2018 SCHOOL'S HANDBOOK

PART B: HUMAN POWERED VEHICLES & ENERGY EFFICIENT VEHICLES

RACV

ENERGY BREAKTHROUGH

21-25 NOVEMBER 2018 | MARYBOROUGH, VICTORIA

POWERED BY IMAGINATION

THE PREMIER SCIENCE, TECHNOLOGY, ENGINEERING AND MATHS, ACTIVE LEARNING PROGRAM

A PARTNERSHIP BETWEEN

cep SHARE PARTICIPATE COLLABORATE

CENTRAL GOLDFIELDS SHIRE COUNCIL

RACV we're there for you

racveb.com

1. OVERVIEW

Ages: Open to Primary and Secondary students.

Class: A, B1, B2, C, Open, All-Female

Challenge: To work as a team of students to design, build and compete using a vehicle powered solely by human power.

2. ENTRIES

2.1 Classes

CLASS	YEAR LEVEL	TEAM SIZE	GENDER REQUIREMENTS	SCHOOL SIZE
A	Years 1 - 6	Min 4 – Max 10	At least 50% female.	N/a
A1	Years 1 - 6	Min 6 – Max 10	At least 50% female.	Schools with an enrolment of 200 or less
A2	Years 1 - 6	Min 6 – Max 10	At least 50% female.	Schools with an enrolment of more than 200.
B	Years 7 – 10	Min 6 – Max 8	At least 50% female.	N/a
B1	Years 7-8	Min 6 – Max 8	At least 50% female.	N/a
B2	Years 7-10	Min 6 – Max 8	At least 50% female.	N/a
C	Years 11-12	Min 6 – Max 8	At least 50% female.	N/a
All Female	Years 7-12	Min 6 – Max 8	Female only	N/a
Open	Up to Year 12	Min 6 – Max 8	No gender requirements.	N/a

2.2 Categories, Classes and Quotas

CATEGORY	CLASS	QUOTA
HPV Primary	HPV A1 HPV A2	**90**
HPV Secondary	HPV All Female B/C	**10**
	HPV B1 HPV B2 HPV C	**65**
	HPV Open	**22**

2.3 Team composition

- All entries are to be team entries and must consist of current school students.
- Young people enrolled in a school or young people enrolled in a secondary school certificate/program and under 20 years of age as at 31 December 2017.
- All team members must be familiar with the operation of their vehicle, innovation or pushcart and must participate equally in the assessments at the event in Maryborough.
- Team members do not have to all come from the same school. They could be part of a scout, church, or other community group, however they must all be current school students and be covered by the group's insurance.
- Teams in the Secondary Human Powered Vehicle, Energy Efficient Vehicle and Try-athlon B/C categories will consist of:
    - a minimum of six (6) and a maximum of eight (8) riders.
    - of whom at least half must be female.
    - except in Open classes where there are no gender requirements.
- Teams in the Human Powered Vehicle A and Try-athlon A categories will consist of:
    - a minimum of six (6) and a maximum of ten (10) riders.
    - of whom at least half must be female.

2.4 Category caps, changes and waitlists:

- A maximum of three entries per school will be accepted in any category, except Innovations in Technology, which has no limit. Multi-campus schools may apply to organisers for special consideration on this quota.
- Additional entries from a school will be placed on a waiting list and will be notified if accepted into the event.
- Teams registered in the HPV B or C classes who request a transfer to the HPV Open class will incur a 50 lap penalty in the trial.
- Teams registered in the Try-athlon A or B/C class who request a transfer to the Try-athlon Open class will incur a 15 lap penalty in the endurance trial.
- Only one entry per school will be accepted in the HPV Open and Try-athlon Open classes.
- Schools that have an existing entry in the HPV Open or Try-athlon Open classes will not be able to enter additional teams into this class.
- Correspondence regarding the status of entries on a waiting list will be made directly to a Team Manager only.

3. ASSESSMENT

3.1 Overview

The RACV Energy Breakthrough is unique in that all teams must compete across three areas of assessment: Design and Construction, Display and Presentation and Trials.

All sections must be attempted and points are awarded in the following sections:

SECTION	HPV
Design & Construction and Scrutineering	25
Display and Presentation	25
Endurance trial	50
Total	**100**

It is the responsibility of each team to ensure they complete all sections. The schedules for each of these sections are outlined in this Handbook and further details are provided in an Information Kit distributed in November.

3.2 Scrutineering

All Pushcarts, Human Powered and Energy Efficient Vehicles must go through scrutineering which entails a safety inspection to ensure the vehicles are safe and meet all the design specifications outlined in the relevant Part B of this Handbook. These checks ensure that the vehicle is safe for the occupant, other teams and spectators.

Scrutineering is led by RACV Scrutineers, with support from experienced volunteers.

Where entries do not comply with specifications, or are considered unsafe, scrutineers will provide assistance and/or direction with work required in order to comply.

Schedules and locations for teams to complete scrutineering and other judging assessments are provided in the Information Kit distributed to schools in early November.

Organisers will assume that teams will have arrived in Maryborough and be available from 12 noon on the day of the assessment. Late arrivals will be accepted only by negotiation.

3.3 VicRoads Participant Licence

All team members are required to present their Licence to the VicRoads station at the start of Scrutineering & Design and Construction process at Maryborough.

If no licence is presented, any number of riders in your team will be required to demonstrate competence in vehicle control by undergoing a tough test. Safety is the number one priority at the RACV Energy Breakthrough.

By signing the Licence, the Team Manager and Principal both certify that the student has completed the necessary track safety, vehicle maneuverability training and has read and is familiar with the Trial regulations.

Visit the Downloads section of the website to download the Licence >

3.4 Design and Construction

3.4.1 Purpose

Following scrutineering, teams will be required to demonstrate to judges that all members have developed a thorough understanding of the Design and Construction aspects of their entry.

The focus of the Design and Construction is to assess the team's understanding of the vehicle and the concepts involved in its design and construction. To this end, teams who have simply purchased a recumbent bicycle (complete or in kit form) and carried out basic modifications, will not score as well as teams who have built a vehicle from scratch. Consideration will be given to teams who have 'Inherited' a vehicle from previous teams but who have improved the design and/or construction in some way.

3.4.2 Criteria

As part of the Design and Construction assessment, teams will be required to:

- discuss and explain design and construction processes.
- show all rider safety equipment, including each person's gloves, helmets and glasses.
- show copies of relevant design drawings.

The focus for Design and Construction assessment will be:

- **Effort and input** – this is based on issues such as whether the vehicle bought, made from new, modified from the previous year and to what extent the students were involved in the various aspects of design and construction. Teams can show design drawings and models to demonstrate work undertaken by students.
- **Innovation and Quality** – how effective/clever the design concepts are; the materials used; construction methods and types of gears, brakes and steering.
- **Understanding** –the students' understanding of the vehicle design and key design concepts incorporated, the materials, components, running set-up.
- **Safety: Design and Understanding** – the use of restraints, roll bars, rider protection and visibility.
- **Practicality, Stability & On-road Performance** – vehicle reliability, handling, lighting.
- **Driver Training and Skills Development** – presentation of licences for each team member, skills covered in driver training including driving at night, in the wet, etc.
- **Understanding of Environmental Issues** –the relationship between transport and issues including greenhouse, air pollution and the importance of renewable energy,etc.

- **Vehicle Weight** – Weight is an important factor in efficiency and HPV's and EEV's will be weighed and scored based on their weight compared to other teams and the rules.

3.5 Display and Presentation

3.5.1 Purpose

The purpose of the Display and Presentation is for team members to demonstrate their knowledge and understanding of their entry.

Judges consider the different approaches taken in the presentations, such as some students reading from notes versus student presentations with limited reference to prepared notes. Schools are encouraged to be innovative in their presentations. However, care needs to be taken to ensure that 'distractions' do not overtake the real purpose, that is, '*students demonstrating their understandings*'.

3.5.2 Format

Each team will be required to present for a maximum of 20 minutes to a panel of judges. This will be followed by up to 10 minutes of questions from the judges.

This oral report will relate to the development of the team entry, including ideas that did not work and why.

The judging panel consists of three members: a community representative, a young person with an interest in education and/ or technology and an education/teacher representative. Judges will ask questions of team members following their presentation.

All registered team members are required to participate equally in the presentation. Teams may choose to include up to two (2) additional students (i.e. support crew) to join their registered team members in their presentations. However, the presentation roles must still be shared equally by all participating team members.

The display may include photos, videos, models, prototypes etc to explain the involvement of students, school, community and/or industry in the program and the development of their entry. To reduce interference from nearby panels, no public address or small music (CD) systems will be allowed without prior approval of the Display & Presentation Coordinator.

The presentation should be designed in a way that ensures information is well presented by students and enables the students to demonstrate their knowledge, understanding and involvement in all aspects of the entry.

3.5.3 Schedule

A specific time for each team to complete their Display & Presentation will be included in the Information Kit sent to schools in November. Each team is allocated time to set up their display prior to their time.

Event schedules will require teams to have arrived and be available from 12 noon on the day of the assessment. Late arrivals will be accepted only by negotiation.

3.5.4 Criteria

The assessment covers both oral and visual presentation.

Judges are asked to look for evidence of:

- Student involvement.
- Levels of participation.
- Team work and enthusiasm.
- Individual contributions.
- Understanding of the project.

It is understood that the levels of student involvement in the technical and practical activities related to the design and building of an entry will vary with age.

The <u>oral presentation</u> will be assessed according to:

Presentation Style:
The introduction and outline of the presentation; awareness of the audience; style of presentation (reading from notes or reciting); clarity of language; use of materials, diagrams and models covered.

Team Work:
The effectiveness of leader's role; sharing of knowledge and responsibility in the team; acknowledgment of individual team members' role; team attitude and enthusiasm and the extent to which the presentation reflects the students' own work.

