

Revised January 2024

2024

# Australian Human-Powered Vehicle Racing Design & Construction Specifications

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## 1.0 Overview

### 1.1 Introduction

The vehicle specifications contained within this document are for vehicles entering in Human Powered Vehicle events in Australia conducted by approved bodies who have been verified to comprehensively and concisely implement them and conduct a standardised Scrutineering process.

Currently approved organising bodies are:

- Australian International Pedal Prix Inc.
- Victorian Human Powered Grand Prix Series
- Western Australian Human Powered Vehicle Association Inc.

### 1.2 Vehicle Type

1.2.1 Vehicles must be single seat recumbents.

1.2.2 They must have three or more load bearing wheels and be solely Human Powered, driving one or more of the wheels.

1.2.3. No alternative propulsion systems are allowed. Motorised fans are not permitted.

### 1.3 Decisions and Interpretation

1.3.1 The organising body will make any decision which is not covered by these specifications (**refer 1.1**).

1.3.2 All changes made to these specifications will be distributed by the approved bodies and published on their websites. Approved bodies will attempt to notify all relevant persons via their nominated Team contact details.

### 1.4 Specification Compliance

1.4.1 No vehicle will be allowed to take part in an event until it has passed **Scrutineering (Definition 1)**. Vehicles must maintain compliance throughout each event. Vehicles may be inspected at any point throughout and after an event for post-race scrutineering.

1.4.2 Team managers have a responsibility and duty of care to their riders as per **Form 2A**.

During construction and use of their 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 (**Section 4**).

b) No aspect of the vehicle compromises rider safety at any time.

c) The Team's riders each fit safely within the vehicle, especially head clearances.

1.4.3 Team Managers and constructors are encouraged to seek early prior clarification from the Approved Body, for any specification needing interpretation, or if seeking a ruling on their vehicle's compliance (**refer 1.1**).

1.4.4 Vehicle exterior bodywork must provide room rearward of the front wheels for attaching Vehicle Number Panels (300mm high and 400mm wide) and also allow room for Event sponsorship stickers. [Details in Event Manuals]

1.4.5 Replacement large body sections, e.g. 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.

## 2.0 Safety

### 2.1 General Safety

2.1.1 All vehicles are ridden at the riders' own risk.

2.1.2 The Scrutineering process is to determine if the vehicle complies with the current specifications.

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

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

## 2.2 Vehicle Safety

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These specifications carry an intention to support subtle, progressive, innovative, evidence-based design and construction. Desirable design directions to enhance rider safety may include:

- a) flexibility designed into structures where appropriate.
- b) deformation allowed for in suitable structural elements.
- c) chassis/roll cage/bodywork sections that are intentionally replaceable.

In general engineering principles, these are preferable 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.

- 2.2.1 The vehicle design must provide substantial protection for riders during any incident, see 2.3.3 and Section 4 Vehicles must:
    - a) Contain the rider in a strong and tough enclosure, hard shell or soft shell.
    - b) Prevent contact between rider, the road, other vehicles and obstacles.
    - c) Be formed from metal bar work, composite, metal panels or combinations of materials.
    - d) Have no internal items that could injure the rider.
  - 2.2.2 The exterior of the vehicle must not have protrusions capable of causing interference, injury or damage to personnel, vehicles or infrastructure. These include but are not limited to body or door handles, fins or roll bars. Closed Canopy vehicles are not to have external roll bars.
  - 2.2.3 Exposed axle ends must be recessed or flush in the hub, covered by bodywork, bar work, dome nuts or be shielded by annulus capping.
  - 2.2.4 All batteries must be mounted securely so that they do not come loose. Batteries containing liquid are not to be used.
  - 2.2.5 **Underside of vehicles are to be easily visible (White/very light colours).**
  - 2.2.6 Teams 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.
  - 2.2.7 Bodywork and canopies must be **inherently safe** and maintained in a safe condition.
- See "[Position Statement re G-force Calculations](#)" under [Scrutineering Advice on the AHPVSS website Education Tab](#).

## 2.3 Rider Safety

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- 2.3.1 Canopies must be able to be opened independently from the inside by the rider, and, from the outside without rider help.
- 2.3.2 Location of closure devices for canopies must be marked externally with an equilateral triangle with sides of 50mm in a colour that contrasts with the vehicle colour.
- 2.3.3 The cockpit must be free of hazards that could injure the rider or pit crew. For example:
  - a) Zip tie ends need to be cut flush, filed round, taped over or rotated away.
  - b) Brake and gear cable ends must be covered with cable caps.
  - c) No bare edge or rigid material to be within 250mm of the rider's face.
- 2.3.4 Helmet mounted cameras (or other attachments) are not allowed.
- 2.3.5 Airflow for rider ventilation and provision to mitigate internal fogging must be evident.

