

Treball de Fi de Grau

Grau en Enginyeria en Tecnologies Industrials

# **Hydrofoils. Aplicació a la Copa Amèrica**

**Annex-Normativa**

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# **America's Cup Class Rule Version 1.6**

**September 7, 2016**

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## INTRODUCTION

**Competitors** are ultimately and solely responsible for the safety and structural integrity of the whole (and any part or parts) of their **AC Class Yacht**. No express or implied warranty of safety and/or structural integrity shall result from compliance with the whole or any part of this **AC Class Rule**. Any structural testing required for compliance with the **AC Class Rule** does not guarantee safety or structural integrity nor does it relieve the **Competitor** of this responsibility

While racing, **Competitors** shall ensure that their **AC Class Yacht** complies with the **AC Class Rule**.

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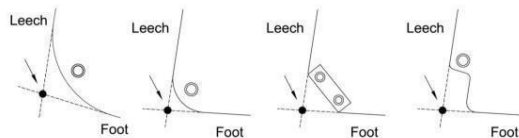
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## SECTION A

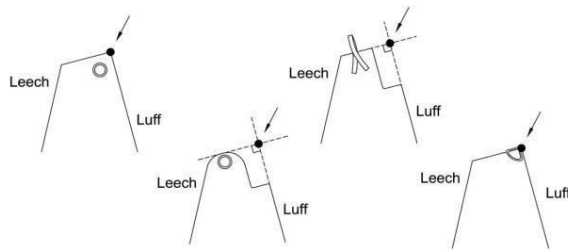
### 1. LANGUAGE AND DEFINITIONS

- 1.1 The official language of the **AC Class Rule** is English. Except for words defined herein, the meaning of any word will be determined by reference to the Oxford English Dictionary. When there is more than one definition in the Dictionary, the **Measurement Committee** will determine the appropriate definition, and may consult other references in making that determination.
- 1.2 When a term is used in its defined sense, it is printed in bold type.
- 1.3 The words "shall", "must", and "will" are mandatory. The words "can" and "may" are permissive.
- 1.4 In interpreting this **AC Class Rule**, the definitions in Article 1 of the **Protocol** shall apply, and:
  - (a) **appendage** means any component that is wholly or partially submerged at any time during racing that is connected to and external to the **hull** canoe body, or a **rudder wing** that is connected to a **rudder**, and including integral components that extend from outside the **hull** into the **hull** (e.g. **daggerboard** head or **rudder** stock). **Appendage** does not include **cross structure**, **daggerboard** bearings, **rudder** bearings, **daggerboard** fairings, other fairings that are above 0.100 m above **MWP**, deck hardware and small fittings;
  - (b) **appendage measurement condition** means the condition of the **AC Class Yacht** as specified in Rule 27.2;
  - (c) **bowsprit** means a spar that supports the **jib** tack and includes the bowsprit end fittings as shown in Appendix D and E.
  - (d) **cant axis** means a **daggerboard** axis of rotation that is within 3.0 degrees of parallel to a **longitudinal** axis;
  - (e) **clew** means the area on the surface of a **jib** within 1.000 m of the **clew point**;
  - (f) **clew point** means the intersection of the **leech** and **foot**, projected as necessary;



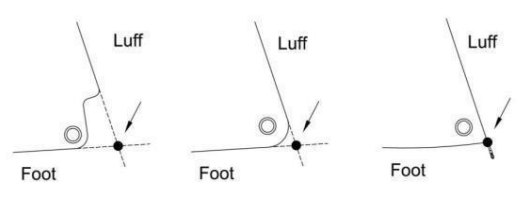
- (g) **control surfaces** means the **wing**, **jib**, **daggerboards**, **rudders** and their attached **rudder wings**

- (h) **cross structure** means the components used to connect the **hulls** or to support the **wing, rigging** or **jib**, including any part of these components which extend into the **hull** and that are removed from the **hull** if the **AC Class Yacht** is disassembled and including non-structural aerodynamic fairings attached to these components, but excluding trampolines. The **wing, rigging** or the **jib** may also be supported from fittings attached to the **hulls**;
- (i) **daggerboard** means a retractable **appendage** primarily used to affect leeway or generate **vertical** force. The term **daggerboard** is synonymous with bilge board, centerboard, daggerfoil, lifting keel and sliding keel;
- (j) **fiber modulus** means the batch-nominal elastic modulus of the fibers in an **FRP** laminate with the modulus measured with impregnated tows, by extensometers, between 1000 and 6000 microstrains; the **Measurement Committee** will accept the following testing methods (and may accept other similar methods): SACMA-SRM16, ASTM D 4018, or JIS R 7601;
- (k) **foot** means the bottom edge of the **jib** in its normal configuration when in use;
- (l) **FRP** means fiber-reinforced polymer matrix composites;
- (m) **head** means the intersection of the **luff** or the extension of the **luff** and a line perpendicular to the **luff** that is coincident with the uppermost point on the surface of the **jib**;



- (n) **hull** means one of two canoe bodies including their removable bows, which together displace the majority of the **AC Class Yacht's** weight when floating in **measurement condition**;
- (o) **hull centerplane** means the **longitudinal** plane of symmetry of a **hull**;
- (p) **IGES File** means a digital file (.igs) issued by the **Regatta Director** that describes specific surfaces of an **ACC Class Yacht**, molds or Master Patterns;
- (q) **interpretation** means an explanation or clarification of the **AC Class Rule** issued in writing by the **Measurement Committee** in accordance with Rule 3.1;
- (r) **jib** means the sail set forward of the **wing**;
- (s) **luff** means the forward edge of the **jib**, excluding **head** pennants or **tack** pennants;
- (t) **leech** means the aft edge of the **jib**;
- (u) **longitudinal** means the direction parallel to the line produced by the intersection of **MWP** and the **yacht centerplane**;
- (v) **LP** means the distance, measured perpendicular to the **luff**, from the **luff** to the **clew point** of a **jib**;
- (w) **manual** means the input is only provided by one or several crew member(s) and such input is not limited to actions with the crew's hands;

- (x) **maximum beam** means the greatest distance on the **transverse** axis of the **AC Class Yacht**, with all components at their greatest distance from the **yacht centerplane**, excluding **wing, appendages** and associated lifting posts, or winch handles;
- (y) **measurement condition** means the condition of the **AC Class Yacht** as specified in Rule 27.1;
- (z) **measurement weight** means the weight of the **AC Class Yacht** in **measurement condition**;
- (aa) **measurer** means a person appointed by the **Measurement Committee** to perform measurement services or compliance checks. A **measurer** may or may not be a member of the **Measurement Committee**;
- (bb) **MWP** is the horizontal reference plane as defined in Appendix C and D.
- (cc) **rake axis** in relation to:
  - (i) a **daggerboard** means the axis of rotation that is within 0.5 degrees of orthogonal to the **cant axis**; or
  - (ii) a **rudder** means the axis of rotation within 1.0 degree of parallel to a **transverse** axis.
- (dd) **rigging** means ropes, cables or rods that are primarily loaded in tension and are essentially ineffective in compression;
- (ee) **rudder** means a movable **appendage** primarily used to affect steerage;
- (ff) **rudder wing** means an **appendage** attached to a **rudder** and primarily used to affect pitch;
- (gg) **sailing weight** means the sum of the **measurement weight** and the weight of the **wing** when the **wing** is in **wing measurement condition**.
- (hh) **stem plane** means the **vertical transverse** plane that passes through the forward-most point of the **hulls** including fittings attached to **hulls**;
- (ii) **stern plane** means the **vertical transverse** plane that passes through the aft-most point of the **hulls** including fittings attached to **hulls**;
- (jj) **tack** means the intersection of the **luff** and **foot**, projected as necessary;



- (kk) **tack point** means the point where the centerline of the **forestay** (or projection thereof) intersects the **cross structure**;
- (ll) **transverse** means the direction orthogonal to the **yacht centerplane**;
- (mm) **vertical** means the direction orthogonal to **MWP**;
- (nn) **wing** means a rigid or semi-rigid structure, similar to an aircraft wing fixed approximately **vertically** to provide propulsion from the wind;
- (oo) **wing centerplane** means the **wing's** plane of symmetry;
- (pp) **wing datum plane** means the plane orthogonal to the designed leading edge of the **wing** through Appendix E point "A", orthogonal to the **wing centerplane**;

- (qq) **wing measurement condition** means the condition used to measure the weight and center of gravity of the **wing** in accordance with Rule 27.3;
- (rr) **wing measurement position** means the **wing** with all movable measured **wing** surfaces oriented symmetrically about the **wing centerplane** and with the **wing centerplane** leveled to the satisfaction of the **measurer**;
- (ss) **wing rotation point** means the point about which the lowest compressive load-bearing component of the **wing** rotates relative to the **AC Class Yacht**;
- (tt) **wing spar** means the spar, made up of two **wing spar** sections, that carries most of the compression loads due to sail (including **wing**) and **rigging** loads, and which are substantially transferred to the yacht through the **wing rotation point**;
- (uu) **wing top plane** means the plane through points C and D on the top of the **wing**, and orthogonal to the **wing centerplane** as shown on the **wing** Appendix E
- (vv) **yacht centerplane** means the **longitudinally** oriented plane of symmetry of the **AC Class Yacht** that is orthogonal to **MWP** and lies between the two **hulls**.
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## 2. UNITS OF MEASUREMENT

