UniSA AUSTRALIAN HPV SUPER SERIES

2017 Vehicle Design & Construction Specifications

for Single Seat Human Powered Vehicles (HPV's)

Revised 8th December 2016

All enquiries regarding Rules and Specifications to:

Australian International Pedal Prix Inc
83 Goodwood Road, Goodwood SA 5034

Email: office@pedalprix.com.au

Teams will be notified of all changes to this document via email and the revised document will be published on the website.

CONTENTS

Appendix References are indicated in the Rule Set by "App.".
These references are intended to help with advice and to clarify expectations.
Changes to Specifications for 2017 are in blue.
Changes to Appendix References for 2017 are in blue.

1 Vehicle Types

The UniSA Australian HPV Super Series is for single seat, wheeled, Human Powered Vehicles (HPVs).

2 Decisions and Interpretations

2.1 The Organising Body will make a decision in any case not covered by these specifications.

2.2 If changes are made to these specifications, the organising body will attempt to notify all teams who have entered an Event in the Series via their e-mail contact and such changes will be published on the website.

3 Specification Compliance

3.1 No vehicle will be allowed to practice or start an Event until it has passed **Scrutineering.**

3.2 Vehicles must maintain compliance with Specifications **throughout** each Event.

3.3 The organising body and/or their representative reserve the right to stop and inspect any vehicle during an Event.

3.4 Vehicles may be required for inspection at the conclusion of an Event.

3.5 Team managers are reminded that they have a particular responsibility and duty of care to their riders. During construction and use of the team vehicle, the Team Manager is required to monitor and assume responsibility for the following -
(a) rider protection structures are strong enough to meet their purpose
(b) no aspect of the vehicle compromises rider safety at any time
(c) the Team's riders each fit safely within the vehicle as described in these Specifications
(d) **Especially** the head clearance of all riders inside the COP

3.6 Team Managers and constructors are encouraged to seek clarification (via the AIPP Office as per the front page of these Specifications) from the Chief Scrutineer, of any specification that they need further interpretation of, or if a ruling on their vehicle's compliance is sought.

3.7 Vehicle bodywork must have room on the exterior of each side, **rearward of the front wheels,** for attaching stick-on Vehicle Identification Number Panels (supplied by Event Organizers), 300mm high and 400mm wide. [Details in Event Manuals]

3.8 Vehicles must allow for placement of sponsorship stickers. [Details in Event Manuals]

4 Safety

Designers and constructors please note:

4.1 Each Team is **responsible** for their own vehicle. This includes compliance with these Specifications and general safety at all times.

4.2 **All** vehicles are ridden at the rider's own risk.

4.3 The purpose of the scrutineering process is to determine if the vehicle complies with the 2017 UniSA Australian HPV Super Series Vehicle Design & Construction Specifications.

4.4 No warranty whether expressed or implied is made in relation to safety or roadworthiness through the Scrutineering process.

4.5 Constructors using composite materials must comply with Safe Work requirements particularly with unbound fibres and complete curing of materials. Such materials must be of suitably rigid design and construction to meet HPV Event requirements.

4.6 The vehicle design must provide substantial protection for riders in the event of a collision or rollover. App. 4.6

4.7 The exterior of the vehicle must not have protrusions capable of causing interference, injury or damage to personnel, vehicles or infrastructure. See App. 4.7 for prohibitions.

4.8 Exposed axle ends further than 300mm from the vehicle centre-line have to be recessed or flush in the hub, covered by bodywork, bar work, dome nuts or hub caps, or be shielded by annulus capping. Such items should be flush with bodywork if exposed.

4.9 Except for VRLA type, liquid lead acid type batteries are not to be used. App.4.9

4.10 All batteries must be mounted securely so that they do not come loose and are safe from collision damage including shorting out. App. 4.10

4.11 Opening body sections must be able to be opened independently from the inside by the rider, and, from the outside without rider help. Adjacent windows that are attached with velcro can give access.

4.12 Unless they are visually obvious, the location of closure devices for opening body sections must be marked externally with a triangle, as per App. 4.12 in size, in a colour that contrasts with the vehicle colour, making it clear for anyone unfamiliar with the vehicle. App. 4.12

4.13 The cockpit must be free of features that could injure the rider or crew. App.4.13

4.14 Vehicles are to have a white or very light coloured underside. Teams with closed canopies are to place the **supplied** reflective material externally on the roof above the rider's head. A 50mm X 250mm space needs to be left for this. (Diag. 6) App.4.14

4.15 All vehicles must have enough head room for **ALL** riders to be able to turn their helmeted head 90° right, through to 90° left.

4.16 Riders observed to have their helmet compressing the Specified Foam [see 14.7B (ii) and Definition 2] will not be allowed to continue riding. App.4.16

4.17 The vehicle must have some form of head restraint that prevents over-extension of the rider's head backward. App.4.17

4.18 Windows that riders need to look out of [or that are deemed to be needed for rider vision] must not be tinted or obscured. App. 4.18

4.19 Tail lights are to be fitted and **turned on** for **all** Events, mounted as per 22.7. App. 4.19

4.20 Helmet mounted cameras (or other devices) are not allowed.

4.21 Velcro mounting of windscreens is an option to ease pedal/chainring repair and possible removal of an injured rider rather than cutting the top off the vehicle. App.4.21

4.22 The main central tube of a "cruciform" chassis protects the rider from impacts through the floor. A peripheral chassis is to protect the rider from such impacts by cross tubes, flooring and seat structures. App.4.22

4.23 Adjustable seats must be prevented from moving during riding.

5 Riding Position

Must be recumbent . App. 5

6 Drive System

6.1 Must be a human powered system, activating one or more of the road wheels.

6.2 Motorised fan systems are no longer allowed. App. 6.2

7 Use of Commercially Constructed Frames and Parts

7.1 Designers and constructors are permitted to freely use any bicycle power transmission systems, brake systems, wheels, hubs and other components.

7.2 The use of Go-Kart frames or motorbike frames is not permitted.

7.3 The use of bicycle frames with a third wheel added is not permitted.

7.4 If there is any uncertainty relating to commercial components, clarification should be sought from the organising body via the AIPP Office in writing before proceeding.

8 Wheels, Track and Wheelbase

8.1 Vehicles must have a minimum of three load bearing wheels.

8.2 For three wheeled vehicles, track must be a minimum of 600mm (width between centres of tyre ground contact points)

8.3 Four wheeled vehicles are to have one axle's track of 500mm minimum and the sum of both axle's tracks is to be 900mm minimum. [Teams are cautioned that this layout is speculative and will need considerable prototyping.]