## 2.4 Rider Vision

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- 2.4.1 Windows that riders need to look out of must not be tinted or obscured
- 2.4.2 Rider vision must not be impaired by bodywork.
- 2.4.3 Riders seated in their normal riding position must be able to sight an object on the road surface 5 metres ahead of the vehicle.

## 3.0 Dimensions

### 3.1 Wheels, Track and Wheelbase

- 3.1.1 Vehicles must have a minimum of three load bearing wheels.
- 3.1.2 Three wheeled vehicles track must be a minimum of 600mm.
- 3.1.3 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.
- 3.1.4 Wheelbase must be a minimum of 1000mm

### 3.2 Vehicle External Dimensions

- 3.2.1 Maximum length 2800mm
- 3.2.2 Maximum width 1100mm
- 3.2.3 Maximum height 1200mm

## 4.0 Rider Protection

### 4.1 Guarding of Moving Parts

- 4.1.1 Front wheels must be enclosed with guards to prevent rider contact with wheels/spokes and to minimise wheel-borne debris.
- 4.1.2 Rider's hair and clothing entanglement must be prevented through Team protocols.
- 4.1.3 Chain ring teeth must be covered on both sides using chain ring discs (**figure 1**).
- 4.1.4 The drive system leading to the chain ring must be covered from under the seat to the chain ring with channel or tube. This channel or tube must extend between or past the chain ring discs or be mounted with skimming clearance of 3mm max (**figure 1**).

### 4.2 Floor Protection

- 4.2.1 The vehicle must protect the rider from impact through the floor, either by the backbone tube of a cruciform chassis or, with a peripheral chassis, by the combination of cross tubes, flooring, and seat structures.
- 4.2.2 A floor pan must be fitted to all vehicles. The whole underside must be enclosed with the floor only being penetrated by cut-outs for wheels. The floor pan must prevent the rider's feet, legs and hands coming into contact with the road surface.

### 4.3 Side Impact Protection

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 riders in all seat positions. It must consist of:

- 4.3.1 Tubing and/or rigid panelling on each side forming an enclosed cockpit.
- 4.3.2 The wheels may form part of this protection.
- 4.3.3 Side impact protection structures must be anchored to not move sideways.

### 4.4 Rear Impact Protection

Rear impact protection must offer the rider protection in the case of a rear impact and ensure the riders shoulders, neck and head are protected.

- 4.4.1 The vehicle must have some form of head restraint that prevents over-extension of the rider's head backward to prevent whiplash.
- 4.4.2 Shoulder and Neck rest/supports can act as head restraints when properly positioned and designed. Care must be taken to ensure that the top, or the edge in contact with the neck/head, will not lead to further injury.
- 4.4.3 The rider must be protected from rear vehicle entry as per **Figure 5**. This may be by rollbar bracing or by bodywork of an impact resistant design using composite or other suitable materials.



## 4.5 Forward Protection

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Vehicles must incorporate forward protection for the rider integral to the design.

- 4.5.1 At 100mm from the front, the vehicle must be bigger than 200mm cross-sectionally.
- 4.5.2 Constructors must 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].

## 4.6 General Vehicle Design Principles

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- 4.6.1 **All vehicles must include Rider Rollover Protection Structures (RRPS)** which are vehicle structures, including roll-bars, providing protection to the rider during a rollover or other track incident.
- 4.6.2 **All vehicles must include Cockpit Overhead Protection (COP)** which is a structure above the rider that will protect them from oncoming traffic when their vehicle is stationary and on its side, with the rider towards approaching vehicles.
- 4.6.3 Vehicles are of two styles.
  - a) Open Cockpit
  - b) Closed Canopy
- 4.6.4 Vehicles may be built of framework incorporating bodywork that is hard shell [composites or metal] or soft-shell materials.
- 4.6.5 Hard shell bodywork may incorporate **RRPS** and/or **COP** in monocoque style construction to provide the same level of bracing as framework, without replicating bar work.

