

APBA Inboard Racing
Inboard Rulebook Extract
Concerning
Restraint Capsules

B. RESTRAINT CAPSULE:

The general term that encompasses all the following type capsules that protect a restrained driver is known as a Restraint Capsule.

Type 1 – Roll Cage constructed of steel tube with water deflection protection without a canopy. JSS class only.

Type 2 – Capsules constructed of composite materials without a canopy.

Type 3 – Capsules constructed of composite materials fitted with canopy which is is not designed to withstand a hard impact.

tubing
withstand
Type 4 – Capsules constructed of composite materials reinforced with steel fitted with structural canopies and bottom hatches designed to withstand a hard impact.

1. It is recommended that if an equipment failure causes a boat to stop during a heat of competition, all drivers in reinforced cockpits should remain fully restrained, with canopies latched shut if applicable, until the race is stopped and the black flag displayed.
2. It is mandatory that all boats competing in the Inboard Hydroplane classes and the JSS class have registered reinforced cockpits or roll cage.
3. It is strongly recommended that all KRR, Pro Stock, and Super Stock boats have a registered restraint capsule installed. The Flat Bottom Capsule Committee will report to the Inboard Chairman annually on the research and development of the flat bottom capsules.
4. It is recommended that all drivers develop a step-by-step cockpit escape plan/procedure; and practice the procedure prior to competing.
5. Canopies are optional but recommended in all classes.
6. A manufacturer of Restraint Capsule must submit their name (company name) and a completed APBA Restraint Capsule Questionnaire (available from APBA) before their cockpit will be allowed in an APBA sanctioned event. Individuals building cockpits for only themselves are still considered manufacturers and must follow the rules established for all manufacturers. All boats must have the official APBA Inboard manufacturers label permanently attached and visible inside the cockpit. It is the boat owner's responsibility that this label be present and legible.
7. Manufacturers will receive an acknowledgment from the Inboard Racing Commission stating that the company is registered to bring build restraint capsule for the Inboard Category. A list of all registered manufacturers will be available from the Inboard Racing Commission upon request.
8. A certification inspection is required at the first event an owner enters with a new boat/restraint capsule. The owner is responsible to bring a copy of the design and paperwork filed with the capsule registration application. The inspector must verify the cockpit matches the design submitted. Where possible the inspector will also verify that the materials on the application match those used on the boat. Discrepancies will be handled at the discretion of the inspector but must be reported in writing to the Inboard Chairman. The original application would then be amended or a new application might be required.
9. The restraint capsule must have enough flotation permanently attached to it to float the capsule and the driver should they be detached from the hull. It will be the responsibility of each owner to verify if their hull's flotation is adequate.
10. Restraint Systems

- (a) General: to the degree practical, the seating system, whether upright or reclining, should provide lateral support on both left and right sides. The driver should be positioned as far rearward and as close to the seat back bulkhead as possible. It is absolutely necessary, in the reclining position, to provide a kick-up (roll-up) forward to the buttocks of sufficient height and strength to prevent forward movement and/or rotation of the torso under the seat belt. In the reclining position, adequate padding is recommended under the buttocks to absorb impact.
- (b) Seat Belts: The use of an approved seat belt with a quick opening clasp is mandatory. Both the fastening design and condition of the belt is subject to inspection. Belt use shall not exceed three years and must meet the following requirements:
- 1) Minimum width: 3 inches
 - 2) Minimum tensile strength: 8,000 pounds (loop test)
 - 3) Metal to metal quick release buckle
 - 4) Belt material to be as short as practical
 - 5) Must be worn as tight as possible
 - 6) Must be worn in such a manner that it passes around the pelvic area at a point below the anterior superior iliac spines. Under no Condition may it be worn over the area of the intestines or abdomen.
 - 7) Should not pass over the sides of the seat. Should come through the seat at the bottom of each side thereby wrapping and holding the pelvic area over the greatest possible area. Where the belt passes through the sides of the seat, the seat edges must be rolled and/or grommet to prevent chafing or cutting of the belt.
 - 8) Seat belt adjusting hardware shall be fitted in a manner to minimize injury in case of impact. Hardware should be placed over fleshy areas of the body and away from bones.
 - 9) Seat belt mounts must not protrude in a manner that could possibly cause a driver injury. These mounts and the attachments of these to the chassis must be designed to withstand loads equal to or greater than the minimum allowable tensile strength of the belts.
 - 10) Five or six point webbed belts connected to main belt quick release system is mandatory.
- (c) Shoulder Harness: Two individual straps of adjustable length with metal ends to join the seat belt at the quick release mechanism thereby forming a single release point for the seat belt shoulder harness system. The shoulder harness mounting points must be installed so as to minimize both rotation and elevation movement of the driver.
- 1) Minimum width: 3 inches
 - 2) Minimum tensile strength: 3,000 pounds.
 - 3) Two belts joining in a 'Y' form, behind the neck; to form one strap may not be used, unless mounted with the 'Y' section outside the cell or in such a way as to not allow the shoulder harnesses to collapse on the driver's neck.