- 2.1 **Vertical, longitudinal** and **transverse** references to a **wing** assume the **wing datum plane** is parallel to **MWP**.
- 2.2 The Metric System shall be used for all measurements. Unless a Rule requires otherwise, the following resolutions shall be used:
- (a) length measured in meters to three decimal places, except that **jibs** shall be measured to two decimal places;
  - (b) **sailing weight, measurement weight, and wing** weight measured in kilograms to the nearest 5 kg;
  - (c) areas measured in square meters to two decimal places;
  - (d) volumes measured in cubic meters to two decimal places, or liters, as specified herein;
  - (e) angles measured to the nearest 0.25 degree; and
  - (f) any other measurement taken to a degree of precision determined by the **Measurement Committee** to be appropriate.
- 2.3 The measuring equipment used by the **Measurement Committee** shall be the reference devices for determining compliance with the **AC Class Rule**.
- 2.4 Herein, "between" two points or numbers means inclusive of those points or numbers, i.e., "between 1.000 m and 2.000 m" means "between 1.000 m and 2.000 m inclusive."
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## 3. INTERPRETATION

- 3.1 A **Competitor** may seek an **interpretation** by submitting a request in writing to the **Measurement Committee**, or the **Measurement Committee** may initiate an **interpretation**. The **Measurement Committee** shall issue **interpretations** publicly within 21 days of the receipt of the request or receipt of any additional required information. The **Measurement Committee** may request a longer period subject to agreement of the **Competitor** seeking the **interpretation**.
- 3.2 A **Competitor** shall not rely on any advice or opinion from a **measurer** or a member of the **Measurement Committee** other than through an **interpretation**.

- 3.3 If a **Competitor** fails to obtain an **interpretation** regarding a characteristic of design or construction, the **Measurement Committee**, with the approval of the **Regatta Director**, may refuse to issue or may withdraw the **AC Class Yacht's** measurement certificate until such characteristic is the subject of an **interpretation** which permits it.
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#### 4. **AMENDMENT**

- 4.1 The **AC Class Rule** may be amended at any time by unanimous consent of **Competitors** still competing and the **Regatta Director**, except that:
- (a) At any time the **Measurement Committee**, in consultation with **Competitors** and with the approval of the **Regatta Director**, may amend the **AC Class Rule** with respect to safety, safety equipment, media equipment, or event branding, including their impact on **sailing weight**;
  - (b) Subject to Rule 4.1 (c), prior to June 11, 2015, the **AC Class Rule** may be amended with the approval of the **Defender**, and a majority of the **Challengers** in the **Challenger Committee**, in any respect.
  - (c) Appendix C, D, and E may be amended with the approval of the **Defender**, and the majority of the **Challengers** in the **Challenger Committee**, in any respect prior to the following dates:

|                |                    |
|----------------|--------------------|
| Appendix C & D | November 25, 2015  |
| Appendix E     | September 30, 2015 |
  - (d) Notwithstanding Rule 4.1 (c), parts of Appendix C, D, and E may be frozen prior to the dates listed in Rule 4.1(c) respectively. Any Rule which has been frozen under this Rule 4.1 (d) may only be amended thereafter by unanimous consent of the **Competitors**.
  - (e) After the dates specified in Rule 4.1 (c), the Regatta Director, with the approval of the Measurement Committee and in consultation with the Competitors may amend Appendix C, D and E at any time, provided the amendment is only to correct errors and omissions. The Regatta Director shall also take into consideration the stage of construction of all competitors components which may be effected by any such amendment.
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#### 5. **AC CLASS YACHT IDENTIFICATION**

- 5.1 **AC Class Yacht** identification numbers shall be allocated sequentially by the **Measurement Committee**, except numbers that may be culturally objectionable may be skipped at the discretion of the **Measurement Committee**. When an **AC Class Yacht's** ownership is transferred, it shall retain the same identification number.
- 5.2 A new identification number (in sequence) may be reserved by a team when construction of an **AC Class Yacht's hull(s)** has commenced.
- 5.3 A new identification number shall be issued to the **AC Class Yacht** when its original measurement certificate is issued, or when otherwise required by the **Protocol**.
-



## SECTION B

### 6. GENERAL

- 6.1 The **AC Class Yacht** shall be a vessel, generally known as a catamaran, which has two **hulls** that are connected by **cross structure** and arranged symmetrically about the **yacht centerplane**, with each **hull** having one **rudder** and one **rudder wing**, one **daggerboard**, and no other **appendages**. The **AC Class Yacht** shall have one **wing** and no more than one **jib**.
- 6.2 The **hulls**, **cross structure**, and **wing spar** curved shell shall be built using **Measurement Committee** certified Master Patterns. The build tolerance on these patterns shall be +/- 0.002 m referenced to the **IGES File** supplied by the **Regatta Director**. Where specified in Appendix C, D and E, molds approved by the **Measurement Committee** shall be built and used for component fabrication but they shall not be manipulated or modified or designed to manipulate or modify the resulting component shapes in any way.
- 6.3 The build tolerances specified in Appendices C, D, and E shall not be used to modify or optimize any supplied design.
- 6.4 Construction and assembly and methods, from Appendices C, D, and E form part of the **AC Class Rule** must be complied with and certified by declarations of Appendix B, except:
- (a) **Competitors** may make up to 2 changes to the structural design in the **wing** and each **hull** as defined in Appendices C and E. The changes shall not exceed the redistribution of more than 5 kg total for each **hull** and 3 kg in the **wing**. These changes are only permitted to accommodate local fitting of **AC Class Rule** permitted systems.
  - (b) **Competitors** shall submit design documentation regarding the changes allowed in Rule 6.4(a) for approval by the **Measurement Committee** that demonstrates equal or greater strength, stiffness, weight, and near equivalent watertight subdivision, than the supplied design documentation in accordance with Appendices C, D, and E.
- 6.5 The overall length between the **stem plane** and **stern plane**, not including equipment required or provided by **ACEA**, shall not exceed 15.000 m.
- 6.6 The **maximum beam** shall not exceed 8.480 m.
- 6.7 The distance between **hull centerplanes** shall not exceed 7.480 m, nor be less than 7.470 m, and shall be measured on the **transverse** axis at any point along the **hull**.
- 6.8 The **AC Class Yacht** shall have a single **wing rotation point** that shall be:
- (a) within 0.020 m of the **yacht centerplane**;
  - (b) located within 0.004 m of the **wing centerplane**;
  - (c) located between 1.400 m and 1.450 m above **MWP**; and
  - (d) located between 6.940 m and 6.960 m forward of the **stern plane**.
- 6.9 Excluding the **wing**, **jibs**, **rigging**, **daggerboards**, instrumentation, and **ACEA**-mandated equipment, an **AC Class Yacht** shall have no component that is more than 1.550 m above **MWP** that:
- (a) has a chord length/thickness ratio greater than 3:1; and
  - (b) makes an angle of greater than 10 degrees to **MWP**.
- 6.10 In **measurement condition** and **appendage measurement condition**, no part of the **AC Class Yacht** shall extend more than 2.400 m below **MWP**.

- 6.11 The **Sailing Weight** shall be between 2332 kg and 2432 kg. The **Sailing Weight** includes 149 kg of **ACEA** equipment in the **measurement weight** and 18 kg of **ACEA** equipment in the **wing measurement condition** weight.
- 6.12 When in **measurement condition**, the **AC Class Yacht** shall be capable of being weighed by a three or four-point lift using multiple load cells.
- 6.13 The center of gravity of the **AC Class Yacht** when in **measurement condition** shall be between 6.100 m and 6.400 m forward of the **stern plane**.
- 6.14** Gases with a density less than standard atmosphere air shall not be used to reduce the weight of an **AC Class Yacht**.
- 6.15 The **AC Class Yacht** shall comply with Appendix G - Safety Equipment and Appendix I – Media and Race Committee Equipment.
- 6.16 The **Regatta Director** and the **Measurement Committee**, in consultation with **Competitors**, will specify structural tests that shall be conducted by **Competitors** on their **AC Class Yachts** and components and:
- (a) **Competitors** shall document this testing and supply that documentation to the **Measurement Committee** and **Regatta Director** for review prior to the issuing of an **AC Class Yacht**'s first measurement certificate;
  - (b) the **Competitor** shall provide a declaration as shown in Appendix B confirming that this testing has been properly completed and that the **AC Class Yacht** and its components have passed such tests;
  - (c) details of the required testing will be published by the **Measurement Committee** as an amendment to Appendix H (as permitted by Rule 4.1(a)) as soon as practical; and
  - (d) if modifications or alterations are made to previously-tested structural components, engineering documentation or test data shall be provided to demonstrate continued compliance with the structural test requirements.
- 6.17 350 bar pressure relief valves shall be located on the supply side of hydraulic systems in order to limit maximum system pressure. Prior to November 30, 2015, the **Measurement Committee** may specify standard relief valves and their location in the hydraulic systems of the **AC Class Yacht**.
- 6.18 **Hulls** and/or **cross structure** components shall be rigidly attached to each other. No part of the **cross structure** shall be laminated or bonded to the **hulls**. Small amounts of sealant may be used in **hull/cross structure** joints solely for waterproofing, provided this adds less than 1% to the strength of the joint.
- 6.19 The following areas shall be able to support loading of 100 kg distributed over an area of 0.100 m by 0.100 m:
- (a) the area bounded by a **vertical transverse** plane 1.250 m forward of the **stern plane** to the forward side of the front cross beam and the inboard side of each **hull**; and
  - (b) the area formed by a triangle whose corners are no less than 1.200 m each side of the **yacht centerplane** at the forward edge of the front cross beam, and the **tack point**.

