

PART VIII – STABILITY AND PITCH GYRADIUS

8.01 Inclining Tests.

Inclining tests shall be made to determine the righting moment of the yacht. Except for inclining apparatus including spinnaker pole(s) as specified below the yacht shall be in measurement trim as detailed in 5.02.2. In the case of a yacht fitted with a centerboard or drop keel which is not locked to prevent movement for measurement and racing, the inclining tests will be carried out with the centerboard or drop keel fully raised. The yacht shall be inclined as detailed below:

- 8.01.1** A manometer, to the specification circulated to rating authorities, shall be positioned athwart the yacht where it can be read by the measurer, who shall be stationed off the yacht.
- 8.01.2** Two poles shall simultaneously be positioned port and starboard at the MB station and suspended outboard to provide arms for supporting inclining weights. The poles shall be arranged normal to the yacht's centerline and as nearly horizontal as is possible but allowing sufficient clearance to prevent the weights touching the water. The poles shall be approximately SPL in length and the yacht's pole or poles shall normally be used when available. If a yacht's pole is not used it shall not be on board.
- 8.01.3** A set of weights shall be prepared (see 8.05). The weights shall be recorded in pounds when the yacht is measured in feet and in kilograms when the yacht is measured in meters. The weights shall be measured and recorded to a level of precision not less than 0.1 of a pound or 0.2 of a kilogram. If water containers are used as weights the scales used for measurement shall be regularly tested to ensure that they are accurate.
- 8.01.4** When the poles are rigged and all the weights suspended on the starboard side the datum on the manometer shall be marked. In the case of an electronic inclinometer with continuous sampling, a record shall be recorded and the average taken.
- 8.01.5** The weight shall be transferred to the port side, the measurer recording the weight transferred and the manometer read.
- 8.01.6** All the weights shall be suspended on the starboard side once again and the datum on the manometer verified following the procedures in 8.01.4.

INCLINING MEASUREMENTS

8.02 Pendulum Length (PL).

Pendulum Length Measured (**PLM**) shall be the length of the manometer from the center line of the fluid reservoir to the centerline of the gauge cylinder; it shall be recorded in millimetres to one place of decimals and shall not be less than 2000.0mm. Gauge surface area (**GSA**) shall be the surface area of the manometer gauge. Reservoir surface area (**RSA**) shall be the surface area of the fluid reservoir. PLM, GSA and RSA shall be common to all readings. PL shall be obtained from the formula:

$$PL = PLM / (1 + GSA/RSA)$$

Note: Where an ORR approved electronic inclinometer is used instead of a manometer, PLM is conventionally recorded as 9000; GSA and RSA as 1.0.

8.03 Weight Distance (WD)

WD shall be the horizontal distance from the point of attachment of the starboard weight to the point of attachment of the port weight. It shall be measured with the weights distributed equally on the two pole ends. The weights shall be attached so that the weight distance is constant for all tests. The weight distance shall be of the order of maximum beam (MB)+2.0*SPL.

8.04 Pendulum Deflections (PD)

PD shall be the deflection on the manometer gauge after each weight of the set has been moved, from the datum established in 8.01.4 above. They shall be recorded in millimetres and shall be within the limits given in 8.05 below.

8.05 Weights (W)

W shall be the total weight suspended from the port pole for each reading of the manometer. The weight shall be of suitable magnitude to ensure that the largest PD is within +/- 0.01*PL of 0.105*PL for yachts with LOA > 41.0 ft and +/-0.01*PL of 0.125*PL for yachts with LOA <= 41.0 ft.

RIGHTING MOMENT -- MEASUREMENT TRIM

8.06 Inclining Slope (SLOPE)

The slope of the straight line through the inclining weight vs. pendulum deflection is determined.

8.07 Righting Moment (RM).

$$RM=WD*PL*0.0175/SLOPE$$

8.08 Righting Moment Corrected (RMC).

8.08.1 For yachts with fixed keels or centerboards locked to prevent any movement: RMC=RM

8.08.2 For movable boards or drop keels, RMC is adjusted for the movement of the board/keel.

RIGHTING MOMENT AND WEIGHTS -- SAILING TRIM

8.09 Righting Moment per Degree in Sailing Trim at 2 degrees Heel (RM2).

RM2 shall be calculated from the displacement and vertical center of gravity in Measurement Trim by the addition of weight for the mainsail (MSW), crew, gear and other sails at their established centers of gravity.

8.10 Righting Moments by Heel Angle (RM2, RM20, RM25, RM40, RM60 and RM90).

These are the Sailing Trim righting moments at 2, 20, 25, 40, 60 and 90 degrees of heel (with all crew on the yacht's centerline) divided by the heel angle in degrees. The VPP uses these to establish the righting moment vs. heel angle curve for the yacht. This stability curve is augmented by moving Crew Weight to the weather rail when appropriate, by dynamic stability effects, and by moveable ballast.