## 4.7 Rider Rollover Protection Structure Requirements

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- 4.7.1 Be structurally integrated with the chassis/frame/monocoque shell and be constructed to meet their purpose.
- 4.7.2 RRPS including bracing, can be formed from metal tubing, composite materials or other suitable materials.
- 4.7.3 Must entirely encompass the rider viewed from all directions. [front, rear and sides]
- 4.7.4 The structures and bracing may be removable, providing that appropriate attachment methods are used [multiple bolts – minimum M5 Grade 8.8 (Unbrako, Wurth) bolts with sleeving or flanges. Not pins or clips.]
- 4.7.5 The rider's legs, knees, feet, and head must be protected from injury by the vehicle's structures/panels when the vehicle is upside down or on its side.
- 4.7.6 Opening parts of the **RRPS** must be secured to not open involuntarily. Large components, such as clam shell or semi-clam shell styles, must have a closure system shutting with an audible click. Supplementary systems of locating pins, tabs, or lips may be needed to ensure that body sections align correctly.
- 4.7.7 Front structures must be stabilised by bracing (**figures 3 & 4**)
  - a) to the boom structure, OR
  - b) by using twin hoops, OR
  - c) by longitudinal connection to the rear structure

## 4.8 Open Cockpit Vehicle Rider Rollover Protection Structures

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- 4.8.1 Must be a minimum of 500mm wide at the riders' shoulders and an integral part of the side impact protection.
- 4.8.2 At the rider's head the structure must:
  - a) Be at least 300mm wide, 150mm down from its highest point (**figure 2**)
  - b) Be 100mm minimum above every rider's helmet.
  - c) Be braced longitudinally from its highest point to a substantial chassis/body member see (**figure 3**) or be sufficiently braced within the structure's functional region requiring two braces.
  - d) Form a minimum angle of 10 degrees to the brace and this angle must include the vertical line through the highest point (**figure 4**).

## 4.9 Closed Canopy Vehicle Rider Rollover Protection Structures

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- 4.9.1 The vehicle must be robust enough to act as RRPS and COP.
- 4.9.2 **Specified Foam** must be installed above all riders' "head positions" (**Definition 4**).
- 4.9.3 There must be sufficient room for all riders to be able to move their head easily from resting on the head restraint, forwards so that their chin is on their chest, as per the Roller Test (**Definition 3**), with the minimum width of the headspace being the length of the rider's helmet.
- 4.9.4 Riders observed to have their helmet compressing the Specified Foam will not be allowed to continue riding (**Definitions 3 and 4**)

## 4.10 Cockpit Overhead Protection Requirements

- 4.10.1 COP is to be above the head position of all Team riders and must be capable of deflecting an oncoming vehicle. [Such as a hard-nosed composite]
- 4.10.2 The total width of the COP structure required depends upon the vehicle's shape and structure and should be checked when it is lying on its side.
- 4.10.3 The minimum for an **Open Cockpit** vehicle is two longitudinal bars with a maximum separation of 200mm. These bars must be straight or upwardly arched and suitably cross-braced.
- 4.10.4 **Open Cockpit** vehicles must have a minimum clearance between COP and rider's helmet of 100mm.
- 4.10.5 For **Closed Canopy** vehicles, the COP must incorporate a rigid panel, of composite material or metal, having a minimum width of 200mm (measured around the outside of the structure) and a minimum length of 600mm.
- 4.10.6 All COP structures must have locating fixtures able to keep the COP in place during track incidents and to cope with any flexing.
- 4.10.7 A moveable door/roof/COP panel must have 20mm minimum overlapping at its margins to maintain its integrity. If constructed of a material with inherent flexibility, greater overlap is required.
- 4.10.8 Movable COP structures **must not** be hinged from the rear.
- 4.10.9 Closure devices must be secured using a locking mechanism, to be proven at Scrutineering, that will maintain the required protection during track incidents. The locking mechanism must comply with the following:
  - a) Velcro is not sufficient by itself.
  - b) If elastic cord or loops are used:
    - i. A minimum of two must be provided, independently secured and under tension
    - ii. They must be a minimum of 300mm apart
    - iii. Elastic cord must be a minimum diameter of 5 mm
    - iv. Fastener components (loops, cords, hooks, buttons etc) must be fixed to structural members/bars/composites
    - v. Hooks must be fixed