Knowledge and Understanding:
Knowledge of the aims and values of the Energy Breakthrough; highlights of the school and community participation; team planning; preparation and training and technical aspects of the development of the vehicle.

Development of a Story:
About the entry, including the challenges; the preparations; the school and community's involvement and the students' achievements.

The <u>visual display</u> will be judged according to:

Layout and Organisation:
The range of visual media and written text depicting vehicle development; the arrangement of items; the variety of information presented and the acknowledgment of sponsorship/financial support received.

Quality of Display:
The effective use of diagrams, models, photos, text, drawings, etc. to convey message.

3.6 The Trials

In this section, the operation of each entry will be tested.

- **Secondary Human Powered** and **Energy Efficient Vehicles** will participate in a practice session and a 24-hour trials on a street circuit in Maryborough. The track is titled the RACV Track.
- **Primary HPV** teams will participate in a practice session and 14-hour trial on a street circuit in Maryborough.

3.6.1 The Circuits

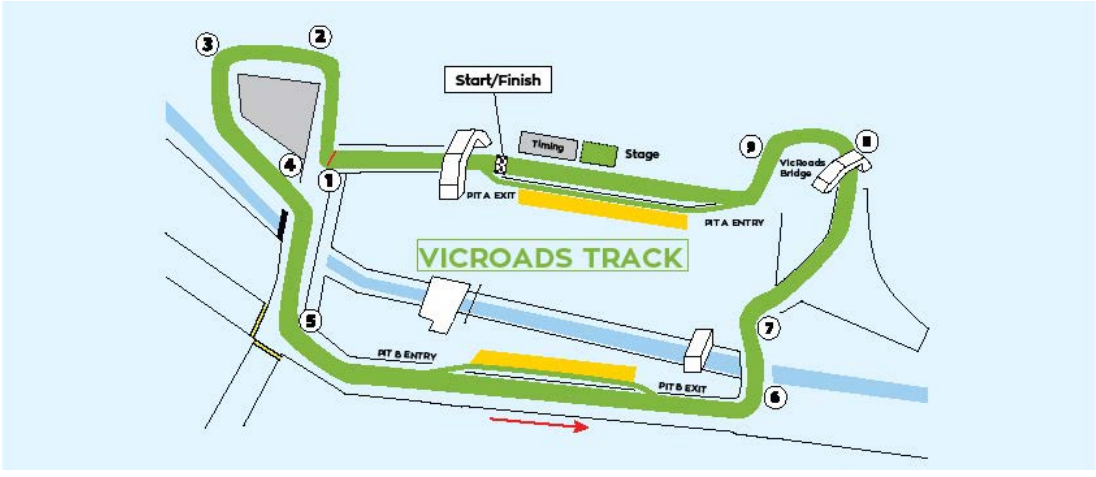
There are two tracks in Princes Park, Maryborough surrounding the beautiful Lake Victoria. On both tracks there are some unlit sections at night, and the sealed surfaces are not "billiard table smooth".

The **RACV Track**, shown below, is a challenging 1.76 km street circuit that reflects real-world conditions.

This track will be used for the Secondary HPV, Energy Efficient Vehicle and Pushcart sprint trials.

The **VicRoads Track**, shown below, is a challenging 1.11 km street circuit that reflects real-world conditions.

This track will be used for the Primary HPV and the Pushcart Endurance trials.



4. RIDER TRAINING

There are three key elements to Energy Breakthrough preparation:

- **Technology and design of the vehicle,**
- **Fitness and endurance, and**
- **Vehicle handling skills.**

Participants plan and prepare the first two well.
Long hours are dedicated to Design and Construction, diet and physical training plans sometimes rival Olympic efforts. However, time in the vehicle in a range of scenarios is the key to safe vehicle handling.

Manoeuvrability is an extremely important safety issue. Teams will be riding for 24 hours, so well-planned training programs may prevent accidents when riders are tired.

Riders need to have some experience and training in the demands of the track. It is essential that students are well prepared for the varied conditions and challenges at the event through pre-event track conditions simulation and manoeuvrability practice.

What should our training program include?
We recommend that all team members undertake at least 3 hours practice in the competition vehicle.

Practice in many and varied conditions, here are a few areas you should cover:

- **Safety experience**
- **Skid mitigation:** sprinkle sand or gravel on the track turn the wheels into a skid
- **Wet conditions training:** hose your training track down to simulate rain
- **Night riding practice:** come back after dinner
- **Cornering:** chalk some tight corners onto the asphalt
- **Cutting in and out** of 'the pack': use witches hats
- **Passing slower vehicles**: use a bicycle as the other vehicle
- **Defensive driving techniques**: be ready for the unexpected.
- **Pit Procedure:** practice smooth rider changeovers, including fastening seatbelts, adjusting seats and adding drink bottles.
- **Traffic lights and flag signals:** test each other to know what each light and flag colour means.

  The traffic lights/flag signals are the main way for Marshals and Traffic Officials to communicate with riders during the trial. During Design and Construction assessment members will be questioned about their knowledge of Traffic Lights/Flag Signals and track Conduct.

Here are some extra tips to help you prepare:

Driver position

Each team driver should be able to reach the pedals and be comfortable over their full range of movement, without stretching the leg straight.

Make sure the back is fully supported so that maximum effort can be applied to the pedals without needing extra support gained by pulling back on the steering wheel.

Both mirrors should be adjusted so that a vehicle following close behind – either side – can be clearly seen without undue head movement.

Seat belts must be worn low over the pelvic bone (not high over the waist) and across the chest. The belt should be comfortable, firm and not prone to slipping off the shoulder.

The seat position must ensure that the rider does not slide forward and under the seat belt.

Corners

A blue line is marked on the track. Vehicles are required to stay on the inside of the track (that is to the left of the blue line) at all times unless overtaking.

When entering a bend, look to where you want the vehicle to go – this will help to pull you through in a smooth curve.

Mirrors

You must always be using your mirrors to know what is behind you, or if you are going to be overtaken, and to be aware of other vehicles around you.

Finally, if you are planning to move from one side of the track to the other, give a quick glance over your shoulder to avoid moving into the path of another vehicle.

Steering the vehicle

Use a light grip on the steering wheel or levers; push the pedals from the hips, back and shoulders, with relaxed arms. This will allow you to steer smoothly and keep a straight line.

VicRoads Log Book

With the help of VicRoads, an optional Log Book has been prepared for students to record their training and preparation.

Find the VicRoads Log Book in School Zone

VicRoads Participant Licence

All team members are required to present their Licence to the VicRoads station at the start of Scrutineering & Design and Construction process at Maryborough.

Find the VicRoads Log Book in School Zone

HUMAN POWERED VEHICLES (HPVS) - PRIMARY*

All Track activities are on the VicRoads Track.

All teams should have arrived and registered by 12noon on Thursday. Display & Presentation and Design & Construction schedules will be prepared with this in mind.

WEDNESDAY 21 NOVEMBER

4.00 pm – 5.00pm **Registration open**

Location: Administration Centre

THURSDAY 22 NOVEMBER

9.00 am **Registration opens**
Location: Administration Centre

9.00 am – 5.00pm **Display and Presentations**
Location: Display & Presentation marquees

8.30 am – 5.30pm **Design and Construction and Scrutineering**
Location: Display & Presentation marquees

6.00pm **Rider Briefing**
Location: In front of VicRoads Track Stage

6.30 pm – 8.30 pm **Practice Session**
VicRoads Track

FRIDAY 23 NOVEMBER

11.00 am **Team Managers' Briefing**
Location: Rear of VicRoads Track Stage

11.30 am **Assembly of Starting Grid**
Location: Front Straight, VicRoads Track

12 noon **HPV A Trial Start**
Location: VicRoads Track

8.00 pm **Compulsory HPV A Break**

SATURDAY 24 NOVEMBER

6.00 am **HPV A Restart**
Location: Pit Lane, VicRoads Track

12 noon **HPV A Trial Finish**

3.30 pm **Presentation Ceremony (Primary)**
Location: Stage in Energy Expo area

SUNDAY 25 NOVEMBER

No activities

*** PLEASE NOTE THAT THIS TIMETABLE IS SUBJECT TO AMENDMENTS**

HUMAN POWERED VEHICLES (HPVS) - SECONDARY*

All Track activities on RACV Track

All teams should have arrived and registered by 12noon on Friday. Display & Presentation and Design & Construction schedules will be prepared with this in mind.

WEDNESDAY 21 NOVEMBER

4.00 pm – 5.00pm **Registration open**
Location: Administration Centre

THURSDAY 22 NOVEMBER

All Day Teams arrive and set up camp

11.00 am **Registration opens**
Location: Administration Centre

FRIDAY 23 NOVEMBER

All Day Teams arrive, register, set up camp, set up displays etc.

8.00 am - 6.00 pm **Scrutineering, Design and Construction**
Location: Display & Presentation Marquees

9.00 am - 6.00 pm **Display and Presentation**
Location: Display & Presentation marquees

5.30 pm **Spirit of Competition – Team Captain's Meeting**
Location: Hospitality Marquee, RACV front straight.

6.30 pm **Team Managers' Meeting**
Location: Hospitality Marquee, RACV front straight.

7.15 pm **Assembly for Night Practice**
Location: Pit Lane, RACV Track

7.30 pm – 9.30 pm **Night Practice**
Location: RACV Track

SATURDAY 24 NOVEMBER

12:00 pm **Assembly of Starting Grid**
Location: Back straight, RACV Track

1.00 pm **Start of 24-hour Trial**
Location: RACV Track

SUNDAY 25 NOVEMBER

1.00 pm **Finish of Trial**
Location: RACV Track

1.45 pm **Presentation of Trophies** (Secondary)
Location: Stage in near Display & Presentation marquees

Afternoon Pack up and depart.

Note: Teams may stay overnight on the Sunday after the event to ensure that the team travels home safely.