If **cross structure** cannot support the required loadings or there is an opening that a sphere with a diameter of 0.050 m can easily pass through, then trampoline in compliance with Rule 9 must be present in that area.

6.20 While racing:

- (a) the **sailing weight** of the **AC Class Yacht** shall not vary from the **sailing weight** on its measurement certificate by more than 25 kg, and shall always comply with the limits of Rule 6.11;
- (b) bilge water shall be promptly removed;
- (c) other than mandated in rule 6.20(b), dead weight, ballast, the **jib** and other equipment shall not be moved for the purpose of changing trim or stability;
- (d) No more than one **jib** is allowed on board. The total **jib** weight (including no more than one **jib** bag, **luff** attachments, battens, and **jib** hardware) shall not exceed 32.0 kg. No **jib** bag shall exceed 4 kg in weight. **Jib** bags shall not be designed to retain water;
- (e) the total weight of food and drink including any carried on the crew shall not be greater than 6 kg; and
- (f) the top and bottom strop lengths on each element of **wing rigging** and the position of the **wing rotation point** shall be as measured in rule 25.11.

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7. **HULLS**

- 7.1 The general layout of the **hulls**, defining their arrangement and structural design is detailed in Appendix C.
- 7.2 The **hulls** outer surfaces shall be built from a **Measurement Committee** approved mold referenced in Rule 6.2 except for **hull** surface that is:
- (a) on the lower outer surface of the **hull** surrounding the **daggerboard** penetration in accordance with Rule 11.2 and does not exceed 0.750 m **longitudinally** by 0.150 m **transversely** either side of the **hull centerplane**;
  - (b) on the lower outer surface of the **hull** surrounding the **rudder** penetration in accordance with Rule 10 and does not exceed 0.600 m **longitudinally** by 0.150 m **transversely** either side of the **hull centerplane**;
  - (c) an area on the upper surface of the **hull** no larger than required, for permitted **rudder** and **daggerboard** movements and systems;
  - (d) as defined in Rule 7.11;
  - (e) within 0.050 m of fittings, **rigging** attachments, or instruments;
  - (f) local reinforcements;
  - (g) openings for cockpit drainage complying with Rule 7.5, and positioned no lower than the cockpit sole.
- 7.3 Each **hull** shall be capable of being disassembled into two sections as specified in Appendix C.
- 7.4 No **hull** component, including fittings, shall extend forward of the **stem plane**.
- 7.5 Water, the weight of which could increase performance, shall not be retained in a bilge, any recess, or other volume. Any recess in a **hull** capable of retaining water at any heel angle less than 25 degrees or at any trim angle less than 10 degrees relative to **MWP** must be self-draining with the size of the drain between 0.005 m<sup>2</sup> and 0.010 m<sup>2</sup> per 1.00 m<sup>3</sup> of the recess volume that could contain water in **measurement condition**.

7.6 No part of a **hull** shall be adjusted or trimmed except for a flexible surface on the upper part of a **hull** that connects to:

- (a) the **daggerboard** case, permitting movement of the **daggerboard**; and
- (b) the **rudder** stock, permitting movement of the **rudder**.

These flexible surfaces shall be no larger than necessary to permit this movement, and need not comply with the limits on materials in Rules 18 and 19.

7.7 The intersection of the **hull centerplane** and the **stern plane** shall be **vertical**.

7.8 Each **hull** shall have watertight compartments constructed in accordance with the drawings and specifications listed in Appendix C.

7.9 Each **hull** between the **stern plane** and 1.250m forward of the **stern plane** shall be fitted with an enclosed watertight compartment with a volume not less than 0.30 m<sup>3</sup>.

7.10 In **measurement condition**, with **appendages** in **appendage measurement condition**, the combined calculated floodable volume below **MWP** of all **daggerboard** and **rudder** cases shall not exceed 0.060 m<sup>3</sup>.

7.11 The cockpits in each **hull** shall:

- (a) be as defined in accordance with Rule 6.2 and Appendix C;
- (b) have a cockpit sole that is a continuous watertight boundary;
- (c) be built as defined in Appendix C

7.12 Rigging shall not attach to the hulls forward of the forward-most watertight bulkhead.

7.13 Hatches and watertight covers are permitted in the **hull** provided they shall:

- (a) be closed by a cover permanently attached to the **hull** by hinges, fasteners, slides or similar arrangement;
- (b) be watertight, meaning a closed hatch shall prevent the ingress of water from a garden hose applied from any direction;
- (c) meet the **hull** construction requirements in Rule 19; and
- (d) be closed while racing, except during emergencies or briefly to perform inspections.

7.14 Ports for hand access to **hull** compartments are permitted, provided each does not exceed 0.035 m<sup>2</sup> and is secured by a watertight cover that meets the **hull** construction requirements in Rule 19.

7.15 Openings in the watertight bulkheads, soles, and **hulls** are permitted for the passage of permitted systems, provided they shall:

- (a) be no larger than required for their specific task;
- (b) have a rubber gaiter boot or other means of closing the opening if the area exceeds 0.00035 m<sup>2</sup>;
- (c) be no further forward than 8.500 m forward of the **stern plane**; and
- (d) be at least 0.400 m above **MWP** unless the net area of the opening is less than 0.000035 m<sup>2</sup> (35 sq mm).

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## 8. CROSS STRUCTURE

8.1 The **cross structure** shall comply with Rule 6.2 and Appendix D.

8.2 The **jib** self-tacking track shall be specified and fitted in accordance with Appendix D.

- 8.3 Compliance with the construction requirements of Appendix D will be confirmed by determining the weight of each defined component of **cross structure**, net of any components or materials not required by the **AC Class Rule**.
- 8.4 **Cross structure** or fittings attached to **cross structure** shall only be allowed in the area detailed in Appendix D, except for:
- (a) spray guards within 0.500 m of the local inboard edge of the **hull** and between **cross structure** beams. The material used for the spray guards shall be capable of being folded flat in any direction and shall be in addition to the required **trampoline**; and
  - (b) **ACEA** media equipment and associated fittings.
- 8.5 When viewed orthogonal to **MWP**, the combined projected area of the **cross structure** within 3.200 m of the **yacht centerplane** shall not exceed 33.00 m<sup>2</sup>. Spray guards referred to in Rule 8.4(a) are excluded in this projected area calculation. Additionally:
- (a) this area shall be symmetrical about the **yacht centerplane**; and
  - (b) **rigging**, fittings, attachments or other surfaces shall be included in this projected area if they have a chord length/thickness ratio greater than 3:1;
- 8.6 With reference to Appendix D, the area labeled "Media Equipment" shall be available for **ACEA** media and Race Management equipment. Further details will be included in Appendix I.
- 8.7 The **cross structure** including fittings but excluding **ACEA**-mandated equipment:
- (a) shall not extend aft of the **stern plane**; and
  - (b) shall extend no more than 12.500 m forward of the **stern plane**. Wind instrumentation is not included in this limit but shall extend no more than 14.000 m forward of the **stern plane**.
- 8.8 No area of **cross structure** when viewed orthogonal to **MWP** shall be greater than 1.000 m from an edge that provides a clear view to the water below. Clear windows in the **cross structure** to comply with this edge distance requirement shall be no smaller than 0.05 m<sup>2</sup>. The calculated area of clear windows shall exclude any area occupied in the window by non-transparent fibers or elements.
- 8.9 No part of **cross structure**, including fairings or other surfaces and excluding fittings and deck hardware, shall move (translate or rotate about any axis) or be adjusted relative to any other part of the **cross structure**, except for normal deflections caused by sailing loads.
- 8.10 Any recess in the **cross structure** capable of retaining water must be self-draining, with the size of the drain at least 0.005 m<sup>2</sup> per 1.00 m<sup>3</sup> of the maximum recess volume, calculated at any combination of heel angle less than 25 degrees, and trim angle less than 10 degrees, relative to **MWP**.
- 8.11 No part of **cross structure** or its fittings, external to any **hull**, shall be less than 0.100 m above **MWP** or greater than 1.550 m above **MWP**.
- 8.12 **Cross structure** shall be capable of being removed from the **hulls** and shall be capable of being disassembled such that all components of the **cross structure** shall be capable of fitting into standard shipping containers with interior dimensions 12.000 m x 2.311 m x 2.650m.
- 8.13 There shall be equipment lockers with location and dimensions defined in the **cross structure** construction specifications in Appendix D, which shall be part of **cross structure**.
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## 9. TRAMPOLINE

- 9.1 Trampolines shall be fixed to the **hulls** or **cross structure**, except trampolines may be attached to **rigging** that runs from a point approximately on the **yacht centerplane** and no further aft than the **tack point** to points at least 1.100 m from the **yacht centerplane** on the forward edge of the forward cross beam, and shall comply with Rule 6.19.
- 9.2 Trampolines shall:
- (a) be constructed of NET Systems Ultra Silver™ netting with 0.050 m nominal dimension mesh size; and
  - (b) be strongly secured with regular spacing on their support edges; this spacing shall not be greater than 1.000 m when tensioned but without supporting the weight of crew; gaps between the trampoline and the **hulls** or **cross structure** shall not be greater than 0.200 m when tensioned but without supporting the weight of crew or a **jib**;