8.4 Wheelbase must be a minimum of 1000mm (longitudinal distance between axles at tyre ground contact points)

9 Vehicle Dimensions App. 9

(a) Maximum length 2700mm
(b) Maximum width 1100mm
(c) Maximum height 1200mm

10 Floor Pan App. 10

10.1 A floor pan must be fitted to all vehicles

10.2 The floor pan will be of sufficient size and construction to prevent the rider's feet, legs or hands coming into contact with the road surface when seated

10.3 The floor pan area under the cranks and pedals must be of sufficient strength and rigidity to support the weight of the rider's feet when in the riding position

10.4 Floor pans must extend underneath riders if there is any possibility of hands contacting the road surface.

10.5 A chassis without a backbone tube requires floor, chassis and seat structures with the strength and rigidity to protect the rider from an impact through the floor. App. 4.22

11 Guarding of Moving Parts

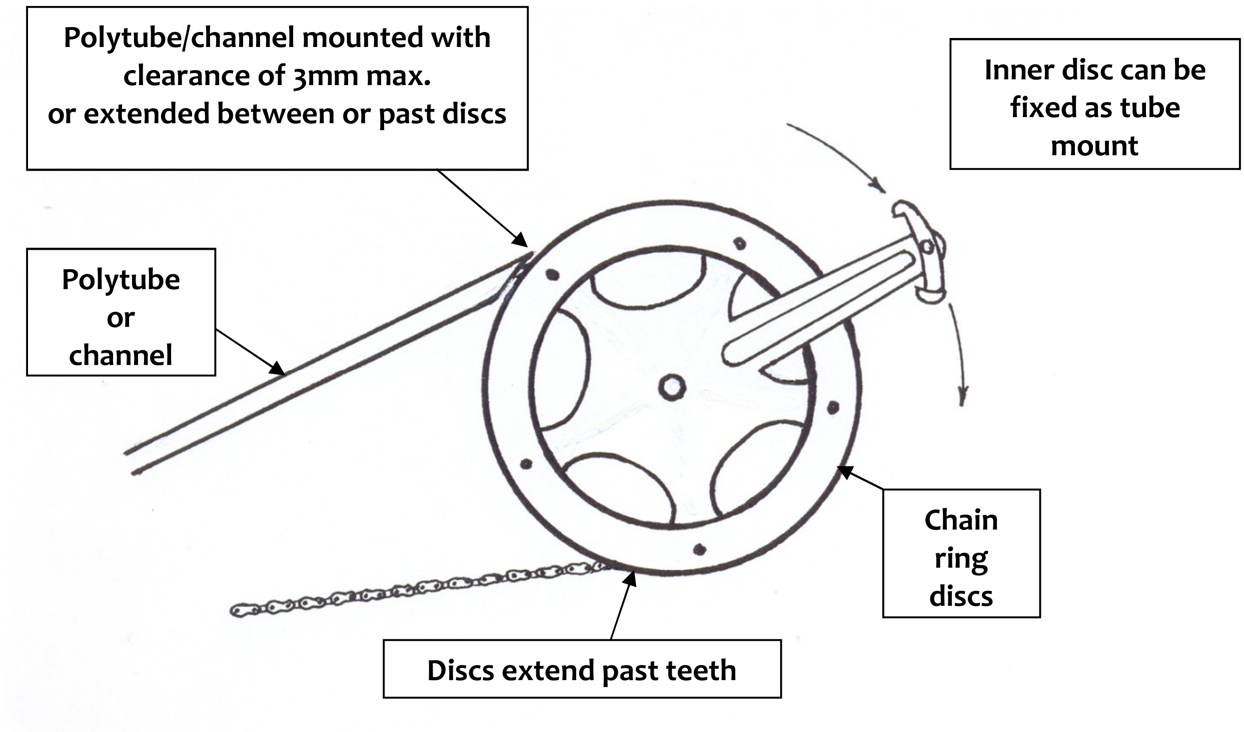
11.1 All moving or dangerous parts, especially the components of the drive system, must be guarded to ensure that no part of the rider or clothing can make contact or become entangled. App. 11.1

11.2 Where a rider's hands are likely to come into contact with spokes or tyres, guarding must be provided.

11.3 Chain ring teeth must be covered both sides using chain ring discs. (Diagram 1) App. 11.3

11.4 The chain leading to the chain ring (tension side) must be covered from under the seat to the chain ring with channel or tube – eg: polytube. This channel or tube must extend between or past the chain ring discs, or be mounted with skimming clearance of 3mm max. (Diagram 1) App. 11.4

DIAGRAM 1



12 Side Impact Protection and Rear Impact Protection

12.1 Side impact protection must be afforded to the rider's body, from shoulders to hips to knees, capable of protecting the rider from entry by another vehicle during a "T-bone" style of collision and must protect all riders in all seat positions.

12.2 Tubing and/or rigid panelling on each side forming an enclosed cockpit is required.

12.3 The wheels may form part of this protection.

12.4 Side impact protection structures must be anchored to not move sideways.

12.5 See 4.17 re Rear Impact Protection requirements.

13 Forward Protection

13.1 Vehicles must incorporate substantial forward protection for the rider, to cope with the event of a collision.

13.2 Such protection must be integral to the design, and strongly braced for feet protection.

13.3 Frontal vehicle design must also prevent easy penetration of another vehicle. At 100mm from the front, the vehicle must be bigger than 200mm cross-sectionally.

13.4 Constructors should ensure that forward projecting struts will not become a hazard if surrounding bodywork is no longer intact. [eg.by use of end plates or lateral tubing]

14 Rider Rollover Protection

Rider Rollover Protection Structures must comply with the following

14.1 Be structurally integrated with the chassis/frame/monocoque shell.

14.2 Be constructed to meet their purpose.

14.3 Can be formed from metal tubing or sheet, or composite materials, including the bracing. App.14.3 App. 14.12 (i)

14.4 Be a minimum of 500 mm wide at the rider's shoulders and an integral part of the side impact protection. Compliance with this dimension will be relaxed for hard shell vehicles but must be maintained for open framework vehicles. App. 14.4

14.5 Entirely encompasses the rider viewed from the front and rear App.14.5

14.6 Such structures and/or their bracing may be removable providing that appropriate attachment methods are used eg. bolts, flanges. (pins or clips are not acceptable)

14.7 The Rider Rollover Protection Structure **at the rider's head** : App. 14.7

Rider Head Clearance will be determined as per Definition 4 if required.

A: For Open Framework Vehicles the structure must:

i) be at least 300mm wide, 150mm down from its highest point (Diag. 2) App. 14.7A(i)
ii) be 100mm minimum above every rider's helmet for head out designs.
iii) have corners of minimum 50mm radius (Diagram 3)
iv) be braced longitudinally from its highest point to a substantial chassis/body member (Diagram 4) App. 14.7A (iv)
v) form a minimum angle of 10 degrees to the brace and this angle must include the vertical line through the highest point. (Diagram 5) App. 14.7A (v)

B: For Hard Shell Vehicles or equivalent: App. 14.7B

i) the hard shell/panelling/COP system must be robust enough to protect the rider, acting as roll bar and complying with 14.2 .
ii) 20mm thick Specified Foam of minimum size 600mm X 240mm must be fixed so it is above all riders' head positions (Diag.6) (Diag. 7) App. 14.7B (ii) Definition 2
iii) particular attention to 3.5, 4.15 and 4.16 is required.
iv) There must **NOT** be an **external** roll bar App. 14.7 B (iv)
v) A flexible handle is an option for shifting the vehicle App.14.7 **B** (v)

14.8 When an opening body shell is part of the rollover protection structure system, the Team must demonstrate that it is secured with a system that will function reliably, shutting with an audible click whenever it is closed, and will not open involuntarily. Opening bar work must also be shown to operate reliably. App. 14.8

14.9 All riders must be entirely within a line between the highest point of frontal structures and of the Cockpit Overhead Protection. (Diagram 6)

14.10 The rider's legs, knees and feet must be protected from injury by the vehicle's structures/panels when the vehicle is upside down **or on its side.** App. 14.10

14.11 Front structures must be stabilized from their highest point by bar bracing, as per Rule 14.7 **A** (iv), (v) or, through sufficient attachment of canopy/bodywork material of enough integrity to prevent it collapsing App. 14.11

14.12 Cockpit Overhead Protection [COP] must be provided to protect the rider when the vehicle is on its side and the rider is towards oncoming vehicles. App. 14.12

(i) Such protection is to be capable of deflecting an oncoming vehicle. App. 14.12 (i)

(ii) For a vehicle with a Team rider having a helmet within 100mm of the COP, and for a vehicle that is enclosed but not hard shell, the COP structure must be of minimum size 240mm wide X 600mm and comply with "Equivalent" as defined in Appendix 14.7B. The vehicle will consequently come under Specification 14.7B. The width will be measured around the outside of the COP and include structures contributing to the COP purpose. [as per Heading + (i) + (xi)]

(iii) An open framework vehicle requires at least two longitudinal bars with maximum separation of 200mm.