*** PLEASE NOTE THAT THIS TIMETABLE IS SUBJECT TO AMENDMENTS.**

Energy Efficient Vehicles (EEVs)*

All teams should have arrived and registered by 12noon on Friday. Display & Presentation and Design & Construction schedules will be prepared with this in mind.

WEDNESDAY 21 NOVEMBER

4.00 pm – 5.00pm **Registration open**
Location: Administration Centre

THURSDAY 22 NOVEMBER

All Day **Teams arrive and set up camp**

11.00 am **Registration opens**
Location: Administration Centre

FRIDAY 23 NOVEMBER

All Day Teams arrive, register, set up camp, set up displays etc.

8.00 am - 6.00 pm **Scrutineering, Design and Construction**
Location: Display & Presentation Marquees

9.00 am - 6.00 pm **Display and Presentation**
Location: Display & Presentation marquees

5.30 pm **Spirit of Competition – Team Captain's Meeting**
Location: Hospitality Marquee, RACV front straight.

6.30 pm **Team Managers' Meeting**
Location: Hospitality Marquee, RACV front straight.

7.15 pm **Assembly for Night Practice**
Location: Pit Lane, RACV Track

7.30 pm – 9.30 pm **Night Practice**
Location: RACV Track

SATURDAY 24 NOVEMBER

10.00 am **Vehicle Fuel-Up**
Location: To be advised.

12.00 pm **Assembly of Starting Grid**
Location: Back straight, RACV Track

1.00 pm **Start of 24-hour Trial**
Location: RACV Track

SUNDAY 25 NOVEMBER

1.00 pm **Finish of Trial**
Location: RACV Track

1.45 pm **Presentation of Trophies** (Secondary)
Location: Stage in near Display & Presentation marquees

Afternoon Pack up and depart.

Note: Teams may stay overnight on the Sunday after the event to ensure that the team travels home safely.

VEHICLE SPECIFICATIONS

HUMAN POWERED VEHICLE AND ENERGY EFFICIENT VEHICLE SPECIFICATIONS

Version 2018.02

Please note these Vehicle Specifications also cover the EEV and Try-athlon category.

EEV teams should also refer to the EEV Supplement at the end of these specifications.

Any significant specification changes have been highlighted in blue.

If changes are made to these specifications, the event committee will notify all team managers who have entered via their e-mail contact and changes will be published on the website.

All enquiries regarding Rules and Specifications should be emailed to:

enquiries@racveb.com

1. SCOPE & CONFIGURATION

1.1 Intent

The Energy Breakthrough is intended as an experiment in personal mobility. The objective is to build an efficient and stable machine powered either entirely by human effort (Human Powered Vehicle) or a combination of power sources (Energy Efficient Vehicle).

Entrants must:

- **Participate in the design and construction of the vehicle whether it is from a clean sheet or the modification of an existing vehicle**
- **Understand the fundamental design and construction elements of the vehicle.**
- **Liaise with local industry or community groups to design and build a machine.**

The RACV Scrutineers have the final authority to decide if any vehicle or team participates in the event, based on safety and their interpretation of the following rules.

Clarification of rules and specifications must be submitted by e-mail to enquiries@racveb.com

1.2 Seating Capacity, Wheels

- The vehicle shall carry a rider alone, and shall have three or more load bearing wheels arranged in a stable configuration.

1.3 Riding Position

- The riding position shall not compromise machine control or safety, nor shall the riding position place the rider in a potentially hazardous position in the event of a collision.
- A riding position (body angle) of less than 20 degrees from the horizontal is not allowed. *(See Section 4.2.1)*
- It is not advisable for the 'bottom bracket' or pedal crank to be higher than the rider's chest.

1.4 Power Source

- HPV - Motive power shall be entirely supplied by the rider.
- EEV – See EEV Supplement

1.5 Potential Maximum Speed

- The maximum speed of vehicles shall be 60 kph. The trial is a test of endurance and efficiency and therefore vehicles should not just be designed with achieving high speeds in mind.

2. DESIGN AND MATERIALS

2.1 Inherent Safety

- The design shall provide protection for the rider in the event of a collision or rollover. *(See Sections 2.3 and 4.0).*
- The design must be free of protrusions or other features capable of causing interference or injury to fellow competitors or spectators.
- Vehicle control and stability shall not be jeopardised by inappropriate design and construction methods.
- The onsite repairing, securing or joining of steering, brake or any other safety related components with glue or epoxy resins during the event is strictly forbidden.
- 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 should be covered with cable caps.
    - c) No bare edge, rigid material should be within 250mm of the rider's face.

2.2 Exclusions

Choice of design and construction materials is free, except that:

- Designers and constructors are permitted to freely use any bicycle component except for complete frame sections.
- The use of Go-Kart frames or motorbike frames is not permitted.
- Maximum overall tyre width is 70mm.
- Rope, cable, tilt, lean, rear wheel only steering systems and flexible steering columns are prohibited.
- Our experience has shown Rear Wheel Steer (RWS) vehicles to be highly unstable. For this reason, RWS vehicles will not be accepted at the RACV event.

2.3 Bodywork

- There are three bodywork configurations, which impact the structure of the vehicle.
    - **Open bodywork (**or 'head out') vehicles requiring full roll bar protection

    - **Aerodynamically enclosed** vehicles with a soft shell or corflute panels requiring full roll bar protection
    - **Fully enclosed hard shell** bodywork built from a stiff composite material (carbon fibre / kevlar / fibreglass / etc.)
- The test for whether a vehicle will be accepted as a fully enclosed hard shell is if the roof is able to support the weight equivalent to a rider in between where the riders head would be located and their knees. If the roof is unable to support this weight it will be deemed 'aerodynamically enclosed' and must meet all roll bar requirements.
- If teams prepare multiple bodywork configurations for use, then all configurations must comply with all specifications and must be presented for approval during scrutineering.
- *Try-athlon competitors* – Bodywork must not be removed if doing so compromises occupant safety i.e. The roof in hard shell vehicles.

2.3.1 Clearances and Access for Enclosed Bodywork Vehicles

- There must be a forward clearance of at least 300 mm between the rider's face and the steering wheel or any bodywork.
- The rider shall be able to open and/or remove bodywork and exit the vehicle without external assistance.
- Bodywork shall be capable of being easily opened and or removed from outside the vehicle independently of the rider by someone who is unfamiliar with the vehicle. In an emergency marshals must be able to open the vehicle without explanation.
- The location of closure devices for opening body sections must be marked outside with a triangle of contrasting colour to the body and side length of at least 10cm making it clear for anyone unfamiliar with the vehicle.
- The word "RELEASE" should be written near the triangle.
- If a hole has been cut in a window to enable access to an elastic strap then the hole must be at least 10cm wide to allow for an adult hand to easily reach into the vehicle.

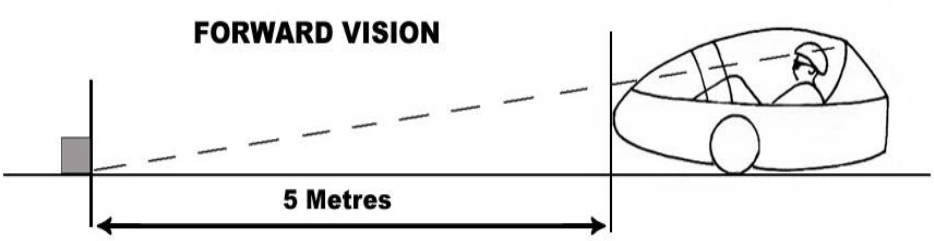
2.4 Vision and Ventilation

- Rider vision must not be impaired by excessively enclosed and restricting bodywork
- Side windows must be incorporated in the vehicle body design, which must extend from the shortest rider's shoulder line to above and behind the tallest rider's eye line. Riders must have a clear view over their shoulders to see surrounding vehicles.
- Windows must not be tinted or covered with any stickers, regardless of if they are intended to be see-through.
- It is a requirement that officials can monitor designated riders and correct riding apparel.
- Rider and vehicle safety must not be impaired by restricted ventilation or visibility.
- Airflow for rider ventilation, provision to mitigate rain and window fogging must be demonstrated.

Vision Tests

The shortest rider and the tallest rider seated in their normal riding position are required to comply with the side and forward window requirements and have sufficient vision to comply with the following vision tests during scrutineering.

1. Sight an object on the road 5 metres in front of the vehicle.



2. Sight 180 degrees ahead of the rider, and be able to turn their head sufficiently to see 15 degrees behind the rider on each side of the vehicle. The intent of this clause is that a rider is able to turn their head to visually check for other vehicles before changing their position on the road.

3. Riders must be able to demonstrate that the vehicles mirrors provide effective rear vision.

3. VEHICLE DIMENSIONS

Length
2700 mm maximum

Width
1100 mm maximum

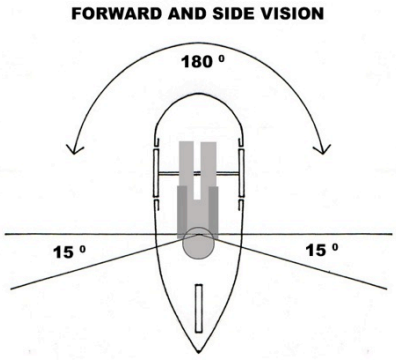
Height
1200 mm maximum

Wheelbase
1000 mm minimum wheelbase between the most forward and most rearward axles.

Track
600 mm minimum (width between centres of outermost tyre ground contact points)

Turning circle
10 metre maximum diameter (left and right).

Note: Due to the hairpins in Try-athlon Time Trial and Obstacle courses, Try-athlon teams are **strongly encouraged** to set up their vehicle with a **maximum** turning circle of 8 metres.