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## 10. RUDDERS and RUDDER WINGS

- 10.1 Each **hull** shall have one **rudder** fitted with one **rudder wing**. The **rudder** or **rudderstock** shall penetrate the **hull**.
- 10.2 No part of a **rudder** or **rudder wing**, while in **appendage measurement condition**, shall be aft of the **stern plane**, or more than 0.750 m forward of the **stern plane**.
- 10.3 No part of a **rudder**, external to the **hull**, and excluding the **rudder wing**, while in **appendage measurement condition**, shall be greater than 0.100 m from the **hull centerplane**.
- 10.4 **Rudders** shall rotate only, and shall have a maximum of two axes of rotation. One axis shall be within 0.010 m of the **hull centerplane**, measured between the upper and lower bearings, and the other shall be on a **rake axis**. **Rudder** rotation about the **rake axis** shall be limited to a 3.00 degree range while racing.
- 10.5 **Rudder** rotation about the axis within 0.010 m of the **hull centerplane** shall only be controlled by steering wheels, which shall be no less than 0.600 m in outside diameter.
- 10.6 While racing, **rudders** shall not be retracted or extended from their position in **appendage measurement condition**.
- 10.7 **Rudder** and **rudder wing** components shall be rigidly fixed to each other and their shapes shall not be adjusted while racing. The **rudder wings** shall be rigidly fixed to the **rudders** and shall not be adjusted relative to the **rudders** while racing.
- 10.8 Each **rudder wing**, while in **appendage measurement condition**, shall not exceed 1.250 m in the **transverse** direction, and shall be symmetrical about the **hull centerplane** within a tolerance of 0.020 m. The planform area, excluding the area within 0.080 m of the **hull centerplane**, shall not be less than 0.170 m<sup>2</sup> and not greater than 0.190 m<sup>2</sup>, when projected orthogonal to **MWP**.
- 10.9 No part of a **rudder wing**, excluding the area within 0.080 m of the **hull centerplane**, shall be less than 2.100m below **MWP** while in **appendage measurement condition**.
- 10.10 **Rudder wing** chords parallel to and offset 0.080 m from the **hull centerplane** shall be within 5.00 degrees of parallel to **MWP** while in **appendage measurement condition**.

10.11 While an **AC Class Yacht** is moored:

- (a) **rudder** rotation about the axis within 0.010 m of the **hull centerplane** shall be capable of being locked at approximately 90 degrees to the **hull centerplane**; or
- (b) **rudders** shall be capable of being removed; or
- (c) **rudders** shall be capable of being retracted such that no part of the **rudders** and **rudder wings** extends more than 0.450 m below **MWP**.

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## 11. DAGGERBOARDS

11.1 Each **hull** shall have one **daggerboard**.

11.2 **Daggerboards** shall penetrate the lower surface of the **hull** entirely between 7.300 m and 8.050 m forward of the **stern plane**, and entirely within 0.150 m **transversely** either side of the **hull centerplane**.

11.3 The distance from the bottom of the upper **daggerboard** bearing to the top of the lower **daggerboard** bearing shall not be less than shown in Appendix C.

11.4 No part of a **daggerboard** that extends below the **hull** shall be connected to or supported by the **AC Class Yacht** in any location other than in the region described in Rule 11.2.

11.5 The maximum dimension of any **daggerboard** shall be 4.200 m in any direction, measured along a straight line.

11.6 When fully retracted, **daggerboards** shall extend no more than 0.400 m below **MWP**. The **Measurement Committee** may install draft stripes or other references to verify that **daggerboards** are fully retracted.

11.7 **Daggerboards**, in any and all positions, shall not exceed **maximum beam** below **MWP**. **Daggerboards** (including fittings and control systems) may exceed **maximum beam** above the diagonal line formed by a point 1.000 m above **MWP** at **maximum beam**, and a point 3.000 m above **MWP** at 0.500 m outboard of **maximum beam**. No part of a **daggerboard** or **daggerboard** system shall extend beyond 0.500 m outboard of **maximum beam**, regardless of height above **MWP**.

11.8 The center of rotation of the lowest load-transferring **daggerboard** bearing shall not translate relative to the **hull**.

11.9 At the lowest load-transferring **daggerboard** bearing, and relative to that bearing surface, no point of the **daggerboard** in contact with the bearing shall translate **longitudinally** more than 0.020 m or **transversely** more than 0.010 m.

11.10 A **daggerboard** shall only:

- (a) be retracted or extended; and
- (b) rotate around no more than two axes (or combination of the two axes) whose limits shall be determined as follows:
  - (i) The maximum rotation about the **cant axis** shall be 15 degrees with the **rake axis** rotation set to **appendage measurement condition**; and
  - (ii) The maximum rotation about the **rake axis** shall be 12 degrees and the **rake axis** shall be within 15 degrees of horizontal with the **daggerboard** set to **appendage measurement condition**.

11.11 **Daggerboard** components shall be rigidly fixed to each other and the **daggerboard** shape shall not be adjusted while racing.

- 11.12 **Daggerboard** cases or trunks shall effectively drain within ten seconds of the **hull** being lifted above the surface of the water.
- 11.13 **Daggerboard** bearing fairings are allowed within the area defined in Rule 7.2 (a); they shall not be controllable and shall move only passively as the result of the permitted movements of **daggerboards** and their bearings.
- 11.14 **Daggerboards** shall not be used to generate force for the purpose or effect of increasing righting moment when used on the windward side of an **AC Class Yacht**. This Rule 11.14 does not apply:
- (a) when the **daggerboards** are fully retracted (in accordance with Rule 11.6);
  - (b) prior to starting, as defined in **RRSAC**;
  - (c) when the windward **daggerboard** inadvertently penetrates the surface of the water for less than 10 continuous seconds;
  - (d) when the **AC Class Yacht** is within 10 seconds prior to and after tacking or gybing; or
  - (e) when the **AC Class Yacht** is taking a penalty.

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## 12. WING

- 12.1 The **IGES File** named "ACC WING\_RULE\_V4\_SRM.igs" forms part of the **AC Class Rule**. This file contains definitions of the surfaces of the main element ("ME"), consisting of the **wing spar** (including the curved shell and the shear web) and attached aerodynamic surface, and the three flap elements ("FE") and their locations, and measurement marks.
- 12.2 The general layout of the **wing**, defining the main components of the **wing** and their arrangement, is detailed in Appendix E.
- 12.3 Except for the **wing spar** "D" shaped section, the **wing** outer surface shall be designed as represented by the **IGES file** and built within the tolerance of 0.006 m over internal structure, and 0.006 m external and 0.045 m internal to the **IGES file** surface over unsupported film areas, or as set out in Appendix E except:
- (a) Region "F" in Appendix E, where no component shall extend more than 0.750 m outside the **IGES file** surface;
  - (b) with the **wing** in **wing measurement position**, a gap no larger than 0.060 m is permitted between flap elements. This gap may be filled or covered with pliant material, which shall not deviate from the **wing** surface by more than 0.020 m;
  - (c) control systems, and control system fairings that the **Measurement Committee** determines are no larger than required; and
  - (d) fittings, **rigging** attachments, instruments, and local reinforcements around components listed in 12. 3 (c) and (d).
- 12.4 The **wing spar** shall be a "D" shaped section which is made up of a curved shell and a full length shear web above Region "F" in Appendix E. The curved shell outer surface shall be built from a **Measurement Committee** approved mold referenced in Rule 6.2 and the outer surface shall be designed as represented by the IGES file and built within the tolerance of 0.004 m. One opening in the shear web wholly within 1.000 m of the spar join is allowed up to an area of 0.185 m<sup>2</sup>. Other openings in the shear web up to an area of 0.050 m<sup>2</sup> are allowed. The combined total area of shear web openings shall be less than 0.400 m<sup>2</sup>.
- 12.5 The **wing rotation point** fitting on the **wing** shall not be adjusted while racing.