- 4) Harness straps should be attached directly to reinforced structural member of the race boat close behind the driver's head and neck. At points of attachment they should be 4 to 6 inches apart. They should be attached to a line approximately 90 degrees to a line of the seat back and approximately level with but not above the top of the driver's shoulders.
- 5) Where the straps pass through the seat or body structure of the race boat, the edges must be rolled and/or grommet to prevent cutting or chafing of the straps.
- 6) Fasteners for driver restraint systems that are mounted through .062 inch thickness or less panels, of these to the chassis must be designed to withstand loads equal to or greater than the minimum allowable tensile strength of the belts.
- 7) The harness should be worn as tight as possible. Harness adjusting hardware shall be fitted in case of impact. Hardware should be placed over fleshy areas of the body and away from bones. Harness pads must be fitted.
- 8) Harness mounts must not protrude in a manner that could possibly cause driver injury.
- 9) See Illustration 1.

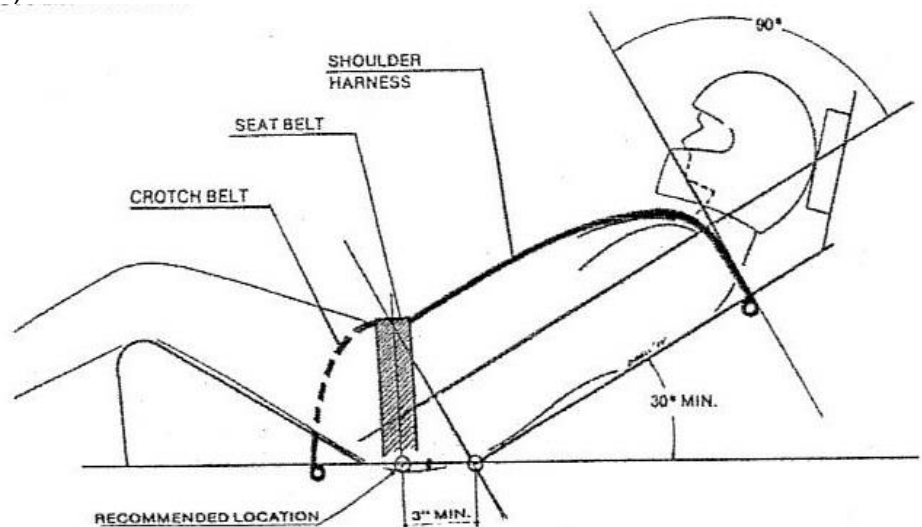


Illustration 1

- 10) A removable steering wheel is required with a 360 degree spring loaded release collar.
- 11) To assist rescue crews, reinforced cockpit boats must have the following critical information labeled on the bottom of the cockpit, using 3" letters on a strongly contrasting background.
 - a) Boat letter and number designation.
 - b) Restraint belt- if using lever type (latch & link), do not put anything; if using rotary type, put rotary.
 - c) If air system is used, put air.
 - d) If head restraint is used, put head restraint.
- 12) Boats with reinforced cockpits and full coverage canopies must have:
 - a) Positive air flow ventilation.