3.1 Vehicle Weight

HPV

50kg maximum

EEV

Single Power Source – 60kg maximum

Hybrid 1 – 60kg maximum

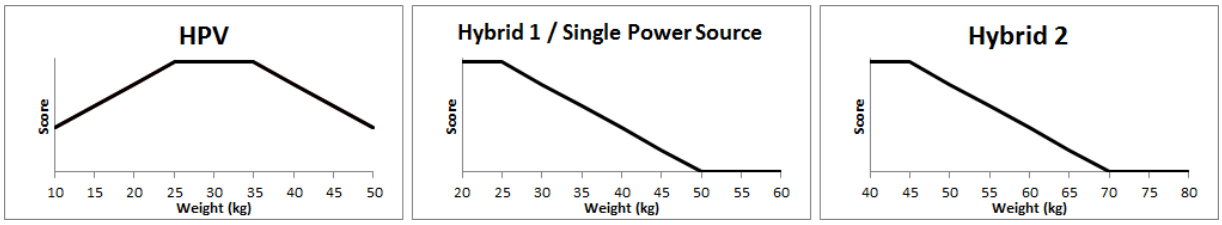
Hybrid 2 – 80kg maximum

The specified maximum weight includes batteries however EEV's will be scored on their weight without batteries.

Note: EEV teams should strive to make their vehicles as lightweight as possible **without compromising safety**.

3.1.1 Scoring of vehicle weight

All vehicles will be weighed and this will contribute to D&C score. Scores will be allocated according to the following charts:



4. OCCUPANT PROTECTION

4.1 Protection Bars for Open and Aerodynamically Enclosed vehicles

Vehicles must have four sets of protection bars:

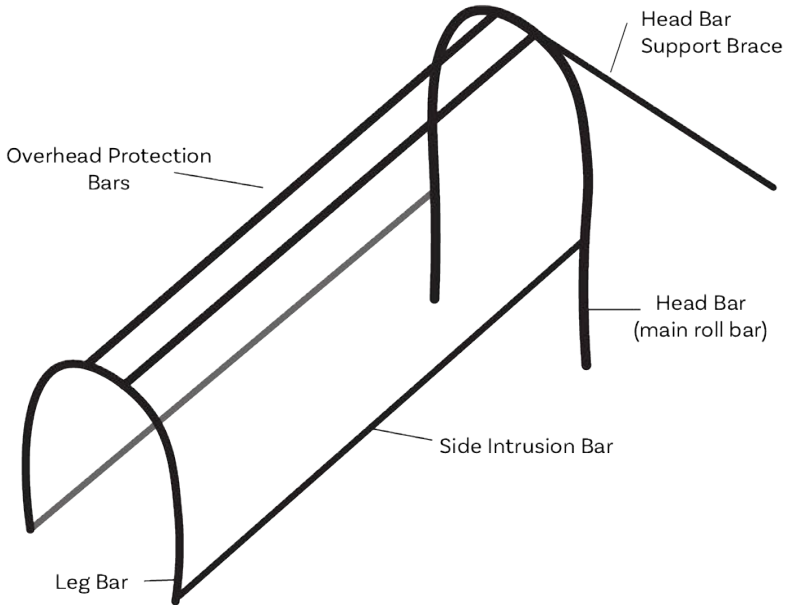
- "Head bar" (main bar) including brace,
- "forward leg bar" including brace,
- "side intrusion bars", and
- "overhead protection".

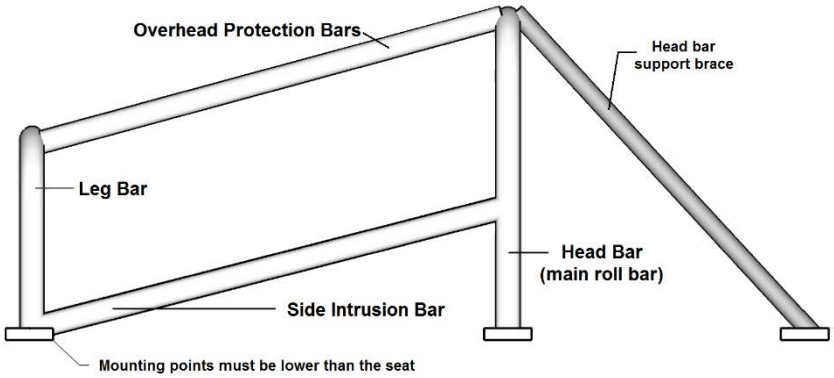
4.1.1 Construction

All protection bars, including bracing must be constructed from metal meeting the minimum outside diameter (O.D) specifications in the following table. All bars except the overhead protection bar must be joined either by welding or plate method (refer 4.1.4). The overhead protection bar may be hinged and locked to enable easier access for riders.

	HPV	EEV
Steel or Chromoly tubing	12.7mm O.D	16.0mm O.D
Aluminium tubing	16.0mm O.D	19.0mm O.D

Positioning of Roll Bars





(Please note: Drawings are not to scale)

4.1.2 Head Bar

The main head bar and brace together with the side intrusion bars must be one continuous welded frame, constructed according to the diagram above and must be solidly attached to the vehicle frame. (See Section 4.3: Plate Joints)

The "head bar" hoop must be braced from its highest point with one bar, preferably two, to a major structural member to form a tripod.

Note: The diagrams above show secure mounting plates; teams can use other mounting approaches but it must be solid, and able to support the weight of the vehicle and rider in a rollover.

4.1.3 Leg Bar

The "leg bar" (forward bar) must protect the riders legs, knees and feet from contacting the ground in a rollover or side slide situation and must be mounted across the vehicle above the riders knee area.

The "leg bar" must be braced to prevent the bar from folding over in a rollover or sliding situation.

The protection bars (head bar & leg bar) must be able to support the weight of the vehicle and rider in a rollover (a 40km/h impact is equivalent to dropping the vehicle on its roof from a first floor landing).

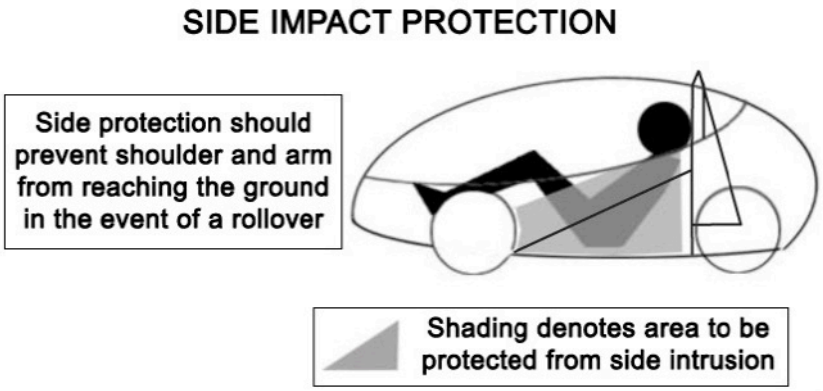
4.1.3 Side Protection

The vehicle must have side intrusion bars typically in line with the rider's body (as described and illustrated in 4.1.1) that are an integral part of the continuous "head bar".

In addition to the side intrusion bars, side protection bodywork or shielding is required to protect the area between the rider's hip and shoulder from making contact with another vehicle and to prevent the rider's shoulders and arms from reaching the ground in the event of a rollover.

This side protection bodywork should be constructed from suitably strong materials that will withstand sliding contact with the road.

No part of the rider is allowed to protrude outside the side protection during normal operation and there must be a clearance of 50mm between any part of the rider and the shielding.



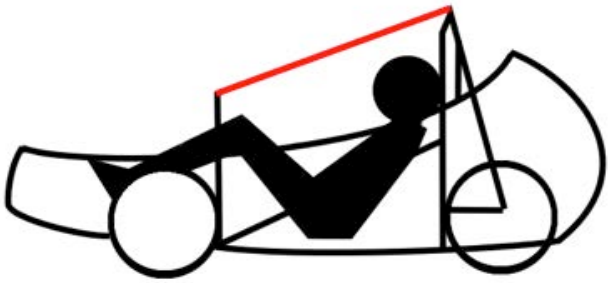
4.1.4 Overhead Protection

The structure over the head of the rider must provide enough strength to prevent the rider's head from being struck by another vehicle when on its side after a roll over.

Open top and aerodynamically enclosed vehicles must have two longitudinal bars connecting the main head bar to the knee bar.

Bars must be symmetrical around the vehicle centreline and there must be 100mm to 200mm of separation between the bars.

These bars may be detachable or hinged to enable easier access for riders, but must lock in place and be strong enough to ensure the structure remains attached during a rollover.



4.1.5 Rider Protection Bar Clearances

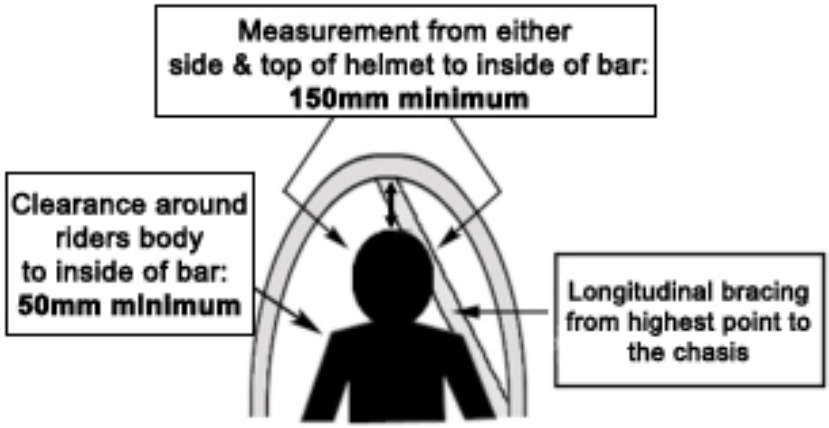
With the tallest of the competing riders in the normal riding position, the "head bar" must be fully visible outside the rider silhouette when viewed from the front or rear.