- 12.6 Items listed in Rule 12.3 (c) and (d) are permitted external to the **wing** surface. When viewed perpendicular to the **wing datum plane**, the projected area of these items outside the **wing** surface detailed in the **IGES File** in the region within:
- (a) 4.000 m below the **wing top plane** to the **wing top plane** shall not exceed 0.30 m<sup>2</sup>; and
  - (b) 2.000 m above the **wing datum plane** to the lowest extent of the **wing** shall not exceed 2.00 m<sup>2</sup>.
- 12.7 The main element **wing spar** and main element aerodynamic surface shall not be adjusted relative to each other.
- 12.8 The three flap elements and the main element shall each be single enclosed aerodynamic surfaces, except for surfaces in way of items listed in Rule 12.3 (c) and (d).
- 12.9 A flap shall only rotate, or twist as a result of the differential rotation at the top and bottom of the flap, and:
- (a) that rotation shall be about the flap pivot points that shall be centered within 0.004 m of the **wing centerplane** and specified in Appendix E; and
  - (b) the horizontal sectional shape of a flap shall not be adjusted.
- No other flap movements are allowed, except for incidental movements caused by normal **wing** deformations while sailing.
- 12.10 The weight of the **wing** in **wing measurement condition** shall be not less than 445 kg, and the center of gravity shall be not less than 9.150 m above the **wing rotation point**.
- 12.11 No device shall be used to modify the torsional rigidity of the main element.
- 12.12 The **wing** main element in **wing measurement position** shall be capable of being lifted by points:
- (a) within 0.100 m of the **wing rotation point**;
  - (b) within 0.050 m of the bottom flap pivot axis, and
  - (c) point "U",
- as detailed in Appendix E.
- 12.13 With the **wing** main element horizontal with the flaps removed and supported at points detailed in Rule 12.12 the angular deflection of the **wing centerplane** measured at the **wing top plane** shall be no greater than 2.00 degrees due to the application of a weight of 100 kg added at pivot point "T" as referenced in Appendix E.
- 12.14 The **wing spar** shall be capable of being disassembled into two separate **wing spar** sections as detailed in Appendix E.
- 12.15 The area above the **wing top plane** (refer Appendix E) is reserved for **ACEA** media equipment. Wind instrumentation, if fitted, shall extend no more than 1.000 m above the **wing top plane** (measured orthogonal to the **wing top plane**), and shall have a chord length/thickness ratio no greater than 3:1. Any wind instrumentation extending above the **wing top plane** must not interfere with **ACEA** equipment, and shall be submitted to the **Measurement Committee** for approval.
- 12.16 Teams are required to install a flotation system in the top of the **wing** that provides 415 kg of buoyancy when fully immersed and centered 20.500 m above the **wing rotation point**. A minimum of 300 kg of buoyancy shall be provided by solid EPS (expanded polystyrene) foam with an approximate density of 12 kg/m<sup>3</sup>. The remainder of the buoyancy may be provided by an air bag inside the **Wing spar**. The installed flotation system weight shall be a minimum

weight of 6.0 kg centered a minimum of 20.500 m above the **wing rotation point**.

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### 13. RIGGING

13.1 The **wing rigging** shall be as specified in Appendix E Drawing # ACC-W-1001 RIG AND SAILPLAN.

13.2 **Wings** shall:

- (a) only have two shrouds per side, and one forestay;
  - (b) have the shrouds and forestay connected to their corresponding chainplates on the **wing, hulls** and **bowsprit** and arranged as shown in ACC-W-1001 RIG AND SAILPLAN.
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### 14. JIB

14.1 **Jib** nominal dimensions shall be as shown in Appendix F.

14.2 **Jibs, jib** hardware and battens shall be standard equipment, the make and model of the **jibs, jib** hardware and battens shall be specified by the **Regatta Director** prior to September 30, 2015.

14.3 When set, the **jib** shall be set with the **tack** no lower than the **tackpoint**.

14.4 The **tack point** shall be:

- (a) between 5.190 m and 5.210 m forward of the **wing rotation point**;
- (b) not less than 1.450 m above **MWP**, measured with an upward **vertical** load applied at the **tack point** not exceeding 500 kg; and
- (c) within 0.030 m of the **yacht centerplane**.

14.5 **Jibs** shall not be modified. Any proposed repair to a **jib** shall be submitted to the **Measurement Committee** for review and approval.

14.6 No device shall control a **jib** except:

- (a) a sheet that is part of a self-tacking sheeting system on the **cross structure**, and which attaches to hardware on the **clew** or **clew** board;
  - (b) a cunningham system near the **tack**;
  - (c) **leech** lines and **foot** lines as supplied with the **jib**; and
  - (d) a halyard or **head pennant**.
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### 15. ADJUSTMENT OF CONTROL SURFACES

15.1 The management of power used to adjust **control surfaces** on an **AC Class Yacht** shall only be controlled by:

- (a) **manual** input;
- (b) Electrical or electronic systems, operated in compliance with the **AC Class Rule** and initiated by **manual** input;
- (c) passive devices that limit power transmission or flow to one direction (check valves, relief valves, cams or ratchets, etc); and/or
- (d) relief valves including counter balance valves that release hydraulic oil into a low pressure return.

## 15.2 Control Systems in General

- (a) Except as provided in Rule 15.2(c) and 15.3, systems and devices used to adjust the **control surfaces** may only use direct **manual** input and/ or an internally generated timing signal initiated by **manual** input. Any input or feedback used by the control systems to adjust the **control surfaces** is not permitted unless specifically allowed by the **AC Class Rule**.
- (b) Except as provided in Rule 15.2(c) and 15.3, control systems used to adjust **control surfaces** shall not use positional information of the **control surface** or any part of the control system, whether that positional information is measured, inferred or indicated by any method, including electronic counting, indexing or pulsing (e.g. stepper motors and indexing actuators are not permitted).
- (c) A system controlling a hydraulic valve or drive clutch may use feedback from the internal state of that valve or drive clutch (e.g. to drive a cam or spool to a target position), providing that the feedback provides no information or indication as to the state of the control system outside that valve, drive clutch, or drive clutch actuator.

## 15.3 Control Systems for **Appendage** rotation about the **rake axis**

- (a) Positional feedback for adjustment of **appendage** rotations about the **rake axis** is permitted. Feedback and input to these control systems shall only be provided from the following:
  - (i) input as allowed in Rule 15.2;
  - (ii) **appendage** rotation about the **rake axis** directly measured relative to the **hull** to which they are attached; and/or
  - (iii) the extension of hydraulic rams and/or electrical actuators that are used to control the rotation of **appendages** about the **rake axis**, and whose extension is related only to the **appendage** rotation in Rule 15.3(a)(ii).
- (b) If as a result of **daggerboard** rotation about the **rake axis**, incidental rotation about the **cant axis** may occur but shall not exceed 3 degrees.

## 15.4 Power delivery control devices:

- (a) shall have the wiring for devices permitted in Rule 15.2 isolated and clearly identifiable from the wiring systems permitted in Rule 15.3. The wiring for devices described in Rules 15.2 and 15.3 shall be isolated and clearly identifiable from any other wiring system. Each of these systems shall have its own voltage supply which may be connected to a common battery provided each system is electronically isolated; and
- (b) shall be hard-wired and may use protocol-based communications (CAN, Ethernet, etc.)

## 15.5 Hydraulic valves, drive clutches, and electrical actuators shall be available to all **Competitors** on a reasonable commercial basis. **Competitors** may seek a confidential determination from the **Measurement Committee** as to the components complying with this Rule 15.5. The list of hydraulic valves, drive clutches and electrical actuators approved under this Rule 15.5 shall be made public 150 days prior to the first scheduled race of the **America's Cup Qualifiers** and updated as **Competitors** seek further determinations after this date.

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## 16. MANUAL POWER AND STORED ENERGY

16.1 Power for the adjustment of the **control surfaces** shall only be:

- (a) from **manual** power;
- (b) as allowed in Rule 16.2; or
- (c) from the effect of gravity and the direct contact with wind or sea on that **control surface**, except that:
  - (i) **rudder** rotations (including a **rudder wing** that is connected to a **rudder**) about the axis on the **hull centerplane** may be linked; and
  - (ii) power from one **daggerboard** rotation or translation shall not be used to adjust a different rotation or translation of that **daggerboard**.

For the purposes of Rule 16.1, **wing** is considered as a single control surface.

16.2 The use of stored energy and non-**manual** power is prohibited, except for:

- (a) small springs (or collections thereof), shock cords (or collections thereof), and similar passive devices that deliver less than:
  - (i) 50 J of energy;
  - (ii) 500 N of force; and
  - (iii) 10 Nm of torque.
- (b) nominal amounts of energy stored in hydraulic systems that when isolated from the hydraulic accumulators permitted in Rules 16.2(c), 16.2(d), and 16.2 (e) deliver less than 0.25 liters hydraulic oil from all hydraulic systems combined, when the system is discharged after pressurizing to maximum pressure;
- (c) low pressure hydraulic or gas accumulators of less than 6 bar which provide back pressure to a hydraulic system to prevent cavitation, but do no significant work themselves;
- (d) one **manually**-pressurized hydraulic pressure accumulator as specified by the **Measurement Committee** before September 1, 2015, used to energize the hydraulic system that controls **appendage** rotations about their **rake axes** and any incidental rotation of the **daggerboard** in the **cant axis** as permitted in Rule 15.3(b);
- (e) two **manually**-pressurized hydraulic pressure accumulators as specified by the **Measurement Committee** before September 1, 2015, used to energize the hydraulic system that controls **daggerboard** extension and retraction. These accumulators in 16.2(e) may be linked;
- (f) batteries to power electric bilge pumps;
- (g) batteries to power instruments, on-board crew communication and **ACEA** media equipment; and
- (h) batteries and small capacitors used to operate the control devices permitted in Rule 15 provided none of the power is used in the adjustment of a **control surface**.

16.3 **Manually** powered electrical systems shall only use direct current (DC) and operate at voltage less than 60 volts.

