

eV Challenge Powered by Synergy – Technical Regulations February 2021



The 2020-23 Technical Regulations contain a number of minor alterations to previous editions of the regulations. Please read through them carefully before beginning any new vehicle design and build. Some current vehicles may also require some modification in order to be compliant.

The aim of these Regulations has been to try and address a small number of issues which have been identified in previous years, as well as making the regulations simpler to understand.

Should you have any queries in relation to the regulations please contact the Committee before beginning construction or modifications – evchallengewa@gmail.com

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New and/or modified regulations from 2019 are highlighted in yellow with red font.

Regulations removed or changed are noted with ~~red font and a strikethrough.~~

1. Aim of the Event

1.1 The aim of the eV Challenge is for teams to develop small, single-seat, prototype electric vehicles which will try and complete as many laps a circuit in 1 hour as possible from a limited amount of electrical energy.

1.2 The eV Challenge is primarily an engineering education event for high school and tertiary educational institution teams. Private adult aged teams are welcome guests, however the focus of the eV Challenge always has been and always will be as an educational event.

1.3 Vehicles entered in the eV Challenge must be prototype vehicles purpose-built for the eV Challenge. Any commercially available vehicle is not permitted to enter the eV Challenge.

1.4 The eV Challenge is an endurance event, not a sprint. Vehicles must be designed with this aim in mind. As such, the maximum speed allowed is limited to 60km/h.

1.5 The eV Challenge is an affiliated Club of Motorsport Australia (formerly CAMS) and as such is subject to Motorsport Australia Codes of Conduct (<https://motorsport.org.au/officials/codeofconduct>) and National Competition Rules. These codes and rules extend to all officials, participants and spectators involved with the eV Challenge.

2. Event Classes

2.1 Junior Class: This class is for students enrolled in Years 7-10. Vehicles competing in this category will be identified by a sticker with a white 'J' on a green background.

2.2 Senior Class: This class is for students enrolled up to Year 12, requires drivers to be 16 or over. Vehicles competing in this category will be identified by a sticker with a white 'S' on a blue background.

2.3 Open Class: This is open to private, corporate, or tertiary educational institution teams, requires drivers to be 16 or over. Vehicles competing in this category will be identified by a sticker with a white 'O' on a red background.

3. Vehicle Cost

3.1 All vehicles competing must adhere to a documented maximum value of \$2000.

3.2 The following items are exempt from the value limitation:

- a. Brake components
- b. Safety harness
- c. Mirrors
- d. Horn
- e. Battery
- f. Paint, stickers & signage

3.3 Materials and services which are donated or obtained second-hand are to have their full reasonable cost included. Proof of reasonable cost may be in the form of printed costs of similar items available on websites such as eBay, Gumtree etc.

3.4 Proof of cost and vehicle value is to be submitted at pre-event scrutineering. This will consist of a costing sheet and receipts, product web pages, and other documentation verifying product costings.

~~**3.5** Vehicles competing in Class C are not subject to a budget restriction.~~

4. Motor

4.1 The vehicle will be powered solely by an electric motor or motors.

4.2 The motor/s must be easily accessible for inspection.

4.3 The motor/s may be cooled by passive or forced air or by a liquid cooling system. Any liquid cooling systems must be self-contained. All active cooling systems must be powered from the main drive battery.

5. Batteries

5.1 Vehicles competing in the Junior Class must use the 36V 11.6Ah rack battery from Solarbike

5.2 Vehicles competing in the Senior and Open Classes must use the 36V 17.5Ah rack battery from Solarbike.

5.3 Vehicles may only use other batteries to power horns and communications equipment only but these must not be connected to the drive system, motor or controller in any way, and must be available for inspection by scrutineers.

5.4 Batteries must be securely mounted in the vehicle and must be easily accessible for inspection. See Section 7 for battery location information.

6. Wheels

6.1 The vehicle must have at least three wheels which must remain in contact with the ground at all times.

6.2 All wheels must be greater than 100mm in diameter.

6.4 Nylock nuts, locking nuts or split pins must be used to retain all wheels.

7. Dimensions

7.1 The vehicle's total dimensions must not exceed 2700mm in length, 1500mm in width, and 1200mm in height.

7.2 The track of the vehicle must not be less than 700mm. Track is deemed as the measured distance between the centres of the outermost tyres where they contact the ground.