The overhead protection bars must have at least 50mm clearance above any part of the rider when viewed from the side.

The head bar must conform to the following dimensions:

- Measurement from helmet to inside of bar: 150mm minimum
- Measurement from either side of helmet to inside of bar: 150mm minimum
- Clearance around riders body to inside of bar: 50mm minimum
- Location forward or rearward of helmet: No more than 150mm

Diagram below: Open top or aerodynamically enclosed vehicles



4.2 Rider protection for fully enclosed hard shell vehicles

Fully enclosed bodies made from composites such as Carbon-Fibre, Fibreglass or Kevlar do not require metal protection bars provided they comply with the following requirements for strength and build quality tests.

- The body must have strengthened ribs moulded into the composite that are of at least equal strength to a metal roll bar. (eg: The roll bar area should not be able to flex when pressed by hand)
- All composite roll bar and side intrusion bar ribs must follow the same positioning as the metal protection bars outlined in section 4.1.
- All composite constructions must have finished edges. That is no protruding fibres or frayed edges.
- Metal roll bars can be used with composite bodies.
- Any joins must follow the plate mounting method as described in 4.3 Plate Joints.
- All teams constructing new hard shell composite vehicles with integral protection bars must send photos to the RACV technical contacts for review by the end of October.
- The onus is on schools to ensure that their vehicle is compliant with the required safety standards. The RACV Energy Breakthrough website includes some advice on composite construction in the *'Downloads'* section.

The test for whether a vehicle will be accepted as a fully enclosed hard shell is if the roof is able to support the weight equivalent to a rider in between where the riders head would be located and their knees. If the roof is unable to support the rider it will be deemed 'aerodynamically enclosed' and must meet all roll bar requirements.

4.2.1 Rider Protection Clearances for fully enclosed hard shell vehicles

With the tallest of the competing riders in the normal riding position, the following clearance must be met:

- Measurement from helmet to inside of shell: 50 mm minimum
- Measurement from either side of helmet to inside of shell: 50mm minimum
- Clearance around riders body to inside of shell: 50mm minimum

4.3 Plate Joints

- Where metal protection bars are to be joined without welding or attached to a composite body, plates should be used to distribute the loads into the body.
- These plates must be welded onto the metal protection bar and be no less than 60mm x 60 mm square in size and at least 3mm thick.
- A matching plate should be used on either side of the composite body and spacers must be used to prevent crushing of the composite structure.
- The plates must be joined using at least two 6 mm bolts with locking nuts (eg. Nylock Nuts).
- Corners and edges should be rounded and smoothed off.

4.4 Forward Protection & Nose Cone

All vehicles must have adequate forward protection to reduce the chance of injury in the event that the vehicle collides with a person or another vehicle.

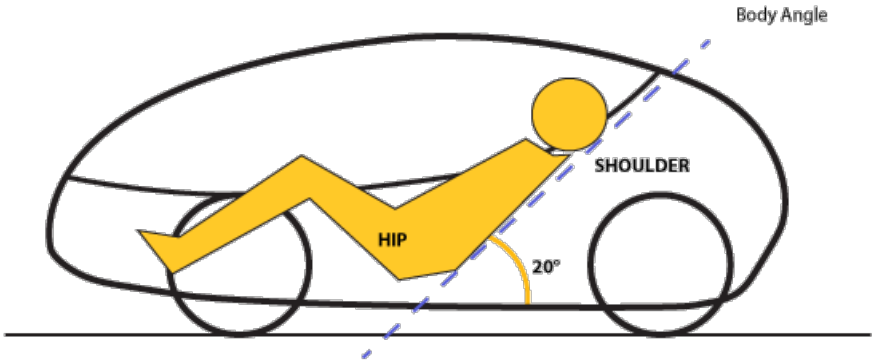
The front of the vehicle must have a curved nose to prevent easy penetration of another vehicle. At 100mm from the front, the vehicle must have a cross section greater than 200mm.

4.5 Seats

It is strongly advised that an “off the shelf” production seat from one of the major HPV component suppliers be used, as seat angle and rider support are critical. These seats can also provide correct seat-belt positioning and head restraint fittings.

4.5.1 Position

- The seat must be fitted in a way that ensures that the riding position does not compromise machine controllability or safety, nor shall the riding position place the rider at risk of neck or back injury in the event of a collision.
- For these reasons a riding position (body angle) of less than 20 degrees from horizontal is not allowed. This riding position is measured from the hip and shoulder joints in relation to the road.
- The seat must be shaped and positioned to prevent the rider sliding under the seat belt.
- In vehicles with moveable seats, riders must remain protected by the side intrusion bars in all seat positions.



4.5.2 Locking of Seat Position

- The seat must be securely mounted.
- Adjustable seats must lock securely into position for each rider and must not move forward or backward.
- Seat belts cannot be used as part of the seat lock system

4.5.3 Additional Padding

- Any temporary or removable padding used for riders MUST be fixed into place using a positive attachment to a fixed part of the vehicle.
- This could be a strap and buckle, velcro straps, dog clips, canvas zips, etc.

4.5.4 Head Restraint

- The vehicle must have a padded head restraint behind the rider's head that reduces the chance of over extension of the riders head backwards.

4.6 Seat Belt

4.6.1 Type

- The vehicle must be fitted with an Approved and Certified adult Four (4) point (minimum) seat belt for all riders.
- Seat belts must have certification label attached.
- The seat belt must be in good condition and completely standard, including buckle, stitching and mounting plates.
- Teams will be required to demonstrate adjustment of the seatbelt to suit each rider.

Suggested supplier:
Hemco Industries - http://www.hemco.com.au/ or Ph: 1300 065 057
APV Safety Products: 4 point, 2 inch webbing available through most automotive parts stores.

4.6.2 Mounting

The belts cannot be mounted to the seat surface alone under any circumstances.

The belts can be mounted through the seat to a bracket/plate/tube that is at least the strength of the seat belt mounting plate and that the strength can be traced all the way to the structural frame of the vehicle.

Upper belts mounted behind the rider's shoulders are required to be horizontal or no more than 40 degrees from horizontal and mounted no more than **200mm apart** so as not to allow the belt webbing to fall from the shoulders when riding.

4.6.3 Positioning

Correct and safe positioning of the belts and catches can be found in the Australian Design Rules (ADRs) for motor vehicles.
This means seat belts must;

- Be positioned such that it does not have any contact with, or rub against, any sharp edges
- Be worn over the shoulders and down the chest, to a low lap belt across the pelvis.
- Be adjusted to be as firm as possible on each rider and fitted to ensure that the seat belt remains properly adjusted on each rider at all times.
- The lap belt should be tightened before the shoulder belts so that the lap belt remains in the correct position.

4.7 Shielding

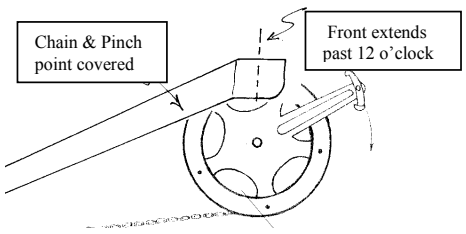
4.7.1 Rider Protection

The rider must be shielded from any rotating mechanical part in the vehicle. This includes Chains, sprocket and teeth, as well as wheels and tyres.

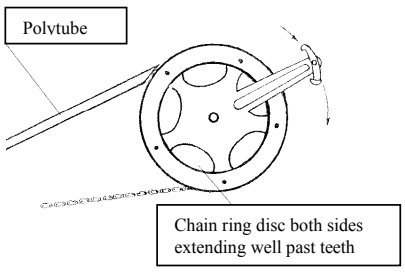
Wheels.

All vehicles must have an inner wall (which can be core-flute) that completely separates and shields the rider from the rotating wheels.

Rigid Chain Guard



Chain Tube and Sprocket Rings



- Chains, sprockets and gear wheels MUST be fully shielded to prevent accidental hazardous contact with rider or clothing.
- Chain ring teeth must be covered both sides using chain ring discs.
- A hair shield must be used to prevent long hair from falling anywhere near the rear wheel, chain or gear components.

There must be a clearance of 50mm between hand controls (including brake levers) and the frame or solid bodywork.

4.7.2 Protection of other Vehicles

- Chains, gear wheels and sprockets shall be suitably shielded to prevent their contact with other vehicles.
- Exposed axle ends have to be recessed or flush in the hub, covered by bodywork, bar work, dome nuts or hub caps.

4.7.3 Shielding from Road Surface

- Vehicles must be fitted with an under-tray or floor panel which prevents the rider's feet from contacting the ground when seated in the riding position.
- Pedal toe clips, elastic straps or pedal-to-shoe locking devices do not fulfil the requirements of this clause.

5. STEERING

5.1 Type

The type of steering mechanism is free, except for:

- Rope, cable, tilt, lean, rear wheel only steering systems and flexible steering columns are prohibited.
- A minimum clearance of 300mm is required between the riders face and the steering wheel.
- The rider must have continuous positive control without the need for regular adjustment.
- Adjustable steering columns must be fitted with a secure/ positive locking mechanism, i.e. a bolt and locknut. Over centre clamps, or pins and R clips are not permitted.

5.2 Freedom from Binding and Fouling

Steering linkages shall operate freely from full left to full right lock without binding or fouling.

5.3 Lock Stops

To prevent the rotating road wheels from coming into contact with any part of the vehicle or rider, there must be positive steering lock stops.

The steering mechanism or any solid component that moves with the steering mechanism must come up against a solid bracket or non-flexible part of the body or frame on full lock in either direction and stop any further steering travel.

In addition, at full lock there must be shielding or a clearance of 100mm between the occupant and any rotating part (such as wheels and controls) and in all steering positions there must be at least 50mm clearance between the hand controls (including brake levers) and the frame or solid bodywork.

6. BRAKES

6.1 Independent Systems

The vehicle shall be fitted with a minimum of two (2) separate effective and independent braking systems.