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## 17. CREW

- 17.1 There shall be six crew (unless reduced while racing due to accident or injury).
  - 17.2 The total weight of crew, dressed in light shorts only, shall not be greater than 525 kg. Compliance with this Rule 17.2 will be determined by the **Measurement Committee**, and may not be protested by **Competitors**. Crewmembers shall be weighed prior to competing in a race, as specified by the **Measurement Committee**. The **Measurement Committee** will use that recorded weight for any verification of compliance until the next specified crew weighing date. In the event that a crewmember is re-weighed at any time, a new weight will be recorded and will be used for any subsequent verification of compliance.
  - 17.3 The weight of clothing and equipment carried (including food, drink and mandated personal safety equipment) shall be no more than 8.5 kg per crewmember. The crew clothing and equipment shall be weighed dry.
  - 17.4 Crew clothing and equipment shall not retain water for the purpose of increasing weight.
  - 17.5 While racing, crew shall not be below the cockpit sole and or inside the enclosed watertight volume of a **hull** except during emergencies or briefly to perform inspections.
  - 17.6 Crew shall comply with Appendix G - Safety Equipment and Appendix I – Media and Race Committee Equipment.
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## SECTION C

### 18. GENERAL LIMITS ON MATERIALS AND CONSTRUCTION

- 18.1 Limits on materials and construction methods in Rule 18 apply except where altered by Rules 19, 20, 21 and 22.
- 18.2 A maximum of 15 kg of **FRP** constituent parts from commercially-available ex-stock material (e.g. tube, plate, etc.) may be used in the construction of the **AC Class Yacht**, provided that no single constituent part exceeds 3.0 kg. These constituent parts are not constrained by the materials limits and construction methods otherwise set out in the **AC Class Rule**.
- 18.3 Boron and Beryllium are prohibited except when used as an alloy in concentrations of less than 0.00042%, or in electronic components.
- 18.4 The use of electron beam or any other non-thermal radiation cure of composites is prohibited. This does not prohibit the use of conductive heating with electrical current for the cure of composites.
- 18.5 Sandwich construction techniques are permitted. Any component materials used in the core shall have a compressive modulus of elasticity in any direction not exceeding 75 GPa, and shall only be composed of aluminum honeycomb, meta-aramid (Nomex) honeycomb, timber or foam.
- 18.6 The temperature of **FRP** components, other than **jibs** and **rigging**, shall not exceed 135 degrees Celsius at any time during construction and post construction.
- 18.7 Other than permitted in Rule 18.2, no **FRP** component shall have **fiber modulus** greater than 395 GPa.
- 18.8 Isotropic materials shall have an elastic modulus less than 220 GPa, except for bearings that are part of commercially available hardware.
- 18.9 Pressure applied at any time during construction of **FRP** components, other than **jibs**, shall not exceed 7.0 atmospheres, but this limitation shall not prohibit building methods including the use of clamps or mechanical fastenings, wrapping, and winding etc.

- 18.10 Materials with elastic modulus exceeding that specified in the **AC Class Rule** may be used in FRP components provided:
- (a) the largest dimension of each particle does not exceed 1 micron; and
  - (b) the total weight of that material in any **FRP** laminate does not exceed 1% of the weight of that **FRP** laminate; and
  - (c) the part or component complies with Rules 18.7 and 18.8
- 18.11 Local reinforcements, increased core density, or removal of core are permitted in way of fittings, attachments, and openings for permitted **AC Class Rule** systems. Any such local area must equal or greater strength, stiffness and weight than the supplied design documentation in accordance with Appendices C, D, and E and complying with Rule 18, 19 and 20.
- 18.12 The addition of structural components and structural reinforcement is permitted.
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**19. HULL AND CROSS STRUCTURE (EXCLUDING BOWSPRIT) LIMITS ON MATERIALS AND CONSTRUCTION**

- 19.1 No **FRP** used to construct the **hull, cross structure** (excluding **bowsprit**), and their internal structures shall have **fiber modulus** greater than 245 GPa.
- 19.2 Each **hull** and component of **cross structure** shall be constructed in accordance with the drawings and specifications listed in Appendix C and D. The drawings define nominal fiber areal weights and resin content, core thickness, and core density permitted.

According to industry standard tolerances it is permitted that:

- (a) the actual fiber areal weight may vary by +/- 3.5 % of nominal;
- (b) the actual resin content may vary by +/- 3% of nominal;
- (c) the actual core thickness may vary up to 0.3mm of minimum; and
- (d) the actual core density may vary by +/- 10 %.

For example:

- (i) a drawing defined 150 gr/m<sup>2</sup> nominal fiber weight is satisfied by using a material which has a fiber weight greater than 144.75 gr/m<sup>2</sup>.
- (ii) a drawing defined 34% nominal resin content is satisfied by using a material which has a resin content greater than 31%.
- (iii) a drawing defined core thickness is satisfied by using a material which has a core thickness of 0.3mm less than the minimum.
- (iv) a drawing defined 70 kg/m<sup>3</sup> nominal core density is satisfied by using a material which has a core density of 63 kg/m<sup>3</sup>.

Laminates resulting in greater fiber weight, resin content, core density, or core thickness than specified in Appendix C and D are permitted.

- 19.3 **Hulls, cross structure** (excluding **bowsprit**), and their internal structures shall not have pressure applied at any time during construction that exceeds 1.0 atmosphere, but this limitation shall not prohibit building methods including the use of clamps or mechanical fastenings, wrapping, and winding, etc.
- 19.4 The shell weight (skins, core, and core bonding adhesive) of any **hull** surface, except cockpit sole shall not be less than 2.80 kg/m<sup>2</sup>, excluding any paint and fairing. The shell weight of the cockpit sole (skins, core, and core bonding adhesive) shall not be less than 2.60kg/m<sup>2</sup>,

excluding any paint and fairing. These limits apply to all areas of the **hull** and cockpit surfaces that are exposed to the sea and/or weather.

- 19.5 The shell weight of any **cross structure** surface, represented in Rule 8.1, (skins, core, and core bonding adhesive) shall not be less than 2.60 kg/m<sup>2</sup>, excluding any paint and fairing.
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## 20. WING SPAR LIMITS ON MATERIALS AND CONSTRUCTION

- 20.1 The shell weight (skins and if fitted, core, and core bonding adhesive) shall not be less than:

- (a) 1.82 kg/m<sup>2</sup> for the outside surface of the **wing spar**; and
- (b) 1.65 kg/m<sup>2</sup> for the shear web.

- 20.2 Wing spars shall be constructed in accordance with the drawings and specifications listed in Appendix E. The drawings define nominal fiber areal weights and resin content, core thickness, and core density permitted.

According to industry standard tolerances:

- (a) the actual fiber areal weight may vary by +/- 3.5 % of nominal,
- (b) the actual resin content may vary by +/- 3% of nominal,
- (c) the actual core thickness may vary up to 0.3mm of minimum,
- (d) the actual core density may vary by +/- 10 %.

For example:

- (i) a drawing defined 150 gr/m<sup>2</sup> nominal fiber weight is satisfied by using a material which has a fiber weight greater than 144.75 gr/m<sup>2</sup>.
- (ii) a drawing defined 33% nominal resin content is satisfied by using a material which has a resin content greater than 30%.
- (iii) a drawing defined core thickness is satisfied by using a material which has a core thickness of 0.3mm less than the minimum.
- (iv) a drawing defined 48 kg/m<sup>3</sup> nominal core density is satisfied by using a material which has a core density of 43.2 kg/m<sup>3</sup>.

Laminates resulting in greater fiber weight, resin content, core density, or core thickness than specified in Appendix C and D are permitted.

- 20.3 Soft aerodynamic surfaces of the **wing** shall be covered with CorTuff® 300 gauge film as detailed in Appendix E. Alternative materials that match stiffness and weight may be approved by the **Measurement Committee** via an **interpretation**.
- 

## 21. HARDWARE AND RIGGING LIMITS ON MATERIALS AND CONSTRUCTION

- 21.1 Hardware and fittings shall be constructed of wood, polymer, aluminum alloys, **FRP**, titanium, or steel and steel alloys, bronze, brass or a combination thereof, except bearings as permitted in Rule 18.8.
- 

## 22. SURFACE FINISHES AND BOUNDARY LAYER INTERFERENCE

- 22.1 The outermost surface of **hulls**, **appendages**, **appendage** fairings, and **cross structure** shall be:
- (a) painted using only paint systems generically specified as two-component linear polyester saturated aliphatic polyurethane, two-component epoxy urethane, or two-component acrylic urethane, and manufactured by International, Awlgrip, Akzo Nobel, DuPont,

Alexseal or Resene, except as specifically permitted by Rule 22.1 (b). Epoxy-based primers and undercoats manufactured for use with these topcoat systems are permitted, and may form part of the exposed surface finish, provided they are unmodified from their standard formulation. No materials other than specified manufacturer-supplied retardants, accelerants, thinners and pigments shall be added. Similarly, the specific gravity of the paint shall not be altered with any material other than those specified above. The **Measurement Committee** may authorize the use of comparable paint products from other manufacturers provided those products meet comparable requirements for product standardization, compliance, and testing;

or

- (b) unpainted, provided that surface complies with the requirements of Rule 18 and as altered by Rules 19, 20 and 21 and does not contain leaching materials or other components designed to reduce surface friction.

22.2 In addition to Rule 22.1:

- (a) the application of vinyl or other plastic film over the surface of the **hulls** for advertising or branding is allowed, provided that the film shall not be specially textured or otherwise manufactured in a way that could improve the characteristics of the flow of water inside the boundary layer; and
- (b) small quantities of friction-reducing compounds (for example, McLube) may be applied prior to racing, to the surface of a **daggerboard** only where it passes through the **daggerboard** bearings, and solely for the purpose of reducing bearing friction while raising and lowering the **daggerboard**. A **Competitor** shall have received the approval of the **Measurement Committee** for the type and quantity of friction-reducing compounds to be used for this purpose.