(iv) Bars must be straight or upwardly arched.

(v) All COP structures must have locating fixtures able to keep the COP in place during track incidents and to cope with any flexing.

(vi) Movable COP structures must be secured using a locking mechanism, to be proven at Scrutineering, that will maintain the required protection during track incidents.

(vii) A moveable door/roof/COP panel has to have 20mm minimum overlapping at its margins to maintain its protection during any track incident. App. 14.12 (vii)

(viii) Velcro as the **only** closure mechanism is not enough. Elastic cords with attached hooks will not be accepted. If elastic loops over fixed hooks or buttons are used, at least two are required. Rotary slam latches (car door/boot style) and spring loaded bolts can provide suitable positive locking. App. 14.12(viii)

(ix) Movable bars and panels must not be hinged from the rear.

(x) The minimum requirement for hard shell vehicles is two layers of cured composite fabric extending from the head structure to rider's knee area.

(xi) The total width of COP structure actually required depends upon the vehicle's shape and structure and should be checked when it is lying on its side.

DIAGRAM 2
Rule 14.7A (i)

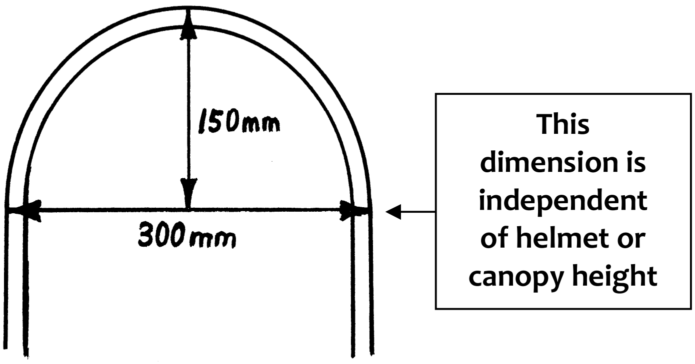


DIAGRAM 3 Rule 14.7A (iii)

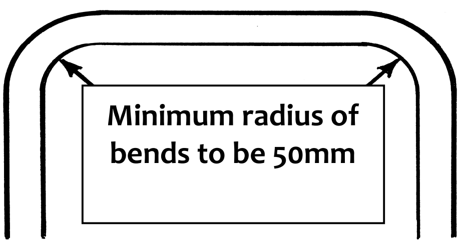


DIAGRAM 4 Rule 14.7A (iv)