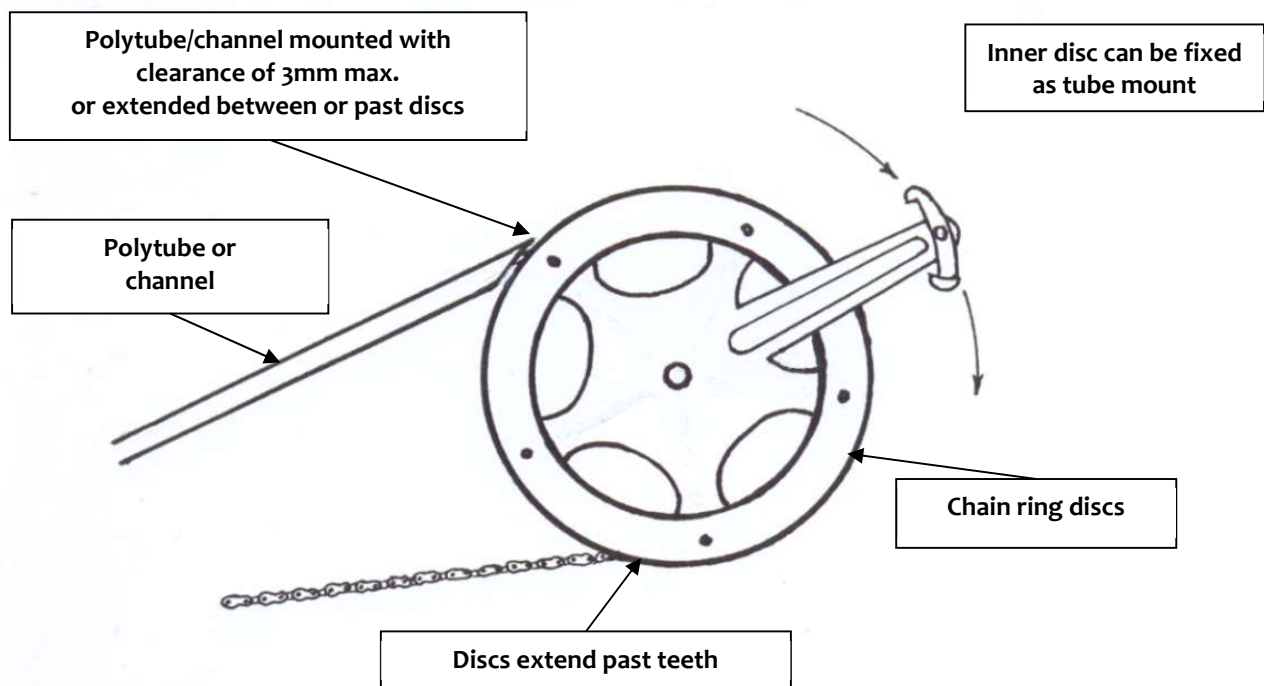


Figure 1, Guarding of chain drive system as per 4.1.3 & 4.1.4

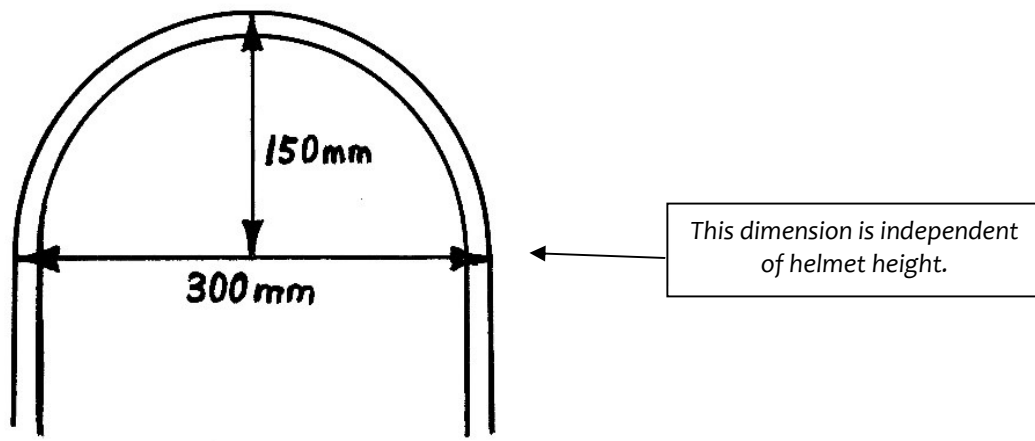


Figure 2, Rider rollover protection structure at the rider's head per 4.8.2a showing required shape.

