

# APPENDIX 1 INCLINING EXPERIMENT AND WEIGHING TEST

## 1 Inclining experiment and lightweight check

### 1.1 General

**1.1.1** The procedure from [1.1.3] to [1.1.8] are to be applied. For multihull or sailing yachts, the procedure from [1.1.2] to [1.1.7] are to be applied. The requirements of [1.1.8] will be examined on a case by case basis. As an alternative to [1.1.8], a detailed list of the weights and their centre of gravity has to be submitted to the Society.

Prior to the experiment, the procedure of the inclining experiment has to be submitted to the Society, for examination.

The report of the inclining experiment has to be signed by the attending Society's Surveyor, in order to confirm all the input data such as density of sea water, draught readings, deflection of the pendulum.

#### 1.1.2 General conditions of the yacht

The Society's Surveyor is to be satisfied of the following:

- the weather conditions are to be favorable
- the yacht is to be moored in a quiet, sheltered area free from extraneous forces, such as to allow unrestricted heeling. The yacht is to be positioned in order to minimize the effects of possible wind, stream and tide
- the yacht is to be transversely upright and the trim is to be taken not more than 1% of the length between perpendiculars. Otherwise, hydrostatic data and sounding tables are to be available for the actual trim
- lifesaving appliances capable of inducing oscillations are to be secured
- the system containing liquids such as pipes, are to be filled
- the bilge and the decks are to be thoroughly dried
- preferably, all tanks are to be empty and clean, or completely full. The number of tanks containing liquids is to be reduced to a minimum taking into account the above-mentioned trim. In particular the filling of slack tanks is to be less than 80% to avoid any influence of structural elements. The shape of the tank is to be such that the free surface effect can be accurately determined and remain almost constant during the experiment. All cross connections are to be closed
- the weights necessary for the inclination are to be already on board, located in the correct place
- all work on board is to be suspended and crew or personnel not directly involved in the inclining experiment is to leave the yacht
- the yacht is to be as complete as possible at the time of the experiment. The number of weights to be removed

added or shifted is to be limited to a minimum. Temporary material, tool boxes, staging, sand, debris, etc., on board is to be reduced to an absolute minimum

- lifting keels have to be located on the highest position. Canting keels have to be upright and cannot be used as shifting weights.

#### 1.1.3 Inclining weights

The total weight should be sufficient to provide a minimum inclination of two degrees and a maximum of four degrees of heel to each side. However, a minimum inclination of one degree to each side may be accepted for sailing yachts or multihulls provided that the requirement on pendulum deflection or U-tube difference in height specified in [1.1.4] is complied with. Test weights are to be compact and of such a configuration that the VCG (vertical centre of gravity) of the weights can be accurately determined. Each weight is to be marked with an identification number and its weight. Re-certification of the test weights is to be carried out prior to the incline. A crane of sufficient capacity and reach, or some other means, is to be available during the inclining experiment to shift weights on the deck in an expeditious and safe manner. If the yacht has water ballast tanks, water ballast cannot be used as inclining weight.

#### 1.1.4 Pendulums

The use of two pendulums is requested to allow identification of bad readings at any one pendulum station. However, for yachts of a length equal to or less than 30 m, only one pendulum can be accepted. They are each to be located in an area protected from the wind. The pendulums are to be long enough to give a measured deflection, to each side of upright, of at least 10 cm. To ensure recordings from individual instruments are kept separate, it is suggested that the pendulums be physically located as far apart as practical.

The use of an inclinometer or U-tube is to be considered in each separate case. It is recommended that inclinometers or other measuring devices only be used in conjunction with at least one pendulum.

#### 1.1.5 Means of communications

Efficient two-way communications may be provided between central control and the weight handlers, and between central control and each pendulum station. One person at a central control station is to have complete control over all personnel involved in the experiment. The internal means of communication inside the yacht may be used for this purpose.

1.1.6 Documentation

The person in charge of the inclining experiment is to have available a copy of the following plans at the time of the experiment:

- hydrostatic curves or hydrostatic data
- general arrangement plan of decks, holds, inner bottoms, etc.
- capacity plan showing capacities and vertical and longitudinal centres of gravity of cargo spaces, tanks, etc.
- tank sounding tables
- draught mark locations
- docking drawing with keel profile and draught mark corrections (if available).