7.3 Ground clearance must not be less than 30mm.

7.4 The base of the driver's seat must not be higher than 100mm from the ground.

7.5 The battery shall be mounted horizontally with the lowest part of the battery not higher than 100mm from the ground.

8. Driver & Seating

8.1 The vehicle will have one seat for the driver which is securely and firmly fixed to the vehicle chassis.

8.2 The seat shall have sufficient shape to provide back and lateral support to the driver in order to assist the seat belts/harness locate the driver securely in case of a forward, rear or side collision. The vehicle floor may form part of this seat.

8.3 The driver must sit in a feet-forward, reclined position. The driver must not kneel on or sit astride a seat. Drivers must be seated in such a way that their chests and head are rearward of their waists.

8.4 The driver must be able to demonstrate a rapid and safe exit from the vehicle unaided.

8.5 There must be a solid floor under the whole of the driver. The floor must be constructed of materials as listed in regulation 9.2.

8.6 There must be a padded headrest behind the driver's helmet to prevent whiplash.

8.7 All seats must be fit for purpose and, at the discretion of the scrutineer, may require protective padding with a minimum thickness of 12mm. All parts of the seat that are in contact with the driver must have some sort of protective padding, with a minimum thickness of 12mm.

8.8 Driver's feet, legs, arms, and torso must remain within the vehicle structure during competition.

9. Driver's Cell

9.1 There will be a rigid driver's cell extending from in front of the driver's feet to behind the driver. The driver's cell needs to protect the driver's feet, legs, arms and torso up to shoulder level, protecting the driver's rib cage, when viewed from the side. The driver's cell must protect these areas of all drivers.

9.2 The skin of the driver's cell in regulation 9.1 must be constructed of sheet material such as aluminium, fibreglass or composite material with a minimum thickness of 0.8mm, polycarbonate material with a minimum thickness of 1.0mm, plywood with a minimum thickness of 3mm, or coreflute with a minimum thickness of 5mm.

9.3 The skin of the driver's cell in regulation 9.1 must form a continuous protective layer and be securely attached to the driver's cell so as to be unlikely to fail as a result of an impact.

9.4 The vehicle must have a skin which covers the top of the driver's cell. This skin must cover from the front of the driver's cell to at least the secondary structure.

10. Bodywork

10.1 Bodywork must not prevent any driver from having an adequate range of vision.

10.2 Bodywork must not prevent scrutineers from being able to inspect steering linkages, wheel bearings and wheel security. Bodywork which is removable to allow such access is permitted.

10.3 Any windows or windscreens must be clear.

11. Brakes

11.1 A minimum of two independent brake systems are required.

11.2 The driver must be able to operate the brakes without removing either hand from the steering system.

11.3 The vehicle must be able to brake in a straight line when either brake system is applied.

11.4 Each brake system will be subject to a force test of 200N ~~300N~~ applied horizontally forwards from the roll bar with the car situated on a flat concrete or bitumen surface. There must be no movement of the car. All drivers must be capable of producing this braking force. This will be subject to spot checks outside of scrutineering.

12. Roll Bars (Adapted from the Motorsport Australia Manual, Schedule J)

12.1 Each vehicle shall be fitted with a principal structure and a secondary structure.

12.2 Under no circumstance may the driver's helmet be less than 50mm below a line drawn between the highest points of the primary and secondary roll structures.

12.3 The principal structure must be positioned behind the driver.

12.4 In open cockpit vehicles the primary structure must be made in one piece, without joins.

12.5 In closed cockpit vehicles any roll bar that is constructed from more than one continuous piece must be reinforced and braced from all junctions/joins in addition to the top in order to prevent deformation.

12.6 There shall be at least one brace from the top of the main roll bar.

12.7 The Principal structure main roll bar must be within 10 degrees of vertical.

12.8 The brace/s shall form an angle between 25° and 60° with the vertical.

12.9 All roll bars and braces must be made from minimum 25mm x 1.6mm aluminium tube or 19mm x 1.2mm steel tube. Larger diameter and wall thickness tubes are permitted.

12.10 Where two braces are used they must be fitted on both sides of the roll bar, and shall be within 100mm from the top of the roll bar.

12.11 Stays or braces may extend forward or rearward and must be adequately secured to the chassis via mechanical fixings or welding.

12.12 The main roll bar (together with any additional members and/or a head rest) shall be configured such that the driver's helmet cannot pass through it.