22.3 The outermost surfaces of the **hulls, appendages, appendage** fairings, and **cross structure** may be sanded and cleaned with normal concentrations and quantities of detergents or similar materials. However, while afloat on a scheduled race day, no substances shall be present on these surfaces other than those permitted in Rules 22.1 and 22.2.

22.4 Devices in, on or near the surface of any **hull, appendages** and **appendage** fairings, the purpose or effect of which is or could be to bleed off or alter the water or air flow of the boundary layer, including (but not limited to) holes in surfaces and Large Eddy Break-Up Devices (LEBUs), are prohibited. Normal through-**hull** fittings (such as self-bailers, drains, and boatspeed transducers) are permitted.

22.5 Specially textured surfaces, including (but not limited to) riblets and compliant surfaces, are prohibited.



- 22.6 Electric, magnetic, sonic, thermal, chemical (other than permitted by Rule 22.2(b)) and other methods, the purpose or effect of which is to reduce the surface drag of the water or air in the boundary layer, are prohibited.
- 

## SECTION D

### 23. MEASUREMENT MARKS

- 23.1 The **MWP** reference plane shall be marked on the master pattern, **hull** mold, and any part produced from the mold.
- 23.2 The **Measurement Committee** may place measurement marks on **AC Class Yachts**. Such marks include, but are not limited to, reference screws or punch marks, measurement bands, and **measurers'** signatures and/or seals or stickers on any component. These marks may be defined in the **hull, cross structure, and wing** molds and shall transfer to any part produced from the molds.
- 23.3 Measurement marks of any type placed or otherwise confirmed by a **measurer** shall not be moved, removed, altered, or replaced without written permission from the **Measurement Committee**.
- 

### 24. DECLARATIONS

- 24.1 **Competitors** shall provide the **Measurement Committee** declarations signed by the relevant designer(s), builder(s) and **Competitor's** representative affirming that:
- (a) **hull(s)** have been constructed from materials (including surface finishes) and using the methods permitted by the **AC Class Rule**;
  - (b) **cross structure** except for items listed in Rules 8.4 (a) and (b) has been constructed from materials and using the methods permitted by the **AC Class Rule**;
  - (c) **appendages** have been constructed from materials (including surface finishes) and using the methods permitted by the **AC Class Rule**; and
  - (d) the **wing spar** has been constructed from materials and using the methods permitted by the **AC Class Rule**.

The form of this declaration shall be as shown in Appendix B. The **Measurement Committee** may require additional declarations of a similar form to confirm compliance with any other aspect of the **AC Class Rule**.

- 24.2 **Competitors** shall provide to the **Measurement Committee** a material usage schedule and the material manufacturer's certificate of compliance for **FRP** used in each component described in Rule 24.1. However, documentation is not required for wet-laminate **FRP** materials used in the construction of any component, provided that the total quantity of wet-laminate **FRP** is less than 5% by weight of the total **FRP** materials used in the construction of that component. Details of the documentation required shall be published by the **Measurement Committee** in accordance with Rule 26.1.
-

## 25. INSPECTION AND MEASUREMENT

- 25.1 **Competitors** shall permit and assist all inspections and measurements by a **measurer** and the **Measurement Committee**, and shall afford all reasonable facility to carry out such measurements and inspections, including during construction. **Competitors** shall provide measurement information reports to **measurers** as requested.
- 25.2 For establishing continuing compliance with Rule weight limits, the **Measurement Committee** will determine and record the weight of any components, modifications, repairs, additions, subtractions, or replacements to a degree of precision and using methodology they determine to be practical and appropriate for that purpose (including re-weighing). **Competitors** shall provide all assistance to the **Measurement Committee** required by them in tracking these changes.
- 25.3 The **measurer** shall take at least two (2) **hull** laminate samples per **hull**, no larger than 0.065m in diameter and from a location of their choosing.
- 25.4 The **Measurement Committee** reserves the right to take samples from the **crossstructure** components.
- 25.5 The **measurer** shall take at least two (2) laminate samples per **wing spar**, no larger than 0.065 m in diameter from a location of their choosing.
- 25.6 The **Measurement Committee** reserves the right to take samples of the paint or vinyl from the **hull** and/or **appendages** for analysis by the manufacturer to ensure that only Rule permitted surface finishes have been used.
- 25.7 An **AC Class Yacht** may be re-measured in whole or in part at the discretion of the **Measurement Committee**.
- 25.8 A **measurer** who becomes aware that a **Competitor** may have failed to comply with the **AC Class Rule** shall advise the **Measurement Committee**.
- 25.9 Weights shall be corrected for local gravitational effects to the geographic datum of the **Match** venue.
- 25.10 When carrying out measurement ashore, the **measurer** shall allow a reasonable time to drain water from the **AC Class Yacht** and allow the substitution of wet **rigging** with equivalent dry **rigging**.
- 25.11 The measurer shall measure the top and bottom strop lengths on each element of **wing rigging** and the position of the **wing rotation point** with the **wing** positioned and **rigging** tensioned as specified in Drawing # ACC-W-1001 RIG AND SAILPLAN.pdf.

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## 26. MEASUREMENT PROCEDURES

- 26.1 Measurement equipment specifications and measurement methodology are determined by the **Measurement Committee** and will be available to all **Competitors**.
-

## 27. MEASUREMENT CONDITIONS

- 27.1 The **AC Class Yacht** shall be brought to **measurement condition** to determine the **measurement weight** and center of gravity as referenced in Rules 6.11 and 6.13. The **measurement condition** includes everything aboard the **AC Class Yacht** during a race, in its racing position, or equivalent **longitudinal** position, and with the yacht level to the satisfaction of the **measurer**, except the following:
- (a) the **wing** as it was weighed in **wing measurement condition**;
  - (b) crew;
  - (c) crew clothing and equipment carried on the person while racing;
  - (d) the **jib** (including **jib** bags, **luff** cables and hanks);
  - (e) food and drinks; and
  - (f) “other safety equipment” as detailed in Rule Appendix G1(g)
- 27.2 In **appendage measurement condition**:
- (a) **appendages** shall be in the position resulting in their deepest draft below **MWP**; and
  - (b) **rudder** root chords shall be parallel to the **hull centerplane**;
- 27.3 The **wing** in **wing measurement condition** shall:
- (a) be capable of being weighed by horizontal suspension from two points, however the **measurer** may use alternative weighing arrangements if he believes they will yield more accurate results;
  - (b) be oriented in **wing measurement position**;
  - (c) include all equipment attached to or mounted on the **wing** and in its normal racing position except for “other safety equipment” as detailed in Rule Appendix G1(g); and
  - (d) have all rigging in place and pulled down tight along the **wing**..
- 27.4 Any component of the **wing** not included in Rule 27.3(c) shall be included in **measurement weight**.
- 27.5 With the approval of the **Measurement Committee**, a removable temporary device to support the forward **cross structure** in the way of the **tack point** may be fitted during determination of **measurement weight**. The effects of this device on **measurement weight** and **longitudinal** center of gravity will be tared out by the **Measurement Committee**. See Rule 14.4 (b) specifying allowed tension applied by this device.
-

## 28. MEASUREMENT CERTIFICATE

- 28.1 When the **Measurement Committee** concludes that the **AC Class Yacht** complies with the **AC Class Rule**, it shall issue to the **Competitor** a measurement certificate as in Appendix A and shall retain a copy for its own records. The **Measurement Committee** shall provide a copy of the front page to the **Regatta Director** for public dissemination.
- 28.2 **Competitors** shall obtain approval of the **Measurement Committee** prior to making any repairs or any other changes which, individually or cumulatively, could impact on the **AC Class Yacht's** compliance with her measurement certificate or any other aspect of the **AC Class Rule**.
- 28.3 The measurement certificate ceases to be valid if there is any change to:
- (a) any information recorded on the **AC Class Yacht's** measurement certificate;
  - (b) the shape of the **hull** surface, except for flexible surfaces on the upper part of the **hull** as permitted by Rule 7.6;
  - (c) the shape of the **appendage** surfaces;
  - (d) the shape of the **cross structure** (excluding fittings);
  - (e) the shape of the measured **wing** surface in **wing measurement position** (excluding shape changes due to changing film tension so long as the tolerances in rule 12.3 are respected); or
  - (f) the **longitudinal** center of gravity caused by movement of equipment that was included in **measurement condition**, that results in a pitch moment difference greater than 50 kg.m . (Note: limits to be specified per Rule 6.13 still apply).
- 28.4 The **Measurement Committee** shall withdraw an **AC Class Yacht's** measurement certificate when they have reason to believe it no longer complies with this **AC Class Rule**.
- 28.5 An **AC Class Yacht** shall have only one valid measurement certificate at any one time.
- 28.6 The **Measurement Committee** shall hold **AC Class Yacht** data and information in strict confidence. The **Measurement Committee** may supply data or information to an appropriate independent official, if the **Measurement Committee** is satisfied the data and information will be held in strict confidence.
-

**APPENDIX A - MEASUREMENT CERTIFICATE**

# **AC Class Yacht Measurement Certificate**

Name of Yacht: \_\_\_\_\_

Yacht Identification Number: \_\_\_\_\_

Measurement Certificate Number: \_\_\_\_\_

Builder(s): \_\_\_\_\_

Owner(s): \_\_\_\_\_

**VALIDATION**

We confirm that this yacht has been measured in accordance with the **AC Class Rule**, and has been found to be in compliance with the Rule.