1.1.7 Determination of the displacement

The Society’s Surveyor is to carry out all the operations necessary for the accurate evaluation of the displacement of the yacht at the time of the inclining experiment, as listed below:

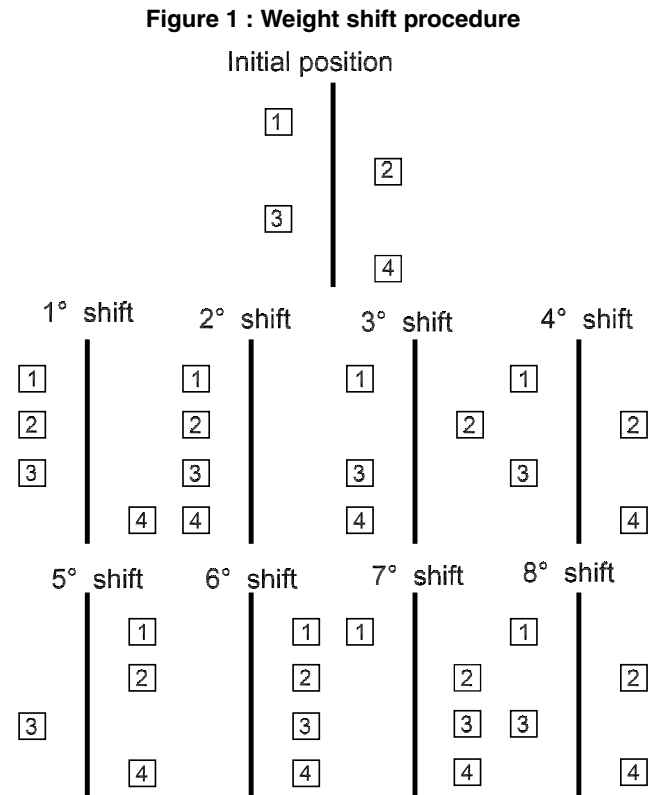
- draught mark readings are to be taken at aft and forward, at starboard and port sides. These draughts are also to be taken at midship, as far as practicable
- the mean draught (average of port and starboard readings) is to be calculated for each of the locations where draught readings are taken and plotted on the yacht’s lines drawing or outboard profile to ensure that all readings are consistent and together define the correct waterline. The resulting plot is to yield either a straight line or a waterline which is either hogged or sagged. If

inconsistent readings are obtained, the freeboards/draughts are to be retaken

- the specific gravity of the sea water is to be determined. Samples are to be taken from a sufficient depth of the water to ensure a true representation of the sea water and not merely surface water, which could contain fresh water from run off of rain. A hydrometer is to be placed in a water sample and the specific gravity read and recorded. Where the value of the average calculated specific gravity is different from that reported in the hydrostatic curves, adequate corrections are to be made to the displacement curve
- all double bottoms, as well as all tanks and compartments which can contain liquids, are to be checked, paying particular attention to air pockets which may accumulate due to the yacht’s trim and the position of air pipes, and also taking into account the provisions of [1.1.2]
- the possible solid permanent ballast is to be clearly identified and listed in the report
- the yacht should be as upright as possible and have sufficient draught so that any abrupt changes in the water-plane will be avoided as the yacht is inclined from side to side. A deviation from design trim of up to 1% of  $L_{LL}$  is normally acceptable when using hydrostatic data calculated at design trim. Otherwise, the hydrostatic data should be calculated for the actual trim. With inclining weights in the initial position, up to one-half degree of list is acceptable.

1.1.8 The incline

The standard experiment generally employs eight distinct weight movements as shown in Fig 1.



The weights are to be transversally shifted, so as not to modify the yacht's trim and the vertical position of the centre of gravity.

After each weight shifting, the new position of the transverse centre of gravity of the weights is to be accurately determined.

After each weight movement, the distance the weight was moved (centre to centre) is to be measured and the heeling moment calculated, multiplying the distance by the amount of weight moved. The tangent is calculated for each pendu-

lum, dividing the deflection by the length of the pendulum. The resultant tangents are plotted on the graph as shown in Fig 2.

The pendulum deflection is to be read when the yacht has reached a final position after each weight shifting.

During the reading, no movement of personnel is allowed.

For yachts with a length equal to or less than 30 m, six distinct weight movements may be accepted.

Figure 2 : Graph of resultant tangents