12.13 The bend radius on the centreline of the main roll bar shall be between two and four times the tube diameter. Vehicles with main roll bars with a larger radius than described approved prior to January 1st 2020 may continue to be used. Roll bars are not to be pinched or rippled.

- 12.14** Principal and Secondary structures are to be attached to the chassis via mechanical fixings or welding.
- 12.15** In conjunction with the vehicle's structure, the main roll bar shall not leave unprotected any part of the driver's shoulders, when viewed from the front or rear.
- 12.16** A substantial secondary structure shall be incorporated forward of the driver's hips, but not more than 1000mm forward of the primary structure. This structure must be constructed from the same materials as the primary structure as described in regulation 12.9.
- 12.17** All parts of the principal structure, including any bracing, which may come into contact with the driver's helmet must be padded. If padding covers or obscures the welds or mechanical fixings of the roll bar or bracing to the chassis, this padding needs to be removable during scrutineering in order to inspect these fixings.
- 12.18** Non-structural bodywork along with the wheels must not be considered part of the roll protection structure.

13. Safety Equipment

- 13.1** Two flat mirrors, each with a minimum area of 2250mm² (e.g. 75mm x 30mm) must be fitted and must be able to be adjusted by the driver when in the normal driving position with belts on. Mirrors will be subject to a rearward visibility test during scrutineering and spot checks during driver changes.
- 13.2** The vehicle must have a clearly audible horn that is at least 90dB in volume when measured on the ground 1m in front of the vehicle. The horn must be operable by the driver without taking either hand from the steering system. **Vehicles must have operational horns at all times whilst on track.**
- 13.3** A correctly rated isolation switch must be fitted. It must be clearly visible and easily accessible to the driver **AND** from outside the vehicle. Two such switches may be used if required. On/Off positions must be clearly marked. The external isolation switch must be located inside a **blue or yellow triangle** of 150mm length on each side.
- 13.4** The vehicle must be fitted with a minimum four fixing point safety harness, with secure fixing points on the roll bar or chassis. Harness shoulder strap fixing points should be close to shoulder height and neck width (approximately 150mm apart).
- 13.5** Where the seat back has an angle of 45 degrees or greater between the seat and the horizontal a minimum 4-point harness is required (**Figure 5**). Where the seat back has an angle of less than 45 degrees from the horizontal, a five or six-point harness is required. **If in doubt, use a 5 or 6-point harness. Teams must ensure harnesses used comply with Motorsport Australia Schedule I expiration date requirements.**
- 13.6** Each point of the harness must be securely attached to the vehicle frame structure by **minimum 10mm grade 8.8 bolts**. The harness must be capable of lifting the entire vehicle from the ground with driver and battery in place.
- 13.7** Each lap belt must be securely attached to a structural point at least 75mm below the top of the driver's waist, and no more than 100mm either side of the driver's torso.
- 13.8** The harness must be able to hold the driver in a position that does not allow any excessive movement. The shoulder harness belts must be installed in such a way that they cannot slip off the driver's shoulders whilst driving. In the event of a sudden stop, the harness must prevent the driver from sliding forward and maintain the driver's shoulders in the 'driving position'. The lap belts must be able to hold the driver securely in place if the vehicle rolls over.
- 13.9** The drive train must be guarded to prevent fingers, hair and clothing being trapped at any time.
- 13.10** The use of locking nuts on safety critical components is mandatory, including but not limited to: safety harnesses; roll bars; wheels; steering system components; braking system components. **If in doubt, use locking nuts.**

13.11 The driver is to be protected from all wheels, motor components, and drivetrain by suitable guards. These should be designed and fitted in such a way to minimise any foreign objects (stones, water etc.) from entering the driver's cell, and to stop seatbelts and parts of the driver contacting the wheels and/or the road. These guards should be made from materials no smaller/thinner than those listed in regulation 10.2.

13.12 Vehicles must have no sharp edges, corners or protrusions that could cause injury to either the driver, team members or officials. **This includes sharp edges of cut cable ties.**

14. Steering

14.1 Steering systems must have minimal play.

14.2 Steering must be able to operate smoothly from lock to lock, without wheels making contact with bodywork or chassis components.

14.3 Steering must be by mechanical linkages only, with all securing nuts to be Nylock nuts or locking nuts.

14.4 Steering must be by front wheels only.

14.5 Steering must be operable by hand only.

14.6 Should the steering system use a steering wheel or handlebar, the steering column would be made up of a single piece of material with no butt joints.