Two (2) separate brake levers must be used.

All wheels in contact with the road must have a braking capability.

6.2 Type
The front axle braking system shall be either drum or disc type.

They must not act on the wheel rims.

No brake systems should apply friction contact to the tyres.

6.3 Directional Stability
Brakes on the same axle line (e.g. both front wheels) must operate via a single lever, so that independent operation of any braking system shall not have the potential to affect directional stability of the vehicle. That is, the braking power of each and every braking system shall be symmetrical about the vehicles longitudinal centre line.

6.4 Simultaneous Operation
The two braking systems shall be able to be operated by the rider simultaneously.

In a Hybrid 2 or single power source EEV a single lever may be used to operate both braking systems provided it is foot operated only.

6.5 Steering Control
Full steering control shall be maintained while braking systems are being operated.

6.6 Contact to the tyres
Brake systems must not apply friction contact to the tyres.

7. ANCILLARY DEVICES
7.1 Lighting
The vehicle shall be fitted with the following as a minimum requirement:

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

Lighting must be adequate to provide good visibility for the rider to see the track in the dark.

Additional lighting to improve the rider's vision is encouraged provided at least one light meets the designated requirement.

Headlights are not to be flashing.

Please note: Sections of the track are in darkness at night and sufficient lighting to see the road will be required.

7.12 Tail Light
Rear Lighting must be:

a) fitted and turned on for the duration of all on track events.

b) red LED.

c) set to steady mode ONLY

d) mounted within 150mm of the rear-most part of the vehicle.

e) mounted on the vertical centre line of the vehicle.

f) visible through 160° rear sweep.

g) securly mounted between 350mm and 600mm above road level.

h) strip lighting or string LEDs must be confined or masked to 350mm – 600mm above road level.

i) all red lights on the vehicle must be rear facing and comply with a – h.

j) a minimum of three LEDs

7.1.3 Outline Lighting

The use of reflective material or strip lighting to indicate machine width and height (especially from the rear) is encouraged.

7.1.4 Mounting

All lights are required to be securely mounted for the duration of the event to maintain correct aim.

7.1.5 Helmet Mounted Lights

Helmet mounted lights are not to be used.

7.1.6 Batteries

Wet cell batteries must be housed in a sealed box (e.g. plastic) that will prevent spillage if the battery is inverted or damaged.

All electrical connections for lights or warning devices must be of an automotive or industrial standard with fully insulated connectors.

7.2 Mirrors

At least two effective rear view mirrors of a minimum area of 18 cm^2 must be fitted, one on each side of the vehicle, and having similar reflection (i.e. same size image) in order to clearly identify overtaking traffic and meet the rear vision test in 2.3.2.

Mirrors may be of the mildly convex type.

Mirrors shall be rigidly mounted to non-moving chassis or body members and steps should be taken to reduce vibration.

The smallest rider must be able to reach each mirror from the normal riding position.

7.3 Warning Device

An electric audible warning device shall be fitted (e.g. smoke alarm siren) and operate from the normal riding position.

The warning device must be directed forwards and directly contact the outside airstream.

The device must not run continuously and operate via a momentary switch.

The warning device should be waterproofed.

7.4 Other Devices

Any other equipment, e.g. drink bottle, shall be securely mounted and shall not impair rider control in its mounting or use.

The use of MP3's or similar music /entertainment devices by riders is NOT permitted.

Small video cameras (eg. GoPro) are allowed as long as they are not attached to the rider's helmet and are positioned so that they cannot pose any safety risk. Cameras should not be mounted outside the silhouette of the vehicle when viewed from the front.

7.5 Speedometer

All vehicles shall be equipped with a simple electronic speedometer (e.g. Cat-eye) to monitor speed during the event (pit area speed limit of 10 kph, track speed limit of 60kph). This speedometer must be mounted on the vehicle in a position where the rider can see from normal riding position. A wristband-based speedometer worn by the rider is not acceptable.

7.6 Transponder

Vehicle design should allow for a lap counting transponder to be mounted inside the vehicle, positioned within 200mm of the road surface, not above carbon fibre or metal; and not within 500mm of any RF source.

Transponders will be issued to Team Managers upon Check-in at the Administration Centre at the event.

8. MARKINGS

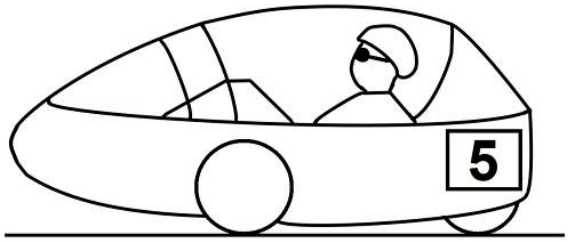
8.1 School Name

Each vehicle shall have their school name visibly displayed on either side of their vehicle.

8.2 Identification Panels

At registration, each vehicle will be provided with two adhesive identification panels (250mm x 300mm) with their competition number on it.

These identification panels must be attached to each side of the tail of the vehicle and as close to the rear as possible.



ENERGY EFFICIENT VEHICLES (EEVS) SUPPLEMENT

Version 2018.02

All specifications listed in the Human Powered Vehicle Specifications apply to Energy Efficient Vehicles with the following additional specifications. This supplement should be read in conjunction with the Human Powered Vehicle Specifications.

All enquiries regarding Rules and Specifications should be directed to:

enquiries@racveb.com

1. OCCUPANT PROTECTION BARS

Occupant protection for Energy Efficient Vehicles is the same as for Human Powered vehicles except that the metal protection bars are of greater diameter as per section 4.1.1 of the specifications.

Note: A Human Powered Vehicle that has been converted to an Energy Efficient Vehicle will satisfy the occupant protection specifications by duplicating the minimum specified bar dimensions for a HPV. (ie. another bar can be welded alongside the existing bar.)

2. FIRE EXTINGUISHER

All Energy Efficient Vehicles must be fitted with an Australian Standard, dry powder minimum 5BE fire extinguisher of minimum capacity 0.9 kg.

Fire extinguishers must be securely affixed to all Energy Efficient Vehicles. The use of weak or flimsy mounting brackets and/or securing straps is not permitted.

Fire extinguishers must be positioned such that it can be readily reached and removed for use by either the rider from the normal riding position or external assistant in an emergency.

The location of the fire extinguisher must be clearly indicated on the exterior of the vehicle.

3. ENGINE IMMOBILISER

All Energy Efficient vehicles are required to fit a cut out switch that shuts down all propulsion sources and is accessible from outside the vehicle.

The cut out switch must be clearly visible, marked by a blue triangle and mounted on the left hand side of the vehicle and within 300 mm of the rider's left shoulder.

4. POWER SOURCES

4.1 Number of Power Sources

There are three types of vehicle allowed in the Energy Efficient Vehicle category:

- **Hybrid 1: Pedal power, plus one other power source.**
- **Hybrid 2 (Open): Two power sources, excluding pedal.**
- **Single Power Source: Electric-only vehicles**

4.2 Principle of Power Generation

The fuel allocation is only available to vehicles fitted with internal combustion engines as one of their driving sources and will only be commercially available pump fuel as supplied from normal retail outlets.

All fuel used for the trial will only be available from the RACV Scrutineers.

4.3 Minimum Duration of Power Generation

- The machine must be capable of sustained operation when powered separately by each propulsion system.
- Pedal assist type vehicles will be eligible to compete in the Hybrid 1
- While satisfying this requirement a power source may be used intermittently during the event to overcome particular loads, such as starting from rest or hill climbing.
- The spirit of this clause is that a sacrificial form of propulsion is not acceptable.
- The test for whether a power source is compliant will be whether the vehicle is able to sustain its speed while driving on either power source on flat road.

5. ELECTRICALLY POWERED VEHICLES

5.1 Motor Type

Choice of motor type and gearing is free.

5.2 Total capacity and type of propulsion batteries

- Propulsion batteries shall be commercially available.
- Batteries and chargers must be labelled with the school name.
- Batteries will be marked by RACV Scrutineers as per Trial Regulation 9.4.

5.3 Battery Casing

- Batteries with deformed or damaged cases are not acceptable for use.
- Any Lithium Ion (Li Ion) batteries with thin plastic wrapping must be housed within a protective case at all times (on and off the vehicle including when charging) to prevent puncture or damage in an accident. This protective case must be made of non-conductive material and preferably made of hard-plastic case with a foam padding and a lead lock.
- Wet cell batteries must be housed in a sealed box (e.g. plastic) that will prevent spillage if the battery is inverted or damaged.

Figure Ref 5.3: Battery Casing Examples

5.4 Total combined mass of propulsion batteries

The maximum total combined mass of propulsion batteries per vehicle is:

Battery type	Kg
Lead Acid	100
Ni Cd	65
Ni Zn	60
Li Ion	30
Ni MH	45

Note: Where Lithium Ion batteries are used a Battery Management System **must be** carried on board that is designed to provide adequate protection during charging and discharging.

5.5 Mass of propulsion batteries on vehicle

Vehicles are required to carry at least one battery pack at all times so that the electrical circuit is complete.

Batteries must be securely mounted in vehicles.

A battery pack is regarded as the normal quantity of batteries required for the electric motor to propel the vehicle.

5.6 Power limitations for EEV's:

Electrical systems are restricted to a maximum of 48 Volts.

The power output of Hybrid 1 and Hybrid 2 vehicles must not exceed 250 Watts at the driven wheel. This output is in accordance with Victoria's legal limit for licensed road use.

The power output of Electric Only vehicles must not exceed 750 Watts at the driven wheel.

All vehicles must be fitted with a maximum 20 Amp circuit breaker which must be mounted:

1. Out of reach of the rider.
2. Within 200mm of the battery pack.
3. In a position where it is visible to trial marshals when the vehicle is in the pits.
4. With tags provided by scrutineers and tags can only be replaced by scrutineers or trial marshals.