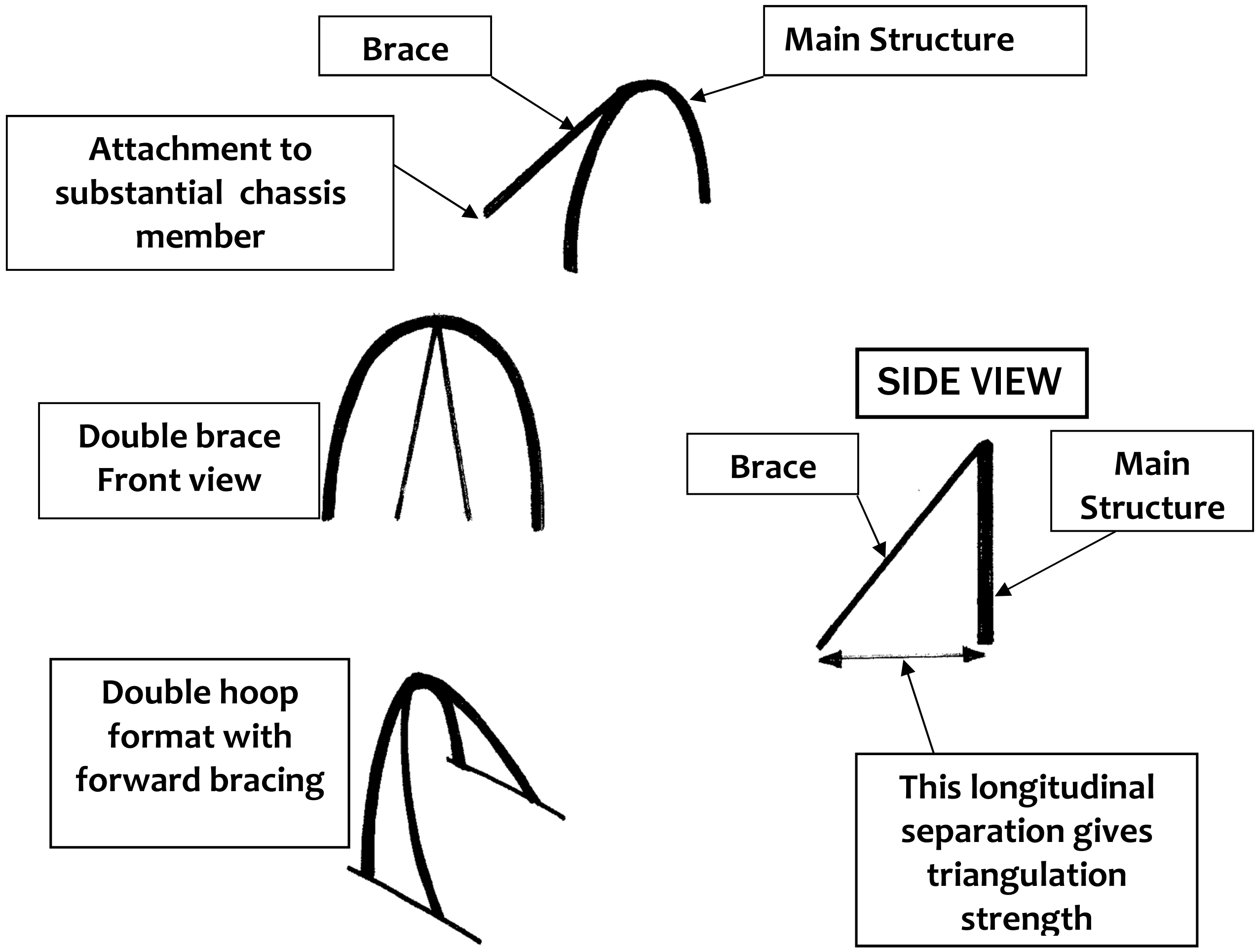


DIAGRAM 5 Rule 14.7A(v) SIDE VIEWS

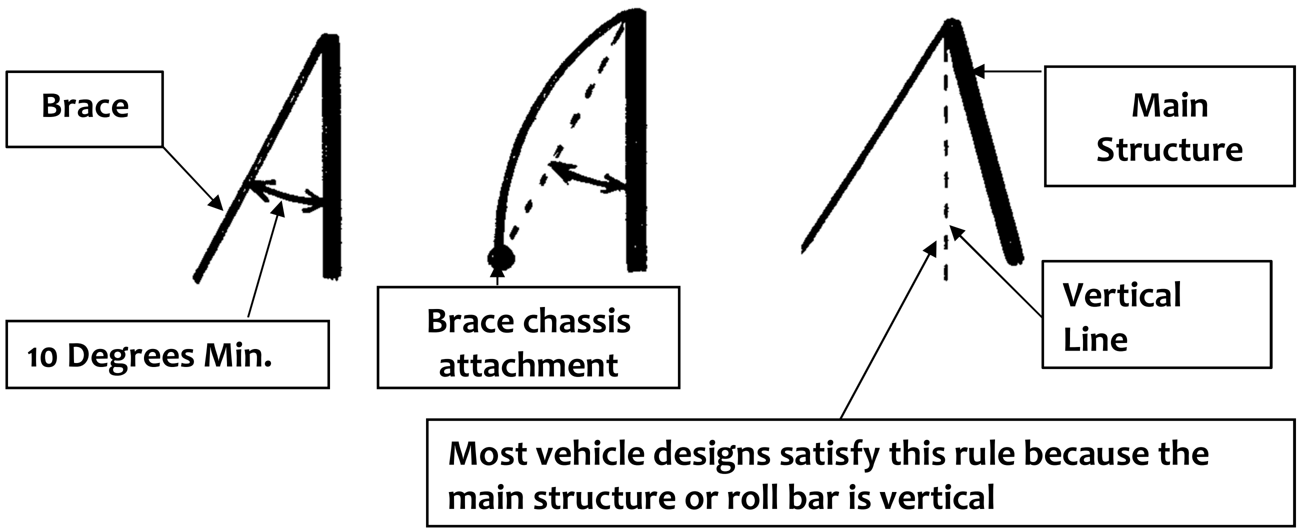


DIAGRAM 6 Rules: 4.14 14.7B(ii) 14.9 14.12

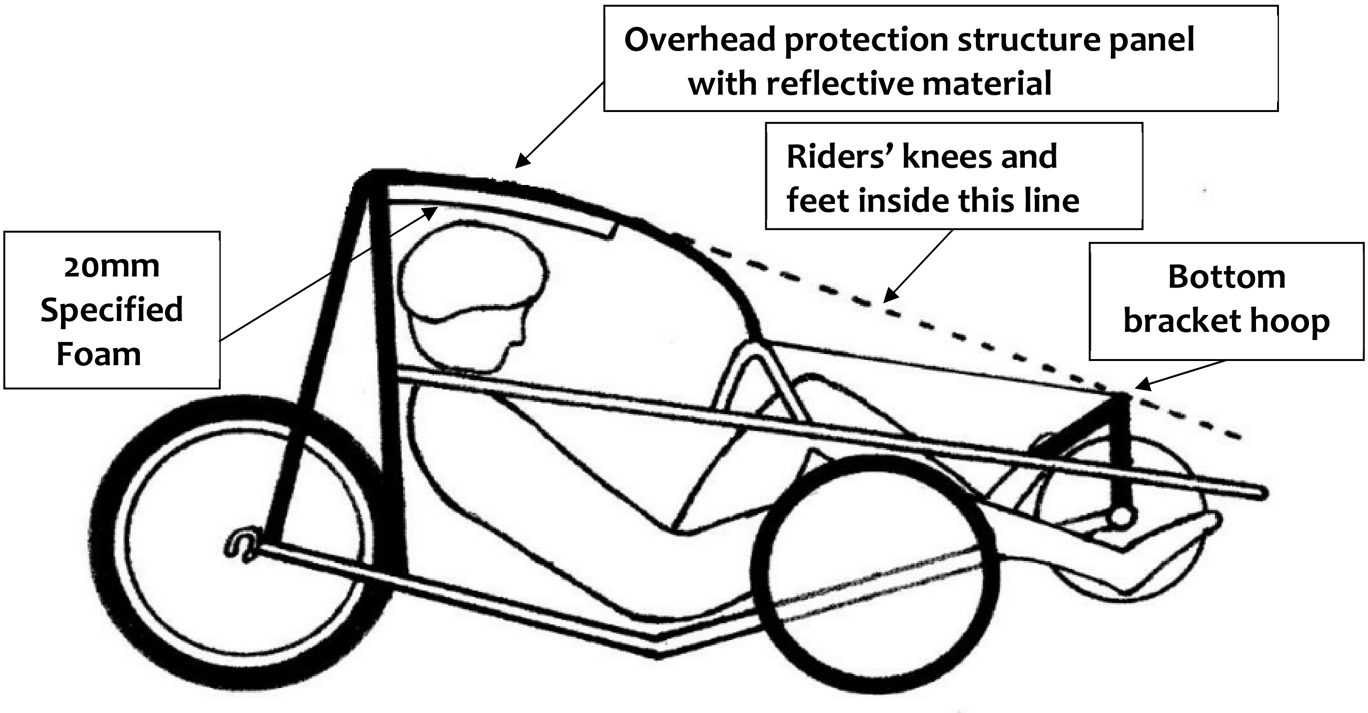
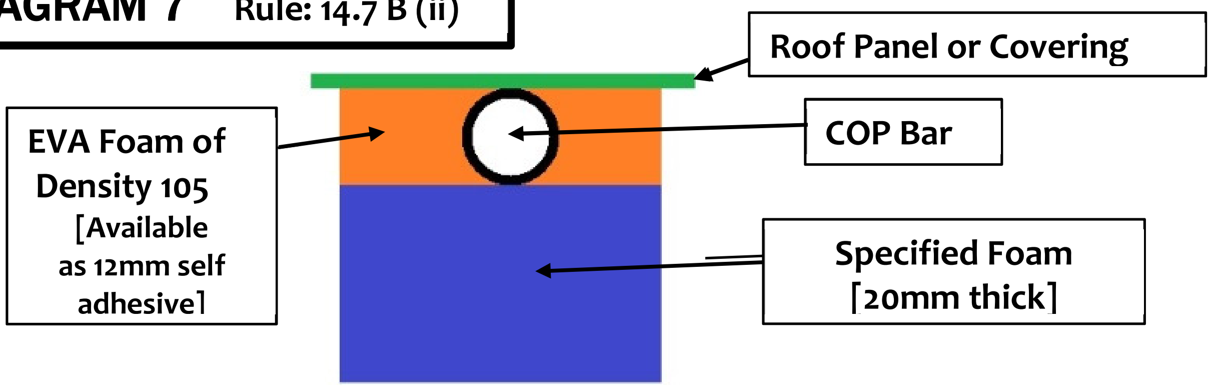


DIAGRAM 7 Rule: 14.7 B (ii)



A suggested way of providing protection when a COP bar is directly above a rider

15 Seat Belts (Type)

15.1 The vehicle must be fitted with an **"Approved and Certified"** 4-strap seat belt

15.2 Automotive full harness types are acceptable

15.3 The seat belt must have the **manufacturer's certification label attached.**

15.4 Belts must be in good condition (frayed, cut or restitched belts will not be accepted)

15.5 **No modifications are allowed to the seatbelt assembly as manufactured.**

15.6 Suggested supplier: HEMCO INDUSTRIES, VICTORIA for price and delivery details, visit
www.hemco.com.au PO Box 444 BALLARAT VIC 3353
1300 065 057
Wayne Fitzgerald wayne@hemco.com.au

16 Seat Belts (Mounting) App. 16

16.1 **Anchorage points should be considered in the early stages of design of the chassis to provide secure mounting points**

16.2 The seat belt must be mounted securely to major vehicle structural members in the manner intended by the belt manufacturer – eg: the HEMCO four point Pedal Prix Harness is to be mounted using four bolts **OR** two bolts for the waist strap with a three bar slide for each shoulder strap.