- b) Internal and external release capability
 - c) It is recommended that canopies with external hinges be equipped with a quick release hinge pin to aid rescue.
- 13) Composite reinforced cockpit guidelines for Inboard Category:
- a) Suggested construction method:
 - STEP 1: Gelcoat
 - STEP 2: 1 Layer Kevlar 235g
 - STEP 3: 1 Layer Kevlar 235g
 - STEP 4: An evenly distributed bond coating to 15mm
Uncross linked PVC foam core
 - STEP 5: 1 Layer Kevlar 235g
 - STEP 6: 1 Layer Kevlar 235g
 - STEP 7: Vacuum Bag

A post-cure of several hours at 80 degrees Celsius produce best results.
 - b) Alternative Construction Method: 2 X aramid 200gr/m² cloth (Kevlar) laid at 0/90 and +45/-45degrees. Fibers shall take stresses in 4 directions because of the cockpit's curved shape. The aramid layers shall be preimpregnated with a resin with very high strength, very good adhesive and elongation properties. Epoxy is well suited. Preshaped and preimpregnated PVC foam shall then be applied to the wet laminate. The PVC foam density shall at least have a density of 80 kg/m³ and have good shear strain properties (typical value is 20% or more, like Divinycell and Airex). Thickness of 12-15mm depending on curvature. Vacuum shall now be applied and vacuum process shall continue until fully cured. After taking vacuum bag off (and the related equipment/fabrics) the gaps between core elements shall be filled with putty made of epoxy and microballoons. The core shall be sanded/ground so the surface becomes smooth. The dust shall be removed with a vacuum cleaner. Then the core shall be impregnated with epoxy which shall be cured. Then the same layers of aramid as on the other side shall be applied and vacuum bagged. When the last layers have cured, the whole cockpit shall cure for at least 24 hours at raised temperatures for sufficient curing (the epoxy suppliers have data on temperatures and time).
- 14) Mandatory standards for all restraint capsules include:
- a) Minimum 2" clearance above driver/riding mechanic to cockpit or canopy.
 - b) The top of the front of the cockpit will be a maximum 4" below eye level.
 - c) Minimum ½" (9lbs) Ethofoam support behind driver/riding mechanic's head to prevent slapping rear of cockpit with helmet.

- d) No sharp edges or protrusions anywhere inside or around entry-way of cockpit.
 - e) Energy absorbing form padding to be strategically placed inside cockpit area where head, arms, hands, knees, etc., might impact.
 - f) The cockpit area must be completely sealed off from the engine compartment to prevent the intrusion of fire, fuel or harmful vapors in the cockpit. Openings for restraint harnesses, wiring, cables, hoses, etc. must be kept to a minimum. The use of grommets or other types of sealing devices are recommended around these openings.
 - g) All canopies must have an external handle or hand hold opening.
- 15) The following guidelines must be followed for those boats using full time onboard air system:
- a) The driver's mask must cover the driver's nose and mouth and designed to be water tight. The mask must be attached in such a way as to prevent it being dislodged or removed inadvertently.
 - b) The mask must be worn by the driver anytime the boat is under power.
 - c) All inboard boats with a permanent onboard air system shall carry a minimum of 30 cubic feet of air. All air delivery systems whether permanent or part time shall carry air in a vessel approved and certified for the delivery of breathing air. Said vessel must meet D.O.T. (Department of Transportation) standards or T.C. (Transportation Canada) standards for such devices. The vessel must also be stamped showing they have been inspected and certified to meet the above D.O.T. and T.C. standards. All components of the air system shall be rated for use with compressed air and for the pressures that they will be subject to.
 - d) Air hoses must be between ten (10) and fifteen (15) feet long; measured starting at the center of the steering wheel.
 - e) A quick release coupler must be installed in the air supply between the first stage regulator and the second stage regulator, located between ten (10) and fifteen (15) inches from the driver's mask or helmet. The coupler/nipple to be used is a Parker stainless steel fluid connector, part number SH1-62/ SH1-63; with the male nipple on the mask side and the female coupler end mounted on the air supply side.
 - f) All connections in the air system must be done with commercially accepted or scuba type, high pressure crimped ends. Hose clamps are not allowed.
- 16) A bottom escape hatch is strongly recommended for all hydroplane and runabout hulls with reinforced cockpits. All hydroplane must have a rollover lift bracket or eyelet permanently attached to the rear area of both sponsons. The

bracket or eyelet must have at least a $\frac{3}{4}$ " hole and be strong enough to support the weight of the boat should it need to be righted for rescue purposes.