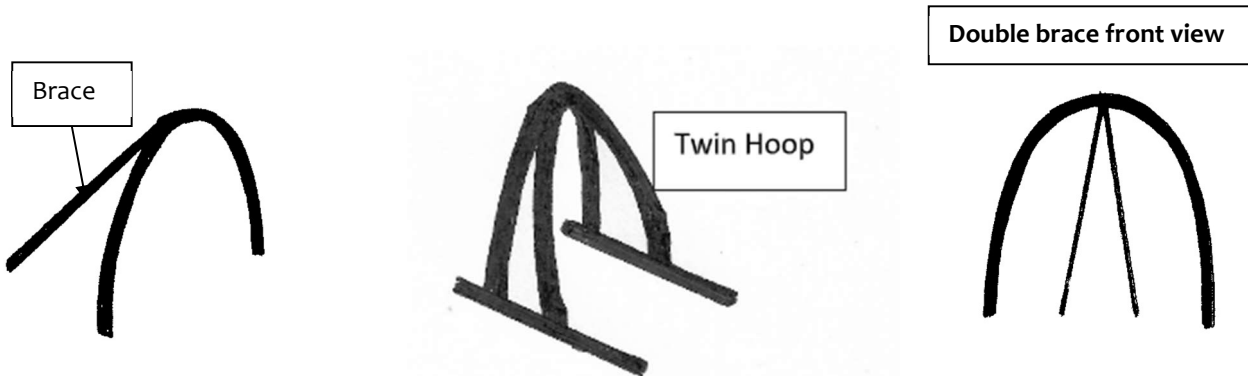


Figure 3, Rider rollover protection structure bracing

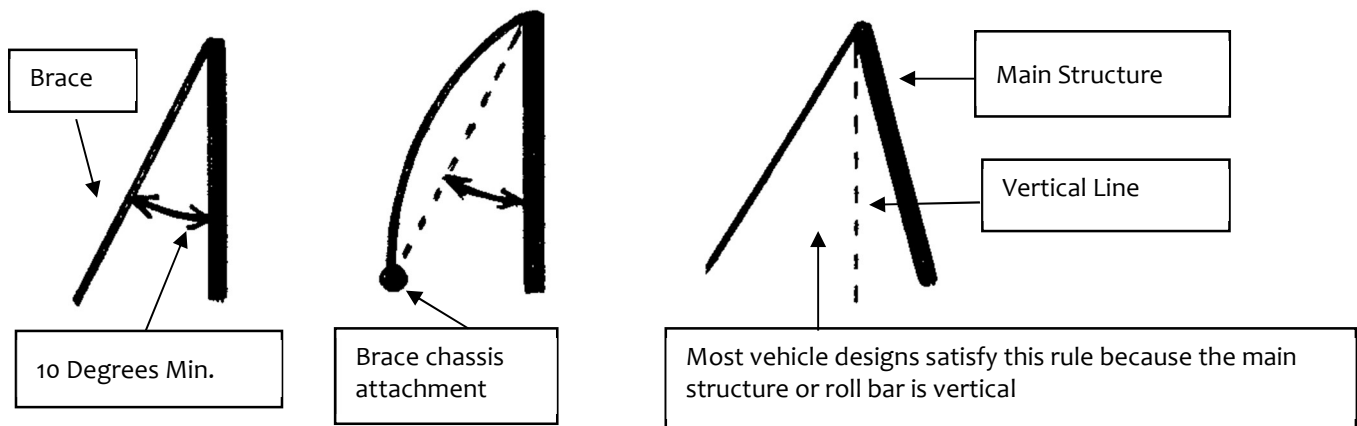


Figure 4, Rider rollover protection structure

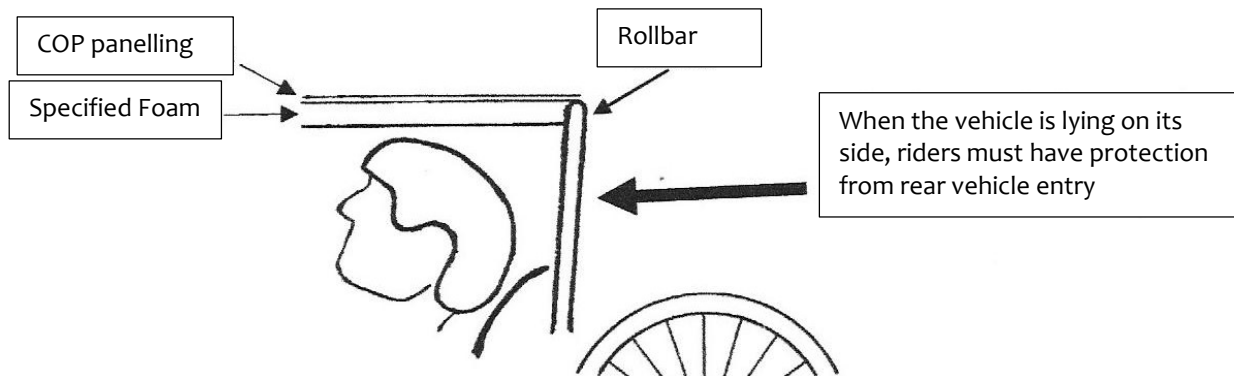


Figure 5, Rider Protection from rear vehicle entry.



## 5.0 Competition Harnesses

### 5.1 Harness types

The vehicle must be fitted with an “**Approved and Certified**” 4-strap harness which must comply with the following:

- 5.1.1 Harnesses must have the manufacturer’s certification label attached.
- 5.1.2 Harnesses must be in good condition and not frayed, cut or restitched.
- 5.1.3 Harnesses must be worn correctly and in accordance with manufacturer’s specifications.
  - i. When putting a rider into an HPV, **START** with all straps loose.
  - ii. Tighten the lap-belt across the rider’s pelvis so that they will stay in the seat bucket during **ANY** track incident.
  - iii. Make shoulder straps snug without shifting the lap-belt.
  - iv. **Lap belt tightness is the single most important rider safety feature under direct Team control.**
  - v. View racing harness safety video under [Scrutineering Advice on the AHPVSS website Education](#) tab.
- 5.1.4 No modifications are allowed to the harness assembly as manufactured.
- 5.1.5 Suggested supplier: HEMCO INDUSTRIES, VICTORIA, [www.hemco.com.au](http://www.hemco.com.au).  
PO Box 444 BALLARAT VIC 3353. Phone: 1300 065 057

See the four harness options in “[Racing Harness – Hemco](#)” under [Scrutineering Advice on the AHPVSS website Education](#) tab.

### 5.2 Harness Mounting

Mounting of the harness should be part of the initial chassis design process to provide secure mounting points. The harness must be mounted to comply with the following:

- 5.2.1 Mounted securely to major vehicle structural members in the manner intended by the manufacturer.