Signatures of Issuing **Measurers**  
(on behalf of the **Measurement Committee**) \_\_\_\_\_

\_\_\_\_\_

Date of Certification: \_\_\_\_\_

Supersedes Certificate No. & Date: \_\_\_\_\_

|                    |  |                 |  |
|--------------------|--|-----------------|--|
| Certificate Number |  | Yacht ID number |  |
|--------------------|--|-----------------|--|

|                               |     |
|-------------------------------|-----|
| <b>Sailing Weight</b>         | kg  |
| <b>Wing Weight</b>            | kg  |
| <b>Wing center of gravity</b> | m   |
| Measured Rake                 | deg |

### COMPONENTS

|                              |  |
|------------------------------|--|
| Port <b>Daggerboard</b>      |  |
| Starboard <b>Daggerboard</b> |  |
| Port <b>Rudder</b>           |  |
| Port <b>Rudder Wing</b>      |  |
| Starboard <b>Rudder</b>      |  |
| Starboard <b>Rudder Wing</b> |  |
| <b>Wing</b>                  |  |

**Measurer:**

\_\_\_\_\_

**Signature:**

\_\_\_\_\_

**Measurer:**

\_\_\_\_\_

**Signature:**

\_\_\_\_\_

**APPENDIX B - DECLARATIONS**

**HULL CONSTRUCTION DECLARATION**

**DESIGN CO-ORDINATOR'S DECLARATION**

I, the design co-ordinator of the yacht \_\_\_\_\_

declare that to the best of my knowledge the **hulls** have been designed and built only from materials, building methods, and complying with the shape as permitted in the **AC Class Rule**.

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|                          |           |      |
|--------------------------|-----------|------|
| Design co-ordinator name | Signature | Date |
|--------------------------|-----------|------|

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**BUILDER'S DECLARATION**

I, the builder of the yacht \_\_\_\_\_

declare that to the best of my knowledge the **hulls** have been built only from materials, building methods, and shape as permitted in the **AC Class Rule**.

---

|              |           |      |
|--------------|-----------|------|
| Builder name | Signature | Date |
|--------------|-----------|------|

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**TEAM PRINCIPAL'S DECLARATION**

I, the Team Principal of the yacht \_\_\_\_\_

declare that to the best of my knowledge, the **hulls** have been built only from materials, building methods, and shape as permitted in the **AC Class Rule**.

---

|                     |           |      |
|---------------------|-----------|------|
| Team Principal name | Signature | Date |
|---------------------|-----------|------|

This declaration is to be preceded by a completed material usage schedule as set out in Rule 24.2.

**COMPONENT DECLARATION**

**Competitor:** \_\_\_\_\_ **Component** \_\_\_\_\_

**DESIGNER CO-ORDINATOR'S DECLARATION**

I declare that to the best of my knowledge the component named and referenced above has been constructed only from materials, and using building methods, and shape as permitted in the **AC Class Rule**.

\_\_\_\_\_  
Design co-ordinator name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

**BUILDER'S DECLARATION**

I declare that to the best of my knowledge the component named and referenced above, is constructed only from materials, and using building methods, and shape as permitted in the **AC Class Rule**.

\_\_\_\_\_  
Builder name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

**TEAM PRINCIPAL'S DECLARATION**

I declare that the component named and referenced above is, to the best of my knowledge, constructed from materials, and using building methods, and shape as permitted in the **AC Class Rule**.

\_\_\_\_\_  
Team Principal name

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Date

This declaration is to be preceded by a completed material usage schedule as set out in Rule 24.2.



**STRUCTURAL TEST DECLARATION**

**Competitor:** \_\_\_\_\_ **Component** \_\_\_\_\_

**Date of Test:** \_\_\_\_\_

**ENGINEER DECLARATION**

I declare that the component named and referenced above has properly completed the required structural tests detailed in Appendix H. The component named and referenced above has passed such tests in accordance with the prescribed requirements.

\_\_\_\_\_  
Engineer who supervised the test(s)                      Signature                      Date

**TEAM PRINCIPAL'S DECLARATION**

I declare that to the best of my knowledge, the component named and referenced above has properly completed the required structural tests detailed in Appendix H. The component named and referenced above has, to the best of my knowledge, passed such tests in accordance with the prescribed requirements.

\_\_\_\_\_  
Team Principal name                      Signature                      Date

**APPENDIX C - HULLS CONFIGURATION**

**APPENDIX D - CROSS STRUCTURE**

**D1 APPENDIX D - CROSS STRUCTURE DIAGRAM**

**APPENDIX E - WING**

**APPENDIX E - WING DIAGRAM**

**APPENDIX F - JIB NOMINAL PLANFORM DIMENSIONS**

**APPENDIX G - SAFETY EQUIPMENT**

- G1 Below is a list of required safety equipment that has been developed by the Regatta Director and Measurement Committee in consultation with Competitors. The AC Class Rule may be amended as allowed by Rule 4 to include any changes to this safety equipment. The Measurement Committee may also adjust the sailing weight as permitted by Rule4(a).
- (a) A grab handle shall be fixed around the lower part of the **wing spar** to facilitate safe movement of crew around the front of the **wing**. The handle shall:
    - (i) be constructed of rigid or soft material;
    - (ii) be a minimum of 0.012 m in diameter;
    - (iii) be capable of taking a load of 300 kg applied in any direction at any point along its length;
    - (iv) extend from aft of the **wing spar** web on the port side, around the front of the **wing spar** to a point aft of the **wing spar** web on the starboard side;
    - (v) be no less than 150mm above the bottom of the **wing spar** at any point; and
    - (vi) be capable of passing a 0.069 m sphere (tennis ball) between the handle and the **wing spar** at any point forward of the **wing spar** web;
  - (b) Handholds, restraints and tethers that the **Competitor** determines are needed;
  - (c) Righting lines attached to the point(s) that are used to right the yacht and the righting lines accessible with the platform capsized at any orientation;
  - (d) A knife securely mounted near each intersection of the forward and aft crossbeams with the **hulls**, in positions that are accessible with the yacht upright or inverted;
  - (e) Four spare personal air supplies (two per side) of at least 80 liters each securely mounted in locations which would be accessible when the yacht is capsized;
  - (f) The compartment aft of the cockpit shall contain buoyancy components of not less than 250 liters. This may be made of 8 x 43 liter partially inflated buoyancy bags (Optimist flotation bags) or other alternative arrangements as may be approved by the **Measurement Committee**. The buoyancy arrangements shall not weight less than 8 kg; and
  - (g) other safety equipment carried at a **Competitor's** discretion that shall not exceed 10kg.”
- G2 None of **ACEA**, the **Regatta Director** nor the **Measurement Committee** warrants or guarantees the safety, in general, of any **AC Class Yacht**, regardless of whether or not the safety equipment Rules are complied with. It is the sole and ultimate responsibility of each **Competitor** to assess the safety of its own **AC Class Yacht** and each **Competitor** assumes the risk of sailing and/or racing the same.
- G3 The **daggerboard** and **rudder** rake control systems shall each be designed to fail safely in the event of hydraulic or electrical system failure. Systems shall either lock or go to a safe default position to avoid uncontrolled rake movement of that **appendage**. Compliance with this requirement shall be demonstrated to the satisfaction of the **Measurement Committee**.



**APPENDIX H - STRUCTURAL TESTING**

- H1 It is the sole responsibility of each **Competitor** to select materials and components for its **AC Class Yacht** that fully and properly withstand the structural tests described in Rule 6.16 and this Appendix. All **Competitors** acknowledge that there is an inherent risk of damage (including latent or microscopic damage) to an **AC Class Yacht** and/or its components from structural testing and agree that none of **ACEA**, the **Regatta Director** and/or the **Measurement Committee** (collectively or severally) shall be responsible for any damage to the whole or any part or parts of an **AC Class Yacht** (and/or its components), any damage to other property and/or any injuries to person or persons (including death) caused or sustained, directly or indirectly, in whole or in part, by or resulting from the use of an **AC Class Yacht** (and/or its components) following the structural tests referenced in Rule 6.16 and this Appendix.
- H2 None of **ACEA**, the **Regatta Director** or the **Measurement Committee** warrants or guarantees the structural integrity of an **AC Class Yacht**, regardless of whether or not the structural testing is deemed to have been successful. It is the sole and ultimate responsibility of each **Competitor** to assess the structural integrity of its own **AC Class Yacht** (and its components) and each **Competitor** assumes the risk of sailing and/or racing the same.
- H3 In starting these tests, **Competitors** freely acknowledge, accept, and assume the risks that may arise from testing, sailing and/or racing their **AC Class Yachts** and they expressly waive and release each of **ACEA**, the **Regatta Director** and the **Measurement Committee** (collectively and severally) of and from any and all claims, damages, liabilities, losses, fees, and costs incurred in connection with structural testing and this **AC Class Rule**.

**APPENDIX I - MEDIA AND RACE COMMITTEE EQUIPMENT**

To be determined.