14.7 The distance from the final mounting point of the steering column to the steering wheel or handlebar must not exceed 250mm.

15. Electrics

15.1 The accelerator must be spring loaded to the off position.

15.2 All wires and terminals on the vehicle must be neatly run, secured and unable to chafe, positioned away from moving parts and be correctly rated.

15.3 The motor control circuit must have a fuse or circuit breaker of suitable capacity installed between the positive side of the battery and the isolation switch.

15.4 The controller may be cooled by passive or forced air or by a liquid cooling system. Any liquid cooling systems must be self-contained. All active cooling systems must be powered from the main drive battery.

16. Other

16.1 Vehicles are free to use telemetry and communication systems however these must operate on national legal frequencies and power levels.

16.2 Driver to pit communications systems must be hands free. Any item in the driver's cell must be adequately restrained and secured. No items shall be secured to the safety harness **nor in driver's pockets.**

16.3 Two racing numbers in the form of A4-size portrait orientation stickers will be provided to entrants by the organisers. These must be located on each side of the vehicle and be clearly visible. (figure 8)

16.4 Two A5-size portrait orientation stickers will be provided by the organisers to indicate which class the vehicle is competing in. These must be located on each side of the vehicle and clearly visible. (figure 8)

16.5 Provision must be made for the positioning of a timekeeping transponder on or in the vehicle. The transponder must be able to be securely mounted and must have a clear line of sight to the ground.

Transponders will be provided at events by the organisers.

16.6 Cameras, such as a Go-Pro, must not be attached to driver helmets. Cameras must be attached to the car via mechanical fixings or via adhesives. Suction mounted cameras are not permitted. Cameras must be installed prior to scrutineering. Cameras must also have a **secondary retention device** to ensure they do not fall to the track surface in the event of them becoming dislodged from the vehicle.

16.7 Lift points, for use by recovery marshals, must be clearly marked on a structural member of the vehicle. Lift points must provide for a balanced lift of the vehicle excluding the driver. Care must be taken to select

lifting points which minimise potential risk to recovery marshals by having these points away from sharp edges and/or moving parts.

17. Driver Clothing

17.1 Drivers must wear a suitable motorcycle or motor racing helmet which is in good condition. Helmets must comply with AS1698 or with the approved helmet specification list from the Motorsport Australia Manual.

17.2 Drivers must have the helmet visor down whilst driving. If the helmet does not have a visor then goggles must be worn. Safety glasses or sunglasses are not permitted to be worn to fulfil this regulation.

17.3 Full length, ankle to wrist length clothing must be worn whilst driving. Paper overalls are not permitted.

17.4 Full fingered gloves must be worn whilst driving.

17.5 Fully enclosed shoes must be worn whilst driving and by all team members in whilst in garages and pit lane.

17.6 Long hair must be tied or covered in such a way that it cannot come into contact with any moving parts of the vehicle.

17.7 Teams must ensure that no part of the driver or their clothing may be able to become entangled with any part of the vehicle at any time.

18. Vehicle Logbooks

18.1 Each team will be issued with a vehicle logbook upon confirmation of entry. This must be brought to scrutineering at every event. Any Scrutineer's requirements must be completed before your vehicle's next event, otherwise the vehicle will not be allowed to participate. These will be trialled in 2021 with the aim of full use from 2022 onwards

19. General Construction Notes

19.1 Mechanical fixings including but not limited to nuts, bolts, and rivets must be fit for purpose, sufficiently tensioned and correctly fitted.

19.2 Welding shall be carried out along the whole perimeter of each tube joint and shall be of the highest possible quality with full penetration, preferably using a gas-shielded arc.

19.3 Although good external appearance of a weld does not necessarily guarantee its quality, a weld of poor appearance may indicate that it is unsatisfactory.

19.4 When using heat-treated steel any special instructions of the tube manufacturer shall be followed (e.g. ambient temperature, special electrodes, gas protected welding).