6. VEHICLES POWERED BY INTERNAL COMBUSTION ENGINES

6.1 Engine Type

Choice of engine type or gearing is free.

6.2 Fuel types

Fuels for internal combustion engines will be commercially available pump fuels supplied by the organisers.

Any team using a fuel other than premium unleaded petrol must notify RACV prior to the end of October.

Notes: Fuels that must be stored under pressure such as LPG, CNG and hydrogen are not permitted.

6.3 Fuel tanks

Fuel tanks must be of sufficient capacity to contain the entire fuel allocation for the vehicle as indicated in Section 9.2 of the Trial Regulations. The fuel tank must be securely mounted using a fixed retaining bracket on a structural component of the vehicle.

The fuel tank must be shielded from the rider by the firewall (see section 6.5 Firewall, below).

The fuel tank refilling cap and any other tank closure shall be capable of having a mechanical seal (wire cable-tie) applied to prevent unauthorised opening.

Any plastic fuel tanks must be designated for petrol use and be compliant with AS/NZS 2906 Fuel Containers – Portable – Plastics and metal.

All fuel line connections must be secure and of an automotive standard.

6.4 Pressurised Fuel Systems

Pressurised fuel systems can be used, that is, diesel or petrol fuel injection, providing they comply with the following:

- all fuel lines are of a standard automotive type
- all fuel lines have crimped, or union type fittings at all ends
- all fuel lines must be securely mounted on the vehicle
- all fuel lines must be protected from heated sources and contact with any moving components
- any pressurised fuel tanks must have a relief valve that prevents pressure exceeding 10 psi and must be fitted with a metal, automotive tyre valve for testing.

6.5 Firewall

6.5.1 Description

Vehicle occupants must be separated and fully shielded (ie. no gaps) from any potential fire by a metal firewall.

This firewall must shield the rider from any direct flame occurring from:

- Engine and other high temperature heat sources.
- Fuel tank and lines
- Exhaust system

6.5.2 Firewall must extend:

- **In height -** above fuel tank, fuel lines, exhaust system, engine and other heat sources or potential heat sources – as well as above the shoulders of the tallest vehicle occupant in the normal driving or riding position.
- **Downward -** to the floor line
- **In width–** As wide as the rider's shoulders, in any case sufficiently to shield occupants from hot surfaces and potential fire sources.
- Body panels must be kept clear of hot surfaces and fuel lines.

6.6 Exhaust

Exhaust fumes, hot gases and vapours shall be routed to discharge clear of occupants and outside the bodywork, at the rear of the vehicle at a minimum angle to the horizontal of 45°, downward.

An effective silencer shall be fitted to reduce noise, and the pipe must not protrude beyond the frame of the vehicle.

The exhaust noise level must not exceed 90dB as measured behind the vehicle.

HPV, EEV AND TRY-ATHLON ENDURANCE TRIAL REGULATIONS:

1. SPIRIT OF COMPETITION

The RACV Energy Breakthrough Trial presents a unique opportunity for students to extend their learning experience beyond the boundaries of formal education. The following competition regulations have been framed so that the efforts and experiences of all participants are maximised, to be bound only by the constraints of safety and the spirit of healthy, but friendly competition.

2. ELIGIBILITY

2.1 Make-up of Teams

Teams will consist of the following numbers of competitors:

- Human Powered Vehicle Primary - 6 minimum – 10 maximum
- Human Powered Vehicle Secondary - 6 minimum – 8 maximum
- Energy Efficient Vehicle – 6 minimum - 8 maximum

2.1.1 Gender balance

- Except for Open Class teams and all female teams, a minimum of 50 per cent of the competitors in any one team shall be female.
- Gender ratio in Open Class teams is free.

2.2 Registered Riders

- Only registered team riders shall take part in the trial, however rider changes can be made up to the start of the endurance trial. (See Section 2.6).
- Emergency riders are encouraged to participate in the practice session to ensure they are familiar with the track and the vehicle.

2.3 Team Member Participation

- Team managers must ensure that every nominated team member participates as a driver.
- Managers are required to keep a log of rider track time, which can be checked by officials investigating incidents.

2.4 Age of Drivers

- Drivers of Energy Efficient Vehicles shall be at least 14 years of age, unless special prior approval is provided by organisers.

2.5 Identification

- All competitors must have official identification, which must be shown on request during the trial.

2.6 Rider Substitution

- Sick or injured riders may be replaced prior to the start of the trial by a registered reserve rider of the same gender. Riders will not be substituted after the start of the trial.
- This substitution will require the identification wristband of the replaced rider to be handed to the Administration Centre and a new identification issued to the reserve rider.

3. RIDER ATTIRE

3.1 Fit and Adjustment

- All vehicle occupants shall wear the following safety attire correctly fitted and adjusted at all times the vehicle is on the track during practice and the trial.

3.1.1 Helmet

- For human powered vehicles and pedal/electric hybrid vehicles, minimum requirement is a bicycle helmet approved to AS 2063, AS 1698 or ECE 22.05.
- For petrol-powered or electric-only Energy Efficient Vehicles, requirement is a motor cycle helmet approved to either AS 1698 or ECE 22.05.

3.1.2 Eye Protection

- Shatterproof glasses, goggles or a helmet visor must be worn at all times.
- Provision must be made for the lights on period overnight.
- Full faced helmets must have the visor down at all times unless the rider is wearing other eye protection.

3.1.3 Gloves

- Strong material BMX or motor-cross type gloves preferred.

3.1.4 Shoes

- Full foot coverage, sandals not permitted.

3.1.5 MP3 players

- The use of MP3 players or similar music/entertainment devices by riders is NOT permitted during trial or practice sessions.

3.1.6 Video cameras

- Small video cameras (eg. GoPro) are allowed as long as they are not attached to the rider's helmet and do not pose any safety risk. Camera's must not be mounted to the outside of the vehicle silhouette when viewed from the front

3.1.7 Clothing

Human Powered Vehicles:

- Minimum coverage of shoulders, upper body and mid-thigh e.g.: shorts and T-shirt; or cycling knicks and jersey.
- **HPV Note:** Sleeveless triathlon skin suits, sleeveless cycling jerseys, sleeveless t-shirts, tank tops or singlets are not permissible.

Electric powered Energy Efficient Vehicles

- Riders of pedal/electric hybrid vehicles may choose to comply with the Human powered Vehicle clothing rules.
- Riders of electric-only vehicles must comply with the requirements for liquid fuelled vehicles below.
- Teams that have battery power must provide a pair of full cover gloves and a pair of protective goggles for anyone handling batteries.

Liquid fuelled Energy Efficient Vehicles

- All competitors shall wear overalls or clothes that cover and are neat fitting from ankle to wrist to neck.
- Fire retardant material is advised and light fabric/disposable overalls are not permitted

- It is not permissible for drivers of fuel powered vehicles to ‘dress down’ when their fuel is used up.

4. SCRUTINEERING

4.1 Compulsory

Scrutineering is compulsory for all vehicles and teams, to ensure compliance with vehicle specifications and safety requirements.

4.2 Before track

Before entering onto the track for practice, all vehicles must be scrutineered for safety.

Scrutineers can refuse permission to enter the track for any safety reason.

4.3 Subsequent scrutineering

All vehicles will also be inspected at random during the trial for operation of safety items or when the vehicle is involved in a track incident. (See Section 7.11).

5. TRAFFIC LIGHTS AND SIGNALS

All competitors shall understand the meaning of the following traffic signals/flag signals:

Green Light or Flag

- The track is clear for competition.

Yellow Light or Flag

- **A sign of danger or track obstruction in the vicinity of the marshal point.**
- Riders are required to stop racing, slow and pass the point of danger at a significantly reduced speed (at or below 20 kph) using extreme caution
- Riders must not resume competition until they are well clear of the danger and until they reach the vicinity of the next marshal point displaying a Green Light or Flag.

Red Light or Flag

- **An indication of extreme danger.**
- All vehicles shall come to an **immediate** stop.
- Racing has ceased.
- Riders must follow the directions of the Clerk of Course and flag marshals.

Blue Flag

- Is an indicator that a faster vehicle is positioned close to you. Competitors shown the blue flag must hold their line to allow overtaking.

6. START, FINISH AND BREAK

6.1 Pre-Race Briefing

All Team Managers must attend the pre-race briefing by the Clerk of Course and Race Director.

6.2 Lap Counters

It is the Team Manager's responsibility to ensure that:

- a transponder is picked up and correctly fitted to the vehicle
- the transponder is working at all times
- the transponder is returned to the Administration Centre at the end of the trial.

6.3 Grid Assembly

- The Clerk of Course, in conjunction with the event committee, will allocate and advertise starting grid positions following the practice session.
- Vehicles will be called to the starting grid assembly area at least 30 minutes prior to the official start.
- If a vehicle is not on the grid within 15 minutes of the scheduled start time, officials reserve the right to place the vehicle at the rear of the grid.
- Vehicles in the first 20 grid positions will be assembled according to the official grid positions. Thereafter teams will be assembled in groups of ten where exact starting position is less critical (ie. 20 – 30, 30 – 40, 40 – 50, 50 – 60, 60 – 70, etc).

6.4 Trial Start

The trial will be started with the drop of the National flag.

6.5 Trial Finish

All trials will conclude with the display of the black and white chequered flag,

- 24 hours after the start for the secondary HPV and Energy Efficient Vehicle teams.
- 14 hours of competition for the HPV Class A teams.

6.6 Class A Compulsory Break

6.6.1 Primary break

All HPV A vehicles will leave the track nominally from the specified time on Friday evening and resume their trial at the specified time on Saturday.

6.6.2 Rejoining the trial

The restart of the HPV A trial will be under the direction of the Clerk of Course.