8.11 Crew Weight (CW), Base Crew Weight (BCW).

A maximum crew weight is calculated for each yacht. The owner may, by "owner declaration" (see 8.12), adjust his yacht's maximum allowed crew weight up or down within calculated limits. The VPP takes this crew weight into account. Where no declaration of crew weight has been made, 1.2 * Base Crew Weight (BCW) will be used in the VPP and will be the maximum allowable for racing. BCW is determined by the formula:

$$BCW(\text{lb.}) = (\text{DSPM}/2240/(\text{.01}*\text{LSM0})^3/254)^{\text{.375}}*(\text{RM}/(\text{DSPM}*MB)/\text{.00571})^{\text{.4}}*\text{LSM0}^{\text{1.55}}*7.6$$

In the above formula, DSPM is displacement in Measurement Trim and MB is the Maximum Beam taken from the hull offsets. RM is the righting moment per degree in standard water in measurement trim with the VCG effect of inclining weights removed. LSM0 is an effective sailing length in Measurement Trim.

8.12 Declared Crew Weight (DCW).

Declared Crew Weight (DCW) shall not be taken as less than the greater of 555.0 lb. or 0.65 times the calculated default for the yacht. Nor shall DCW be taken as greater than 1.2 times the calculated default. Yachts with DCW greater than default do not get credit for the extra crew being above the yacht's sailing trim VCG. These yachts will have sailing trim calculated with default crew weight, but the full DCW will be used in calculations that move crew onto the rail in optimizing performance to sailing conditions.

PITCH GYRADIUS

8.13 Elements of Pitch Gyradius.

The following elements of the pitch gyradius calculation shall be determined by examination of the yacht and recorded on her certificate. Where deemed appropriate, a declaration from the owner may be substituted for examination of one or more elements, but all elements are subject to examination at any time in cases of doubt.

8.13.1 Hull and Deck Construction. Owners are reminded of their obligations under ORR 3.02.4. Hull and deck construction shall be classified as one of the types below. Note that limited amounts of high strength carbon edge capping of bona fide hull structural frames, girders and stringers, and as localized reinforcement on bulkhead faces in way of chainplate attachments, will not affect the hull construction category provided it is used below decks between 0.3LOA and 0.7LOA aft of the stem.

SOLID: Non-cored, solid E-glass, metal or wood hull and deck, but including also E-glass decks with core material. Where the construction is of wood, the minimum density of any layer shall not be less than 300 kilograms per cubic meter.

CORED: Hull skin of E-glass (see above) or wood, but incorporating a core material of less density than the skin.

LIGHT: All other construction types, but excluding the incorporation of any carbon fiber (see below).

CARBON: Where carbon fiber has been incorporated anywhere in the construction of the hull and/or deck.

HCMB: In addition to recording the appropriate construction type as above, where a honeycomb core has been incorporated in hull or deck construction, this shall also be recorded.

8.13.2 Rudder Construction. Rudder construction shall be classified as one of the following:

STANDARD: Neither rudder nor rudder post contain any carbon fiber.

CARBON: Rudder and/or rudder post contain carbon fiber in any amount.

8.13.3 Forward Accommodation. Where the bow forward of the mast is fully fitted out as a separate sleeping or living space built of solid construction, including bunks (pipe berths do not qualify), personal gear stowage, etc., the yacht shall be classified as having Forward Accommodation which shall be recorded on the Certificate.

8.13.4 Number of Spreader Sets. The number of sets of mainmast spreaders shall be recorded on the Certificate.

8.13.5 Jumper Struts. Where the mainmast incorporates jumper struts, this shall be recorded on the Certificate.

8.13.6 Number of Runners (Inner Backstays) and Adjustable Inner Forestays; see 9.12.4.

8.14 Assessment of Pitch Gyradius.

The VPP assesses the added resistance of the hull resulting from sailing in wind-driven waves using a routine which estimates a base pitch gyradius. The pitch gyradius is an indicator of how spread the weights of a boat are. A small gyradius indicates that the weights are relatively concentrated. In general, the higher the gyradius is, the greater the added resistance. Adjustments are made to the base gyradius according to the following recorded characteristics of the yacht:

8.14.1 If Mast Weight (MWT) and Mast Center of Gravity (MCG) have been recorded, the gyradius contribution of the mast is assessed as compared to that of a hypothetical base aluminum mast and a corresponding mathematical gyradius adjustment is made.

8.14.2 For a yacht measured afloat with a carbon mast, where MWT and MCG are not recorded, the base gyradius shall be adjusted by a default mast gyradius increment.

8.14.3 If MWT and MCG are not recorded, the gyradius is increased in accordance with the number of spreader sets, jumpers struts, adjustable inner forestays and running backstays.

8.14.4 Further gyradius adjustments are made for:

- a) Mizzen mast,
- b) Hull construction: SOLID, CORED, LIGHT, CARBON, HONEYCOMB,
- c) Age Date,
- d) Forward Accommodation,
- e) Carbon fiber rudder construction.