

$$HZ_B \text{ (or } HZ_C) = \frac{I}{\frac{\theta}{2} + 14.3 \sin 2\theta}$$

where

I equals the area under the righting arm curve to the allowed angle in metre-degrees

and,

θ equals same allowed angle as for I in degrees except it shall never be taken greater than 90°.

(c) Compute the windage area (A) in square metres with all sail set and trimmed flat, and the windage lever (h) in metres as shown in C.1.3.3.2. Where the total area of the head sails is in excess of the fore triangle area the 100 per cent fore triangle area and centre may be used in lieu of those of the individual headsails.

(d) The displacement of the vessel in tonnes is designated △;

(e) The stability will be satisfactory if the following conditions are met:

$$\frac{HZ_A \times \Delta \times 10^3 \times 9.807}{AH} = \text{not less than 105 Pascals}$$

$$\frac{HZ_B \times \Delta \times 10^3 \times 9.807}{AH} = \text{not less than 115 Pascals}$$

$$\frac{HZ_C \times \Delta \times 10^3 \times 9.807}{AH} = \text{not less than 130 Pascals}$$

If any one of the above relationships is not satisfied the vessel should be modified to provide compliance.

C.13 Sail Training Vessels

C.13.1 Sail training vessels shall comply with the criteria for sailing vessels laid down in clause C.12.

C.14 Sailing Catamarans

General notes for sailing vessels C.12.1 to C.12.6 are applicable for catamarans.

C.14.1 Off-the-beach type catamarans that are under 7 m measured length of recognised design and operate on smooth or partially smooth waters during daylight hours only

These may be exempt from detailed stability analysis provided they meet all of the following:

(a) The vessel shall have sufficient buoyancy to support the crew and remain afloat when flooded or capsized. There shall be sufficient buoyancy in the mast to prevent the vessel inverting after capsize.
(b) Operational tests shall be performed to demonstrate that the sails may be lowered without outside assistance on the water in upright and capsized conditions.
(c) Operational tests shall be performed to demonstrate that the vessel shows satisfactory handling characteristics under sail and may be righted without outside assistance.

C.14.2 Class 2 sailing catamarans under 15 m measured length operating in smooth or partially smooth waters.

Vessels operating during daylight hours only may be considered to meet stability requirements if they meet clause 171.057 of US Coastguard Intact Stability Criteria as follows

$$\frac{0.6(W)B}{2(As)(Hm)} > 4.88 \text{ kg/square metre}$$

where:

B = distance between hull centrelines in metres

As = sail area in square metres

Hm = mast height above deck in metres

W = combined displacement of both hulls in kg

Watertight subdivision shall be in accordance with the relevant sections of the USL Code.

C.14.3 Class 2C sailing catamarans under 15m measured length operating in restricted offshore areas.

C.14.3.1 The minimum capsizing moment determined from the dynamic stability curve shall be in excess of the wind heeling moment based upon a pressure of 100 Pa (25 kts). Details of calculations for the minimum capsizing moment are given in Appendix D.

C.14.3.2 The maximum GZ value for the static stability curve shall be at an angle of 10 degrees or greater.

C.14.3.3 The area under the static stability curve to an angle θ shall be at least:

$$3.15\left(\frac{30}{\theta}\right) \text{ metre degrees}$$

where θ is the lesser of the angle of max GZ or 30 degrees.

C.14.3.4 Information to be provided for all vessels meeting C.14.3 shall be set out in three sections as follows:

(1) OPERATIONAL INFORMATION

(a) plan of tanks and ballast
(b) sail plan which includes the centre of area of each sail above a specified base
(c) angle of half hull emersion and full hull emersion at the given load conditions
(d) guidance notes for the master explaining the significance of maximum GZ with reference to range of stability and also setting out the masters responsibilities

(2) TECHNICAL DATA

(a) tank capacities and KG values
(b) conditions of loading with stability curves and wind heeling moments

(3) REFERENCE INFORMATION

(a) hydrostatic data
(b) KN curves and an explanation of their use
(c) reliable estimate of lightship VCG and LCG
(d) sample calculation from freeboard measurements to hydrostatic draft
(e) sample calculation and plot of wind heeling moment
(f) GZ curve illustrating the loss of effective area under the GZ curve in significant wave conditions.

C.14.3.5 Watertight subdivision shall be in accordance with the relevant section of the USL Code.

C.14.4 Class 1D sailing catamarans under 15m measured length operating in smooth or partially smooth waters.

C.14.4.1 the vessel shall comply with all stability criteria as set out in C.14.3.1 to C.14.3.3.

C.14.4.2 Specific data listed in C.14.3.4 is required.

C.14.4.3 the passenger moment is to be calculated using the passenger crowding data as set out in C.1.1.

C.14.4.4 With the vessel under bare poles the wind heeling moment based upon a pressure of 300 Pa is to be calculated.

C.14.4.5 When the combined passenger heeling moment and wind heeling moment is superimposed on the static stability curve the value of GZ at the intersection of the combined curves shall not exceed 60% of the maximum value of GZ.

C.14.4.6 Watertight subdivision shall be in accordance with the relevant sections of the USL Code.

C.14.5 Class 1 sailing catamarans less than 15m measured length operating in offshore and restricted offshore areas.

Note: *Intact stability analysis is required for the vessel under bare poles as well as under sail. Damaged stability is to be calculated for bare poles.*