16.3 The correct bolts/fittings must be used as supplied by the harness manufacturer OR $^{5}/_{16}$" (8mm) minimum diameter and Grade 5 minimum strength. Bolts to be installed with 2 – 3 threads showing through either a nut with spring washer or a nylok nut.

16.4 Mounting bolts must be put through frame tags or fully welded sleeves through frame tubes. Removable sub-frames or brackets carrying mounting bolts must be attached to major vehicle structural members with strength equivalent to the mounting bolts. App. 16.4

16.5 Use of three bar slides as a mounting system for the shoulder straps is encouraged, provided the slide supplied is used and correct threading procedure is followed.

16.6 Shoulder strap mounting points or slip-through guides are to be:
- (i) as level as possible with the rider's shoulders. [Refer 17.1] App. 16.6 (i)
- (ii) a maximum of 200 mm apart App. 16.6 (ii)
- (iii) positioned so that straps do not fall off the shoulders in use App.16.6 (iii)

16.7 The seat belt may be mounted to an adjustable seat frame provided the strength of the seat belt anchorages is carried through to where the seat is connected to the structural frame member(s) ie if the seat belt is anchored by 4 x 8mm bolts, the seat should be secured to the frame with a minimum equivalent cross section of material of equivalent strength.

16.8 The seat has to be shaped to prevent the rider sliding under the seatbelt.

17 Seat Belts (Positioning) App. 17

17.1 The positioning of buckles and belts on the rider's body must conform to the belt wearing requirements of Australian Design Rules (ADR's) for motor vehicles. The relevant section of the ADR 4/01 is reproduced below:-

"Seat belts are designed to bear upon the bony structure of the body, and should be worn across the chest, shoulders and low across the front of the pelvis; wearing the lap section of the belt across the abdominal area must be avoided.

Seat belts should be adjusted as firmly as possible, consistent with comfort, to provide the protection for which they have been designed. A slack belt will greatly reduce the protection afforded to the wearer".

17.2 Team Managers must monitor lap belt positioning on their riders and alter mounting points to ensure correct pelvic restraint is achieved. App. 17.2

17.3 The seat belt **must** be correctly adjusted for **each** individual rider before leaving the pits and must remain properly adjusted at all times (rider training should include correct seat belt placement and become an automatic protocol).

It cannot be emphasised enough that the lap belt must be adjusted to be tight across each rider's pelvis so that riders can get the expected crash protection from their harness. Lap adjustment has to be done **BEFORE** the shoulder straps are tightened and the incoming rider could have loosened these. Standard road vehicle inertia-reel seat belts require no adjustment but HPV harnesses are not the same and require attention to being tightened for each rider.

18 Steering

18.1 The vehicle must turn within a circle of 12 metre diameter (left and right) measured "kerb to kerb" . App. 18.1

18.2 The design of the steering must be such that the wheels can be moved from full left lock to full right lock in an uninterrupted movement.

18.3 Smooth steering is more important than sharp turning and will be tested by the Steering Slalom Test. Definition 3.

18.4 Steering systems must have some form of maximum lock limitation that prevents jamming, linkage damage, over centre travel and specifically tyre or wheel contact with the rider. Limiting such contact with parts of the vehicle is a Team responsibility.

18.5 Steering controls must be designed and constructed **so that they will not injure the rider** in the event of an accident.

18.6 Steering controls which project towards the rider: (i) must not be closer than 250 mm to the rider's face: (ii) require rounded edges and suitable padding.

18.7 Rope, cable, tilt steer, lean steer, flexible column, rear steer systems are not permitted.

19 Braking Systems (Configuration)

19.1 Minimum of two independently operated systems must be evident. A separate lever for each front brake where there are two front wheels meets this requirement. App. 19.1

19.2 The configuration of the braking systems is left open to the designers and constructors. Experience indicates separate front wheel levers is the most sensible layout. App. 19.2

19.3 A rear wheel brake is not required when there are two front wheels with separately operated brakes. i.e. separate levers.

20 Braking Systems (Conditions of Use)

20.1 Each braking system must be efficient and effective in all conditions and not interfere with directional control of the vehicle when operated.

20.2 Allowance must be made for brake wear, as brakes must continue to work effectively for the duration of the event.

20.3 Brake controls must be away from any moving parts and the road surface, to avoid injury to the rider or compromising the braking system of the vehicle.

20.4 Brake systems must not apply friction contact to the tyres.

21 Braking Systems (Integrity)

A dynamic brake test will be incorporated in the scrutineering process as part of the Steering Slalom Test (from 15 km/h for Category 1 and 25 km/h for Categories 2-4).

22 Lighting App. 22

22.1 Head and tail lights must operate continuously throughout any "declared lighting up period".

22.2 Front lighting must be at least one white light, securely fitted between 250mm and 600 mm above road level, at the front of the vehicle (forward of the rider's feet).

22.3 The headlight(s) must be of sufficient size and capacity to effectively illuminate the pathway of the vehicle, and to illuminate other vehicles being approached from behind.

22.4 Headlights are not to be flashing.

22.5 Helmet mounted lights are not to be used.

22.6 All red lights on the vehicle must be **rear facing and comply with 22.7**

22.7 Rear Lighting must be:
- i) **fitted** and **turned on** for all Events App. 4.19
- ii) red LED
- iii) set to **steady mode ONLY** App. 22.7 (iii)
- iv) robustly mounted between 350mm and 600mm above road level
- v) strip lighting or string LEDs should be confined or masked to these dimensions
- vi) mounted within 150mm of the rear-most part of the vehicle
- vii) mounted on the vertical centre line of the vehicle
- viii) not mounted in an opaque recess - visible through 160° rear sweep App.22.7 (vii)
- ix) Teams need to be considerate of other riders as excessive brightness interferes with following riders' vision. App. 22.7 (viii)

22.8 Teams may use subsidiary lights, of colours other than red or white, anywhere on their vehicle

23 Mirrors

23.1 At least two effective rear view mirrors of minimum area 18 cm^2 each must be fitted, one on each side of the vehicle, and having similar reflection (i.e. same size image).

23.2 Mirrors may be of the mildly convex type.

23.3 Each mirror must be positioned within arm's reach [whether adjustable or not] and enable the rider to clearly identify overtaking traffic. App. 23.3

23.4 The automotive convex spot mirrors sold as size 2" are a good solution. App. 23.4

23.5 Zéfal "Spy" mirrors comply. App. 23.5

24 Warning Device App. 24

24.1 A **loud** warning device must be fitted, mounted in front of the rider's feet.

24.2 Maximum sound from the warning device must be directed forwards to warn people and vehicles in the vehicle's path.

24.3 It shall be electric or electronic (eg smoke alarm siren) and faster teams are encouraged to investigate and use devices with uncommon tone and/or power.
eg. motor bike horn (these are robust and waterproof) or Hornit brand.