17) Type 4 Capsule

- a) The design specifications quoted here are not to be considered the ultimate, but have been established based on analytical and empirical data available. The enclosed/structural cockpit system shall be constructed of a composite shell surrounding a steel or composite roll cage with a polycarbonate or comparable strength canopy covering the areas necessary for adequate vision. The Structure shall be designed to provide a water deflection barrier in all six directions and impact protection in the event of a multi-boat incident.
- b) Roll Cages:
 - i) Forward Hood: See (Illustration 2) A braced hoop, strut, composite, or fabricated supporting structure as high as possible, following the inside contour of the canopy without interfering with the forward visibility of the driver, and must be securely fastened to or incorporated within the cockpit structure. The hoop will be adequately braced fore and aft at the sides of the cockpit shell. The upper portion of the hoop will be designed to provide support for the tilt up portion of the canopy.

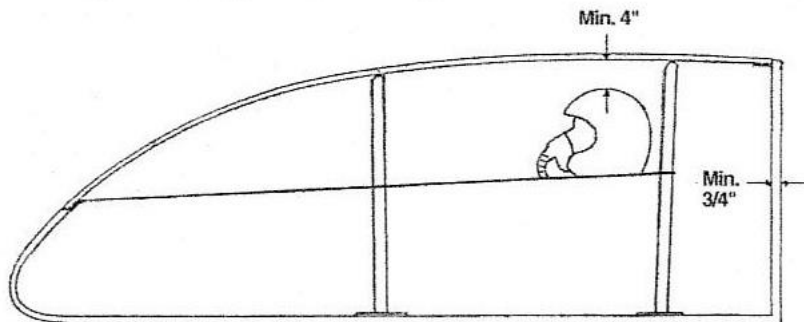


Illustration 2

- ii) The hoop structure and mount must have the minimum mechanical impact properties equivalent to that of a braced hoop constructed of SAE 4130 round seamless tubing with a minimum outside diameter of 1.500 inches with a minimum wall thickness of .065 inches or .118 inches if mild steel is used. The mounts must be constructed to distribute high impact and shear loads into the main cockpit structure in a manner that will insure that the cage and cockpit structure will remain intact.
- iii) Rollover Hoop: (see Illustration 2) the structural cockpit must be equipped with a rollover type hoop that is securely fastened to the main cockpit

structure; immediately forward of, and attached to the rear bulkhead. The contour of the top of this structure shall follow the contour of the inside of the canopy. The hoop will be adequately braced fore aft at the sides of the cockpit at canopy sill level to secure the structure in an upright position, and to provide additional strength to the cockpit walls and rear bulkhead. The mounts must be constructed to distribute high impact and shear loads into the main cockpit structure in a manner that will insure that the roll cage and main cockpit structure will remain intact.

- iv) The aft hoop and support structure shall meet number 3 above.

c) Main Structures

- i) The cockpit shall be fabricated of composite material along the bottom (which can also be the hull bottom), sides (up to at least shoulder level) and continue above the top, and front of the drivers feet and legs. Protection must also be provided for the drivers back, neck, and back of head to a minimum of four inches above the top of the driver's helmet. The aft bulkhead must also serve as an airtight bulkhead to separate the engine/fuel compartment from the cockpit.
- ii) An emergency door or escape hatch must be installed on all hydroplane classes in the bottom of the cockpit, beneath the driver, immediately forward of the seat for emergency exit and rescue. Minimum length: 20 inches, width: 15 inches and area: 300 square inches. Hatch latch mechanism will be internally and externally accessible. Hatch must include a window and minimum ½ inch polycarbonate and be 12 square inches. An emergency door or escape hatch is strongly recommended for ALL RUNABOUT CLASSES.
- iii) Every driver must demonstrate that they can withdraw their knees through dash bulkhead at any time when seated in their normal driving position, unless the forward edge of the hatch opening is flush with the foot pedals.
- iv) Canopy: a canopy of impact resistant shatter-proof material shall be used to enclose the cockpit and provide visibility for the driver.
 - (a) The top of the enclosed cockpit will be covered with an aircraft type canopy, with a tilt-up section allowing normal entry or exit. The forward part of the canopy must be bolted and bonded to

the roll cage and cockpit shell, and be capable of sustaining loads; in aft, side and forward directions, sufficient to break the canopy or fail the roll cage. Canopy mounting must be reinforced at the cockpit sill attachment, and consideration made for thermal expansion.