- 5.2.2 The correct bolts/fittings must be used as supplied by the manufacturer OR  $\frac{5}{16}$ “ [8mm] minimum diameter and Grade 5 [8.8 Metric Grade] minimum strength. Bolts to be installed with 2 to 3 threads showing through either a nut with spring washer or a Nyloc nut.
- 5.2.3 When coupling nuts are used as a captive nut system for attachment points of a harness they are to be 25mm long using 8mm X 20mm bolts marked as 12.9 or 8.8 [Metric Grade].
- 5.2.4 Otherwise mounting bolts must be put through frame tags or fully welded sleeves through frame tubes.
- 5.2.5 Removable sub-frames or brackets carrying mounting bolts must be attached to major vehicle structural members with strength equivalent to the mounting bolts.
- 5.2.6 Use of three bar slides as a mounting system for the shoulder straps is allowed, provided the slide supplied is used and correct threading procedure is followed.
- 5.2.7 Mounting points for shoulder straps must:
  - a) Be level or higher than the rider’s shoulders. Where mounting points cannot be raised, guiding brackets at shoulder height can ensure the belt is effectively acting from shoulder height.
  - b) Be a maximum of 200 mm apart.
- 5.2.8 The seat must be shaped to prevent the rider sliding under the lap belt.
- 5.2.9 Seats, including adjustable seats, must be prevented from moving during riding. Harnesses or rider weight cannot be part of the seat position retention system.
- 5.2.10 The harness may be mounted to an adjustable seat frame. Such a seat frame must be connected to the chassis by strength equivalent to four 8mm bolts [8.8 Metric Grade] as a minimum.
- 5.2.11 Where harness webbing runs through slots in metal or composite seats (or over seat edges), substantial protection is required to prevent damage to the webbing (eg. fraying and cutting). **Tape alone is not sufficient.]**

## 6.0 Vehicle Control

### 6.1 Steering

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The vehicle must steer in a smooth and controlled manner while adhering to the following:

- 6.1.1 The steering design must allow the wheels to be moved from full left lock to full right lock in an uninterrupted movement.
- 6.1.2 Steering systems must have a maximum lock limitation that prevents jamming, linkage damage, over centre travel
- 6.1.3 Tyre or wheel must not come in contact with the rider
- 6.1.4 Steering controls must be designed and constructed so that they **will not injure** the rider, especially during an incident.
- 6.1.5 Steering controls which project towards the rider: (i) must not be closer than 250 mm to the rider's face: (ii) require rounded edges or suitable padding.
- 6.1.6 Rope, cable, tilt steer, lean steer, flexible column and rear only steering systems **are not permitted**.

### 6.2 Braking Systems Configuration

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- 6.2.1 Minimum of two independently operated systems must be evident and operational.
- 6.2.2 A separate lever for each front brake where there are two front wheels meets this requirement.
- 6.2.3 A rear wheel brake is not required when there are two front wheels with separately operated brakes.

### 6.3 Braking Systems Conditions and Integrity

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- 6.3.1 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.
- 6.3.2 Brake systems must not apply friction contact to the tyres.

### 6.4 Mirrors

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- 6.4.1 At least two effective rear-view mirrors of minimum area 18 cm<sup>2</sup> must be fitted, one on each side of the vehicle.
- 6.4.2 Mirrors may be of the mildly convex type, but both must have same the size image and enable riders to clearly identify overtaking vehicles.
- 6.4.3 Each mirror must be positioned within arm's reach of the rider.

## 7.0 Vehicle Electronics

### 7.1 Lighting

Vehicles must have a front white head light for night events and a rear red light for all events.

- 7.1.1 Head lights must operate continuously throughout any “declared lights on period”.
- 7.1.2 **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).
  - be of sufficient size and capacity to effectively illuminate the pathway of the vehicle, and to illuminate other vehicles being approached.
  - Headlights are not to be flashing.
  - All white lights must be forward facing.
- 7.1.3 Rear Lighting must be:
- A minimum of 3 Red LED’s, turned to steady mode for all events
  - mounted within 150mm of the rear-most part of the vehicle.
  - mounted on the vertical centre line of the vehicle.
  - visible through 160° rear sweep.
  - robustly mounted between 350mm and 600mm above road level.
  - strip lighting or string LEDs must be confined or masked to 350mm – 600mm above road level.
  - all red lights on the vehicle must be **rear facing** and comply with a – e.

See [“Taillights on Corflute Canopy”](#) under [Scrutineering Advice on the AHPVSS website education tab](#).

- 7.1.4 Helmet mounted lights are not to be used.
- 7.1.5 Teams may use subsidiary lights anywhere on their vehicle. These lights cannot be flashing.

### 7.2 Warning Device

A warning device must be fitted to each vehicle. It must comply with the following:

- 7.2.1 Mounted in front of the rider’s feet.
- 7.2.2 The warning device must be directed forwards and directly contact the outside airstream.
- 7.2.3 It shall be electric or electronic.
- 7.2.4 The warning device must only be operated by using a momentary switch mounted on a steering handle.

### 7.3 Speed and Electronic Devices

- 7.3.1 A speed display device must be visible to all Team riders.
- 7.3.2 All devices in the vehicle must be securely mounted so as not to come loose during any track incident.
- 7.3.3 See [“Position Statement re Rider Distractions”](#) under [Scrutineering Advice on the AHPVSS website](#), under the Education Tab for guidelines on devices use and reducing rider distraction.

## 8.0 Definitions

1) **Scrutineering:**

Process to ensure vehicles meet specifications, have Team Managers committed to complying with their responsibilities as listed, act to help Teams get their vehicles complying.

Refer to [“Scrutineering Process”](#) under [Scrutineering Advice on the AHPVSS websites Education Tab](#)



2) **The Organising Body:**

Is responsible for the running of the event and the correct and in-depth application of these specifications to all vehicles.

3) **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 be able to move their head easily from resting on the head restraint, to moving forwards so that their chin is on their chest.

4) **Specified Foam:**

The Specified Foam is Ethylene Vinyl Acetate (EVA) foam of density 75kg/cubic metre. 20mm thickness is required with minimum area of 1200 cm<sup>2</sup>, or dimensions of 200mm X 600mm.

See [“Specified Foam”](#) under [Scrutineering Advice on the AHPVSS websites Education Tab](#)