24.4 The warning device must only be operated by using a momentary switch mounted on a steering handle. App. 24.4

24.5 The warning device or its waterproof covering membrane must **DIRECTLY CONTACT** the outside airstream.

24.6 The warning device is intended to be used to warn other riders, not to intimidate them.

25 Speedometer and Pit Lane Speed

An effective speedometer must be fitted to the vehicle in a position where it can be clearly seen by each rider of the Team. Pit lane speed is to be 10 kph maximum.

26 Bodywork, Rider Ergonomics and Rider Vision

26.1 Bodywork and canopies must be **inherently safe**, and maintained in a safe condition.

26.2 Riders must be able to open and remove the canopy or bodywork and exit the vehicle **without any external assistance.** Refer also to 4.11, 4.12, 14.8

26.3 Rider vision must not be impaired by excessively enclosed and restricting bodywork.

26.4 Riders seated in the normal riding position must be able to sight an object on the road surface 5 metres straight ahead of the vehicle.

26.5 Provision to mitigate internal fogging is required. App. 26.5

26.6 Replacement large body sections, eg. tops specifically for night-time, low visibility periods, or improved ventilation use, must be presented at Scrutineering with the vehicle they will be used on.

26.7 Airflow for rider ventilation should be considered. App. 26.7

27 Team Sponsors' Signage

27.1 Teams are invited to display on their vehicles and uniforms, any logos or signs that promote healthy school/institution, industry and community links etc.

27.2 The organising body reserves the right to have removed any offensive signage.

27.3 The organising body may reject any Team or vehicle names deemed to be offensive.

27.4 Signs, logos, stickers etc promoting or representing drug, alcohol or illegal substances

28 Appendix: Numbers in this Section relate to the Rule referred to.

4.6 Rider Rollover Protection Structures

- Are to contain the rider in a strong and tough enclosure
- Are to prevent contact between rider and the road, other vehicles and obstacles
- Are to prevent abrasion injuries
- Can be formed from metal bar work, composite panels or combinations of materials.
- Long term experience has shown that the minimum OD tubing to use is ½" [12.7mm] CrMo (16mm aluminium)
- Materials should be used fittingly. eg composite panels work effectively without being formed into bars
- Are to absorb and/or transfer the kinetic energy of the moving vehicle away from the rider [The front of Formula Tri-Sled vehicles is an excellent example of using a simple material innovatively to form an energy absorbing shape.]
- Must not have internal items that could injure the rider eg. sharp cable tie ends, or bar work that riders will impact with.
- May require judicious placement of padding eg. For shoulders.
- These Specs carry an intention to support subtle, progressive, innovative, evidence based design and construction.
- Desirable design directions to enhance rider safety may include:
  - □ flexibility designed into structures where appropriate
  - □ deformation allowed for in suitable structural elements
  - □ chassis/rollcage/bodywork sections that are intentionally replaceable

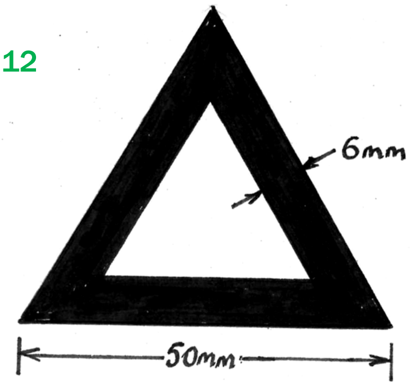
In general engineering principles, these are preferrable to entirely inflexible rigidity. Deformation [permanent or transitory] is not a sign of failure but evidence of crash force attenuation. Total rigidity is more prone to unanticipated complete failure and damage to other structures.

4.7 Externally, hard shell vehicles must not have rigid projections such as [but not limited to] body or door handles, fins or roll bars. Aerodynamic devices can be effective if made from non- or semi- rigid materials. Approval for devices that may infringe 4.7 should be sought prior to construction. Open frame vehicles will intrinsically have "projections". The hazard level these present must be mitigated as far as possible while retaining the safety intent of the structure.

4.9 Valve Regulated Lead Acid batteries have proven to be suitably safe. They have a limited amount of acid that is securely retained inside the battery.

4.10 Batteries have to be protected from track incidents so that they cannot come loose or be damaged. It does not make sense to carry batteries that are overly large.

4.12



Some Teams have found it useful to also add opening instructions.

The triangles and instructions have three benefits:
a) Assisting emergency personnel.
b) Re-assuring riders that they can be got out if needed.
c) Reducing inadvertent damage to the vehicle by helpful bystanders.
d) The triangle can be a solid colour but contrasting to surrounding bodywork.

4.13 Inside the vehicle it is important to have no uncovered sharp edges. Unsafe edges should be rounded and covered. Cable ties that have been trimmed only with side cutters, or similar, leave very sharp ends that will cause severe injury when brushed against. Such ends need to be cut flush, filed round, taped over or rotated away from possible rider or crew contact. Brake and gear cable ends should be covered with end caps. Appropriate padding may be needed to protect riders from some items. Some Teams cover bar work near the rider with pipe insulation foam. Some also use a foam layer on panelling in the shoulder area. No **bare** edge of rigid material including coreflute, PETG or similar is to be within 250mm of the rider's face. Ducts going to the rider from the front of the vehicle must be made safe with flexible or collapsible sections to avoid injury during a frontal impact.

4.14 Vehicles lying on their side, at night, or in daylight Events with low visibility, can be very difficult to see in race conditions. Make the underside visible in white, or a very light colour. Reflective material that is standardized by being supplied and consistently placed above the rider's head will help other riders avoid someone on their side.

4.16 Team Managers have an important responsibility to ensure that every rider fits their vehicle. [3.5] Teams should conduct their own Roller Test long before attending Scrutineering to determine that their canopy or framework gives all Team riders proper room. Clearly such clearance is required to be maintained during Events.

4.17 For some vehicles, the structural formation and design of the cockpit already provides head restraint to prevent whiplash. Some adjustable shoulder supports incorporate a moulded, neck-head support that acts as a head restraint. Ensure that the top edge of such a support is not likely to cause neck/spinal damage. Creating a functional head restraint system can be helped if riders wear helmets without rear peaks. Bell and Limar have models with rounded backs. Many BMX and skate board helmets also have this shape and since they have to meet Australian Standards they are also suitable. This style of helmet also offers better temple protection.

4.18 Tinting is prohibited on road vehicle windscreens. Pedal Prix vehicles are race vehicles and all round visibility is required, hence the wording of the Spec. Window areas needing sun-blocking should be covered with opaque contact. Rider vision of the track must not be restricted.

4.19 If tail lights are on for all Events and track conditions reduce visibility, making them necessary, the Race Director does not need to call all Teams into their Pits to turn lights on.

4.21 A Velcro system for attaching windscreens works well if the hook side is put onto a thoroughly cleaned surface of the body work. Removing half or more of the hooks, in cross strips, [using a vibrating multi-tool] especially close to the ends, leaves the adhesive stronger than the Velcro, allowing the windscreen to be taken off and on without pulling the Velcro off the vehicle. Windscreen cleaning is also easier.