7. TRACK CONDUCT

7.1 Speed Limit

Speedometers are mandatory and ALL competing vehicles shall observe a maximum speed of 60 kilometres per hour during practice and the trial, and **10kph** in pit lane.

Vehicles detected exceeding 60km/h at any point will have the lap immediately voided. Voided laps will be displayed on the results display system but not counted towards a teams total.

7.2 Blue Line

A blue line has been painted on the track.

Vehicles must keep to the **left** of the track, on the inside of the BLUE line, unless overtaking another vehicle.

7.3 Seatbelts

All vehicle occupants shall wear a correctly adjusted seatbelt or harness when on the track during practice and the trial.

See section 4.6.3 of the Vehicle Specifications regarding correct adjustment of seat belts.

7.4 Injured Riders
The Clerk of Course, Track marshals and event officials monitor the trial and where necessary will call for assistance from Medical and Emergency Services to attend to injured riders.

7.5 Right of Way
Competing vehicles have right of way over disabled vehicles that need to be recovered and returned to the pit area.

7.6 Direction of Travel
Under no circumstances is a vehicle to be driven or pushed on the track in the opposite direction to racing.

7.7 Overtaking
Vehicles should overtake on the outside, to the right of the vehicle being overtaken.

Riders must not change lanes without checking their mirrors to make sure it is safe to do so.

It is the responsibility of the overtaking (faster) vehicle to ensure that the overtaking move is carried out without endangering other competitors.

Cutting in, deliberate blocking or leaving insufficient clearance will be penalised.

7.8 Vehicle Recovery
If a vehicle breaks down, the track marshals will report the incident and the team will be informed.

It is the responsibility of the team to recover their vehicle.

If a team is unable to safely recover their vehicle they can request assistance from the Clerk of Course and event officials.

7.9 Vehicle Lighting
Front lights as required by vehicle specifications shall be illuminated during the hours of darkness as directed by the Clerk of Course.

Rear lights as specified are to be turned on steady mode during all on track activities

Riders must stop in the pits as soon as possible to rectify any inoperable or insecure lights.

7.10 Lighting Batteries
Batteries used solely for lighting may be charged and/or recharged and/or replaced as required.

7.11 Track Incidents

All vehicles involved in significant crashes, rollovers etc, are to be removed from the track by marshals only and the barriers quickly restored to trial condition.

All vehicles involved in rollovers or significant crashes must have a “Return to Pits” sticker applied and may then be ridden back to the pits. Inspection in the pits by a Marshal is compulsory before re-joining the trial.

After returning to the pits the rider will NOT be allowed to ride again for at least ONE hour. During this time team managers must monitor the riders’ condition, and if in doubt take the rider to the Trackside Medical Centre

If a vehicle is unable to continue because it is damaged or the rider is unable to ride then the vehicle may be recovered by the team for repair. Teams unable to recover their own vehicle can request assistance.

Riders who are unable to ride their vehicle back to the pits should be taken to the Trackside Medical Centre to be assessed and they must be cleared by the medical team before being allowed to ride again.

7.12 Emergency Vehicles
When emergency vehicles are on the track it displays flashing yellow lights which indicates extreme danger in the same manner as corner yellow lights/flags.

Riders must slow, use extreme caution, must not overtake other competitors and pass when directed by the officials.

8. PIT PROCEDURE

8.1 The Pit Areas

- All pit sites must be set-up as per the direction of Event Officials.
- Each team in the HPV, EEV and Try-athlon endurance trials will be allocated a site in the pit area, except where schools with three entries in a category will be required to utilise two pits sites.
- All pit sites are numbered and are a minimum of 2.8 metres wide by 2.0 metres deep.
- Where possible, pit numbers are the same as the team number.
- All teams must leave approx 1 metre clearance area in front of their pit site for rider changeovers and for other teams to have line of sight of the track and pit lane.
- Closed shoes must be worn in pit lane.
- There is no existing shelter in the Pit areas.

  Teams are encouraged to erect a small tent, or arrange to share a tent with another team. Teams are encouraged to erect a team or school banner in their designated pit area(s) including team numbers. A banner about two by one metres would be ideal.
- HPV A teams are required to share their pit spaces - but not tools and resources - with Try-athlon teams for their Friday night Try-athlon Practice session.
- No vehicles or trailers will be allowed in the Try-athlon pit areas.

8.2 Speed in Pits

Maximum speed in the pit area is 10 km/h.

8.3 Direction of Travel in Pits

Under no circumstances shall a vehicle enter the pit area via the pit exit lane.

8.4 Driver Change-Over

All driver and passenger changes shall occur in the designated area adjacent to each team's pit.

8.5 Stopping in Pits

8.5.1 Brakes only

Vehicles shall come to a halt in the driver change lane under the effect of the vehicle's own braking system.

Stopping with the assistance of others is not permitted.

8.5.2 Full stop

Vehicles shall be stationary prior to unfastening seatbelts or harness.

8.5.3 Riders/Drivers

Driver refreshments and adjustments to clothing etc. shall only be effected when the vehicle is stationary in the pit area.

8.5.4 Pit Crew

- A maximum of three students and one supervising adult, in addition to the incoming and outgoing riders, shall attend a vehicle in the pit lane at driver change-over.
- The four designated people from each team attending the vehicle in pit lane are encouraged to wear a green reflective vest and must wear enclosed shoes.

8.6 Pit Lanes

Pit entry and exit lanes shall be kept clear at all times.

8.7 Pit Crew Communications

- The use of radio communication between rider and pit crew is permitted provided operating the unit does not interfere with the rider's control of the vehicle.
- The use of notice boards for communication between the rider and the pit crew are permitted.

However, such notice boards and their use shall comply with the following:

- they must be held and displayed by one person only at a time
- they must be held so they do not go beyond the line of pit lane barriers.

8.8 Major Repairs

- Major repairs including welding and grinding equipment must NOT be carried out in the pit lane. The pit lane includes a team's tent adjacent to the track.
- These repairs must be carried out in the vicinity of the repair container.

8.9 Stationary Vehicles

In pit or driver change lanes, stationary vehicles shall give way to vehicles proceeding along these lanes.

8.10 Removal of Components

Redundant, superfluous and/or damaged components of substantial mass i.e. greater than 0.5 kg, may not be removed from a vehicle except with the permission of the Clerk of Course. At the discretion of the Clerk of Course, the vehicle may be required to carry ballast. Teams may not substitute or replace power sources or strip the vehicle below its starting weight after the commencement of the event.

8.11 Vehicle Restarts

Vehicles that have been involved in a track incident and received a Return to Pits sticker cannot restart until a Pit Marshal has checked the vehicle is safe to continue and removed the sticker.

9. FUEL USE AND RECHARGING OF BATTERIES:

9.1 Fuel Burning Energy Efficient Vehicles

In accordance with Section 1.4.2 of the EEV specifications, fuel burning entries will receive a single allocation of fuel

9.2 Amounts of Fuel Allocated

- EEV – 3 litres

9.3 Sealing of Fuel Tanks

Fuel tanks on vehicles will be sealed after the allocation of fuel prior to the start of the event.

9.4 Batteries

At scrutineering teams using batteries are required to present all of their battery allocation for identification marking.

All batteries must have manufacturers labels including details of battery type displayed.

Batteries must be labelled with the school name.

9.5 Battery Recharging – process and Procedure

The onus is on the teams to use safe and reliable battery chargers.

Teams will start with fully charged batteries as the charging area will not open until one hour after the trial start. After which, there is no limit placed on the amount of time that batteries can be charged. All recharging is to be conducted in a designated area provided by the event organisers, and under constant supervision, to ensure charging is carried out in a safe manner.

Any team found to be charging batteries not in the designated area will be penalised.

All battery chargers must be electrically tested and tagged. The chargers must also be presented at the battery check on Saturday for an extra Energy Breakthrough tag to be applied. Only approved tagged chargers can be used.

Battery chargers must be of a commercially available type. The physical dimensions of the charger must not exceed 30cm x 30cm x 30cm.

Bare connections and alligator clips are strictly forbidden. All connections must be made using a properly insulated electrical connector. Anderson plugs are the preferred type of connector.

Only one battery pack may be charged at a time. A battery pack is defined as the usual amount of batteries required to run the vehicle.

Teams will be provided with one power outlet in the charging area, which will be fitted with a digital readout. Outlets are restricted to 4 amps (fused) or 720W whichever is the lower and officials will disconnect chargers drawing higher amp readings and notify the team.

10. TRIAL POINT SCORING

- The vehicle completing the most number of laps in each class in the trial period scores the maximum 50 points.
- Other vehicles in each class score points for the number of laps completed in proportion to the number of laps.
- For example, say team AA in a particular class travels the greatest distance, 200 laps, and team BB in the same class travels 160 laps.
- Points scored are as follows:

Team AA:

200 laps = 50 points

Team BB:

160 laps 50 x $\frac{160}{200}$ = 40 points

11. INFRINGEMENTS

11.1 Vehicle Design

Vehicles which are considered safe but DO NOT comply with key elements of vehicle specifications may be given permission to start the trial with a penalty.

This penalty can be up to 50 laps and will be applied by the event officials.

11.2 Reporting of Incidents

Teams may report track incidents or infringements of these competition rules to the Clerk of Course or Pit Marshals who will investigate and act accordingly.

If teams wish to proceed with an official complaint they will be provided the appropriate documentation.

11.3 Penalties

A team that breaches any trial regulation including the spirit of competition, will be notified that they are under investigation for an infringement of the competition rules.

The Clerk of Course and event officials will review the incident and apply a penalty, which they consider is consistent with the severity and intent of the infringement.

Incident reviews will be conducted as soon as practical, but in any case will be resolved before the end of the endurance trial.

Penalties may take the form of:

- A warning.
- A “stop and go” penalty.
- A time penalty.
- 50 lap penalty.
- Disqualification of a rider.
- Exclusion from trial results.
- Withdrawal from competition.

Map not to scale