- (b) The canopy must be fabricated of hot formed polycarbonate material of at least .250 for 1.5L Stock, 1L Mod, 2.5L Stock, 2.5L Mod Classes and 5 Litre Classes. .375 for GP, GNH, NM, SS, PS, and KRR Classes.
- v) The tilt-up section of the canopy must be supported by a structural frame along the sides, with hoops following the canopy contour at the forward and rear edges, and hinged to the forward roll cage hoop, or one side of the cockpit. With the canopy closed, the frame must rest in a channel at least 1 ½" inches deep at the side sill and be held in position for the forward roll cage hoop, or the side of the cockpit structure, by the hinges and a minimum of two locating pins (one per side).
 - a) The tilt-up section will be secured in the closed position with two latch mechanisms. The latches shall secure the aft portion, or side of the tilt-up section of the canopy to the main cockpit structure in at least two locations (left and right side). The cockpit shall be equipped with both internal and external release handles. The external release shall be flush mounted and painted fluorescent or bright orange.

d) Head Rest

1. The area behind the driver's helmet must be constructed to minimize the potential of neck and/or head injuries in case of impact. This structure is to be designed to deflect no more than two (2) inches rearward when a force of 200 pounds is applied. The surface facing the helmet is to be one continuous piece, mounted perpendicular to the hull reference plane, and designed in such a way as to minimize the point loading upon impact with the helmet. Under no circumstances shall sharp or protruding objects be located where they could come in contact with the helmet in normal operating position or during impact situations. Padding of high density foam of sufficient thickness to minimize

injury in case of impact must be fitted in the areas of most probable helmet contact. A ½ inch (minimum) thickness of foam behind the driver's head is also mandatory per rule B.14(c).

e) Cockpit Opening

1. The cockpit opening with canopy open must conform to the following dimensions when measured on a plane parallel to the water. The cockpit structure or roll cage assembly may not encroach on the minimum opening specified. Minimum length: 23 inches, width 16 inches.

f) Cockpit structure outside shell construction criteria

1. Minimum core thickness: 0.75 inches, Minimum core density: 4.5 pounds per cubic foot, Minimum plate shear strength: 170 pounds per square inch.
 2. Minimum skin thickness .070 inches or skin strength should meet or exceed the ultimate tensile strength of .020 inch 2024 T351 aluminum eq. UTS 68 ksi.
 3. In an FRP laminate wherever possible, thirty percent of the plies shall be laid up at an angle of +/- 45 degrees to the main structural plies.
 4. All joined components will be properly flanged and fitted to ensure structural integrity. Staggering and overlapping construction shall be used between plies when it is necessary to join materials to ensure the strongest possible joint.
- g) A full time onboard air system is recommended for all drivers in reinforced cockpit boats, and shall be mandatory for all boats competing with an F-16 type structural canopy in place.

18) Type 1 Capsule (JSS class only)

a) Minimum material and construction recommendations

1. Tubing: Alloy Steel (SAE 4130N) (T45) with mill certification.
2. Tensile strength: 95,000 P.S.I.
3. Yield Strength: 75,000 P.S.I.
4. Welding: Heliarc, Argon purging, normalized after welding.
5. Bolts: 316 stainless or comparable, with locking nuts.
6. Bending: Bends should be smooth with no sign of crimping. Radius of bends shall not be less than 3 times the diameter of the tube, at the center line of the bend.

7. Construction: One continuous length of tubing should be used for the main hoops (minimum of 2 main hoops).

8. Minimum tubing dimension and specifications:

JSS Class: OD: 1-1/4"/.065 wall OD- 1-1/8"/.065 wall OD- 1.0"/.065 wall

9. Those boats with approved safety cages that were installed and competed, prior to the 1996 season shall be grandfathered if they do not meet the new guidelines. Any boat with a new cage that did not compete prior to the 1996 season must meet these new guidelines.
 - b) Cages shall be through bolted to hull in a minimum of 4 places using mounting pads.
 - c) Cage to be designed so as to offer protection from front, rear and both sides (no part of driver/rider to protrude from cage).
 - d) All wires and hoses must be routed on outside of cage tubing.
 - e) An onboard air supply is recommended and must be securely mounted to the cage if used.
 - f) Seats:
 1. Must be mounted to the cage.
 2. Held in place by a minimum of three 5/16" bolts (316 stainless steel or equivalent) with locking nuts.
 3. High back seat or separate rear head support/restraint required.
 - g) Restraint System
 1. Belts must be bolted to the cage itself
- 19) Right and left hand rear view mirrors are required on all boats with reinforced cockpits except Jersey Speed Skiff hulls with roll cage type reinforced cockpits.