4.22 A “cruciform” chassis has a single, large diameter tube running from the bottom bracket past the main cross/axle tube connecting the front wheels, under the rider and on to the back wheel forks. A “peripheral” design uses tubes each side of the rider from the main cross/axle tube to the back wheel forks. It does not have that large tube protecting the rider from anything coming through the floor.

5 HPV vehicles in general are commonly recumbent as this position has been found to be reasonably safe in the event of a collision or rollover. HPV Super Series / Pedal Prix vehicle design has standardised around recumbent tricycles as this position and layout are the most compatible with these types of Events.

6.2 Technological advances now enable defogging-ventilation fans and battery systems to alter the airflow around a vehicle sufficiently to give worthwhile aerodynamic gains. Even to provide propulsion directly. A measureable speed advantage can be gained. This is not a developmental direction deemed to be beneficial to HPV Events, especially in the longer term. It contradicts the ethos of using just human power as the motive force.

Passive defogging and ventilation systems, that are already under test and in use, are seen as the way forward for innovation in this area.

9 These dimensions are to comply with a National framework of Specifications. Vehicles built in 2010 or earlier will comply in SA with the dimensions they were built to.

10 For most vehicle designs it is preferable that the whole underside should be enclosed with the floor only being penetrated by cut-outs for wheels.

11.1 Teams having riders with long hair need to check their vehicles to remove any chance of entanglement, especially with the rear wheel and the chain behind the rider.

11.3 Discs on both sides will protect loose feet/ankles from injury on chain ring teeth during a roll over.

11.4 Putting the tension side of the chain inside a tube improves chain line security. The “skimming clearance” guards the “nip point” where tension chain meets chain ring.

14.3 Team Managers need to be conscious that Rider Rollover Protection Structures need to be capable of withstanding much more than **one** roll over and that a Team with a damaged structure judged to be no longer capable of providing rider protection will be kept off the track until repaired.

14.4 This dimension is “auto” limiting with hard shell vehicles. Riders cannot perform at their best for long when too cramped. Team Managers need to monitor how their riders fit within the vehicle and make changes as needed.

14.5 Some older designs allowed rider’s elbows to protrude and possibly contact the ground.

14.7 “Rider Rollover Protection Structure” is a more inclusive and descriptive title than “Roll bar”.

14.7A (i) Please note that the 300mm dimension is independent of where any rider’s helmet is and is measured 150mm down from the highest point. It is intended to give the vehicle the shape to provide some space between the rider’s head and ground during a rollover and also to encourage a rolling movement rather than a slam into the ground that earlier high peak shaped roll bars led to.

14.7A (iv) Bracing needs to be longitudinal, that is, extending lengthwise along the vehicle and cannot be in the same plane as the main structure if it is to offer any bracing effect. Bracing not going to the highest point but being within that structurally functional region may be a better solution for some designs. It must provide the required level of bracing and strength. Two braces may be required.

14.7A (v) Most vehicles have the main roll over structure vertical or leaning back slightly and this arrangement satisfies this Rule and the requirement of structural triangulation to make the whole structure strong.

14.7 B "Hard shell" is a body system, usually composite, capable of withstanding intrusion, having inherent elasticity, that will not break or shatter on impact and will resist road surface abrasion. "Equivalent" systems may be a rigid panel of polymer, composite or metal above the rider's head; or a head protecting framework with no bar spacing greater than 200mm, covered with sheet polymer of minimum thickness 0.5mm [eg. PETG] or coreflute, composite or metal.

14.7B (ii) This Specified Foam is intended to have a protective function for the rider. It is not just a "clearance foam" as previously. See Definition 2.

Riders deemed to be unsafe due to having their head too close to the roof or safety line will be given Team alternatives as per Definition 1. Team Managers have an important responsibility to ensure that riders do their safety harnesses up correctly so that any protective head space is maintained during a roll over.

14.7B (iv) Not having external roll bars on smooth bodied hard shell vehicles recognizes

a) the extra protection given by vehicles having panel overhead protection
b) possible problems of an external roll bar catching on the road surface or obstructions instead of flowing smoothly across them during a rollover
c) the possibility of such a rollbar acting as a protuberance to cause injury to bystanders or other riders.

Proper in-cabin helmet clearance and using seat belts correctly are essential safety measures.

14.7B (v) A smooth, hard shell vehicle can be very difficult to handle after a roll-over. Rolling a vehicle upright from near the front wheels usually gives enough purchase. A flexible handle can be made using a loop of suitable strapping with reinforced ends, held on with a cup-head bolt. It will lie flat until gripped. An extra-wide zip tie looped through two holes about 100mm apart [longitudinally] also works well. The loop is kept large so when not in use it is pushed down and will spring close to the body on the outside.

14.8 Clam shell designs especially need to have a reliable closure system that will not come open during a crash or other incident and one that operates whenever it is shut. When the opening section is a part of the roll over protection structure system the closure system is best if it is automatic to avoid the situation where students may not get it shut fully. Any opening panel needs to have a reliable closure system. Having an audible click on such systems will alert new Owners, Team Managers and Pit Crew and people unfamiliar with the vehicle if it is closed properly or not. This requirement is aimed at "clam shell" style body work and vehicles that have a significant mass of body work that opens. Supplementary locating pins, tabs or lips may be needed to prevent one half flexing away from the other.

14.10 Teams need to provide protection for the rider's knees when the vehicle is on its side. The possibility of injury is made worse when the rider's feet have come loose. For some designs, rider's knees can contact the ground when the vehicle is on its side even if their feet are still in the pedals unless protective bodywork is put in place. For most designs, a hoop over the bottom bracket region provides the clearances needed but panels may also be needed. (eg. coreflute)

14.11 With some designs, front roll over protection structures can be stabilised through using the body work as a structural material to ensure that the structures do not collapse in any direction during a roll over or other track incident.

14.12 "Cockpit Overhead Protection" is an adjunct to "Rider Rollover Protection Structure" and offers overhead protection for the rider in the space between the roll bars. The intention is that an oncoming vehicle would be deflected from a rider in a track incident where their vehicle is lying on its side and they are towards oncoming traffic.

14.12 (i) In most cases, a vehicle in this situation will tend to be moved out of the way during a collision. However, if no movement is possible, the impact will be more severe and the COP system may need to withstand the forces involved in stopping an incoming vehicle of 100kg [vehicle + rider] at 2G deceleration. As a guide for constructors, this is equivalent to a static test load of 200kg. A practical measurement of COP strength is for Team riders to be able to sit on the roof. A test load may be used as a proof at Scrutineering for a canopy considered marginal by the Chief Scrutineer.

14.12 (vii) 20mm is a minimum for entirely rigid doors/roof panels – those with inherent flexibility in panel material or hingeing will require 30mm or more overlap to maintain closure integrity.

14.12 (viii) The rule is intended to exclude "Occy Straps, Bungy Cords" and any such elastic strap with hooks. Ute tonneau cover loops (or similar) hooked over fixed buttons or hooks work well when the tension is right. Rotary Slam Latches have been demonstrated to stay closed despite severe deformation of bar work if they are correctly installed. Teams should note that the Overhead Protection used will have some impact upon helmet clearances with different vehicle designs.

16 **The primary body restraint is done by the lap belt.** Shoulder straps should be just snug and not pulling the lap belt off the rider's pelvis onto their abdomen.

16.4 Seat belt mounting sub-frames can be lighter and stronger if permanent fixtures. If removable brackets are used, as a means of seasonal adjustment for different sized riders of a new Team, such brackets have to be stronger than seat belt mounting bolts.

16.6 (i) Shoulder straps mounted below rider shoulder height create spinal compression when the rider is forced forwards in a crash. This is exacerbated with an upright seat position though less of an issue with a low recumbent angle. Belt guiding brackets can be used when mounting points cannot be raised so that the belt is effectively acting from shoulder height. Shoulder straps mounted above shoulder height will still locate the upper body since the lap belt is the primary restraint holding the rider in the vehicle.

16.6 (ii) Team Managers may find that a much closer mounting of shoulder straps is best for some riders in some vehicle designs, maybe 50mm. Crossing the belts may help.

16.6 (iii) Team Managers must monitor how belts fit each of their riders and institute structural changes as required.

17 Excessive seat padding interferes with harness effectiveness. Teams should look to use a rigid, positively positioned layer, a sliding seat, moveable seat back or adjustable bottom bracket.

17.2 Lap belt mounting points are recommended to be 50mm (or more) forward of the "normal" position to help compensate for the upward/rearward pull of the shoulder straps and for the Team's smaller riders.

18.1 This alteration to turning circle size reflects the need to develop designs that give **smooth** steering rather than a sharp turning circle so that all riders are able to make controlled direction changes only if needed. The 10m measurement was an arbitary size not reflected in current racing conditions. With vehicles across the field now moving faster, smooth controllable steering is the design intention that all Teams should be aiming for. Generally, smooth and controllable steering happens when the rider's hand has to move a reasonable distance to steer the wheels. This is managed through the relative lengths of the various levers in a steering system. Lengthening the steering handles is the easiest, most direct way of increasing hand movement and will also get rider's hands further away from wheels/tyres.

19.1 The "tadpole" layout has a single rear wheel that is usually lightly loaded, so the tyre is prone to skid with even careful braking, causing a tail end slide and possibly a drastic track incident.

19.2 Teams have found that having separate levers for each front brake has advantages for all age levels. Younger riders can apply more force during braking. Riders find that separate control of each front wheel allows them to "finesse" brake balance and directional control. Riders of all ages are better able to synchronise two separate front wheels than a system having a tandem front lever plus rear brake, especially when the tandem lever has lost its balance.

22 HEADLIGHTS, TAIL LIGHTS, BATTERIES.

Advances in LEDs and batteries have made decent bike head lights commonly available. There are now lights with much higher output than even the shifting light conditions of racing call for. Headlight power needs to be chosen to cope with the expected track conditions.

Battery run times need to be tested, and battery changes planned for, allowing for some reserve. Include the Friday night practice session in your battery calculations.

Tail light selection is simpler than for headlights with some even being over-bright for our purposes. Check that there is a non-flashing mode. Some Teams make their own or use a red light from another purpose. Batteries/charging need to run tail lights throughout races.

The purpose of Rules 22.6 – 22.8 is to keep red lights consistently within a confined region so that riders will confidently be able to gauge where the vehicle in front of them is. It will also enable riders to gauge where the extremities are because the light is within a precise location on every vehicle. This will help avoid rider errors that happened when the main light was out while a red light elsewhere on the vehicle was mistaken for the tail light.

22.7 (iii) Steady mode avoids confusion with track signal lights which have a flashing red signal.

22.7 (vii) This can be achieved by: External mounting of the light unit, mounting the lenses of LEDs, or the unit, flush with the rear surface or putting the unit inside a clear cover to maintain body lines. The LEDs should be visible up to 80° left and right from the rear centre line.

22.7 (viii) Tail lights must not be too bright . This is dangerous as they blind following riders, particularly when it is raining . The red light scatters all over the screen on every raindrop and smear, almost obliterating vision .This is very difficult for vehicles approaching others fast from behind and has caused many incidents. Covering or dimming over-bright LEDs with plastic film or tape may be needed.

23.3 When the mirrors are close enough to reach they will give a wider field of view than if they were mounted further away.

23.4 Small automotive spot mirrors can be mounted rigidly to give a reliable view and with their convex surface don't need shifting for different riders to get a proper coverage.

23.5 Zefal "Spy" mirrors have good mounting and multi-directional adjustment.

24 Waterproofing of horns can be achieved using cling film without apparent volume loss. Horns must have DIRECT CONTACT with the air stream to improve the lack of directional cues given by the electronic horns that we use.

24.4 The rider has to operate the horn without having to take their hand from steering control.

26.5 Defogging systems require astute inlet and exhaust placement. Surface treatments can also help deal with fogging. Sealed wheel wells stop aerosol misting from a wet track.

26.7 Ventilation helps riders to manage heat stress and maintain mental acuity and physical performance.

29. Definitions

1. Nominated Rider: The concept of asking Teams to present to Scrutineering with a defined "Nominated Rider" has proven to be impractical. The responsibility for ensuring that a Team's vehicle allows for correct rider clearances lies with the Team and Team Manager.
If the Race Director becomes aware that a rider appears to not have appropriate head clearance the Team will be offered the following alternatives:
Either: i) Attend Race Control to demonstrate on a Roller Bench that their rider has full head clearance.
Or: ii) The Team withdraws that rider for the rest of the Event. If such withdrawal is too close to the final lap, other sanctions may also be called for.
Or: iii) The Team chooses for the rider to undergo the Roller Test at Event end. If the rider is deemed not to pass, the Team forfeits all points and positions.

2. Specified Foam: High density 20mm resilient foam of a specified type: EVA 75 (Medium Density Premium Foam) available from Clark Rubber as EVA 75 Gym Mat [EVA Foam Premium Gym Mat] (Ethylene VinylAcetate copolymer: 105Kg/m^3) It will act as a protective barrier for the rider and is not just a clearance indicator as previously. It will mean that the vehicle will have at least 20mm head clearance plus any space needed to perform the Roller Test.

3. Steering Slalom Test: Slalom is with four traffic cones spaced at 4.2m [Note to Team Managers – A clear space of about 3.5m X 20m is needed] This test is a swerve and recover test and is more pertinent to HPV Events than turning circle alone. It will demonstrate smoothness of steering and vehicle stability as well as test maneouverability and rider vision.

4. Roller Test: Vehicle is placed on the roller bench with the rider wearing their helmet and belted in. They are to pedal through the gear range up to "race pace" cadence, and show that they are operating using an easily held head position with enough room inside the cabin to satisfy these indicators: ■ able to move their head easily from resting on the head restraint, forwards so that their chin is on their chest ■ move their head 90° right and through to 90° left. [Rule 4.15] A dyno may be included if proof of effort is needed. These stated indicators will allow Teams to carry out the test in their own workshop prior to Scrutineering and Events.

30. Advice to Team Managers:

■ Teams are encouraged to conduct their own Steering Slalom Test and Roller Test as part of their rider and vehicle preparation.

■ Another useful procedure is to have each rider belted into their vehicle and for it to be rolled over on a grassed area [so the body is not damaged]. This will give riders the experience of being upside down and on each side. It will show to them if they have their belt done up properly. It will also help give them confidence that the vehicle will do the work of protecting them in a track incident and importantly give them training in not letting go of the steering handles during any such happening.