20. Appendices

Roll Structure layout (Section 12, page 5)

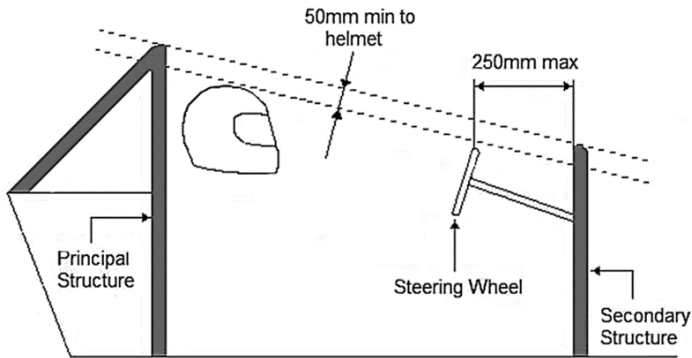


Figure 1 is taken from the Motorsport Australia Manual. This diagram outlines the two roll over structures and how they are arranged in relation to the driver. As many eV Challenge vehicles do not use a traditional steering wheel, the 250mm distance from the steering wheel to the Secondary Structure is instead modified to read from the Lap Belt mounting point (Regulation 12.15)

Roll Bar Diagrams (Section 12, page 5)

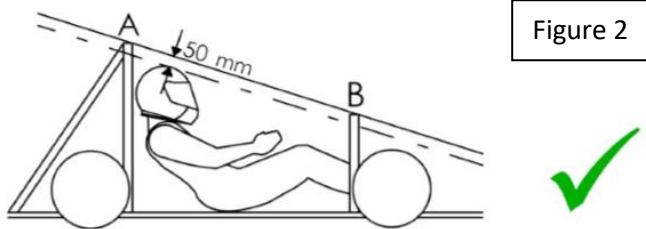


Figure 2

Figure 2 shows a compliant roll bar. It provides 50mm clearance between the top of the driver's helmet and a line connecting the top of the front and rear roll structures. Figure 1 also shows roll bar triangulation which is acceptable. The triangulation bars must not be more than 200mm from the top of the rear roll bar.

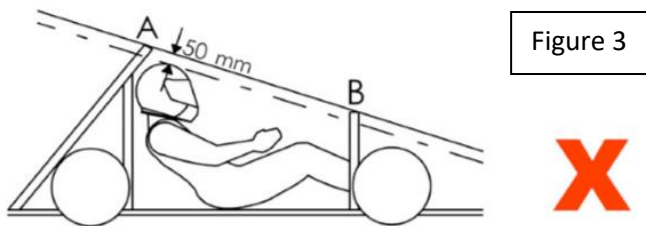


Figure 3

Figure 3 shows a non-compliant roll bar. The roll bar must be within 10 degrees of vertical.

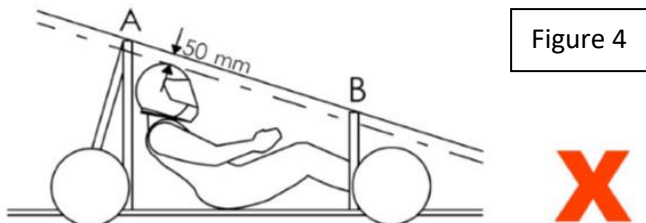


Figure 4

Figure 4 shows a non-compliant roll bar. The included angle between the roll bar and the triangulation must be a minimum of 25 degrees.



Figure 5

Figure 5 shows firstly a non-compliant roll bar when viewed from the front/rear. Roll bar clearance must be achieved by the roll bar, not a single extension. The second diagram shows an example of a compliant roll bar shape. The Driver's helmet must remain within this profile at all times whilst the driver is seated in the vehicle (13.3).

Seat angle & harness diagrams (Section 13, Regulation 13.5, page 3)

Figure 6

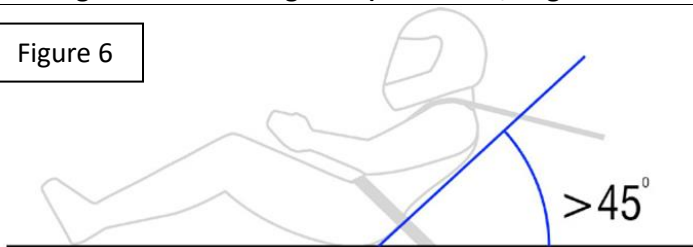


Figure 6 shows a seat angle of 45 degrees or greater from the horizontal. This seat position requires the use of a minimum four-point harness.

Any seat angle less than 45 degrees from the horizontal will require the use of a five or six-point harness.

Figure 7 – Taken from Motorsport Australia Manual

Figure 7 outlines the belt angle ranges required for motorsport harnesses, as shown in the Motorsport Australia Manual.

Note that these angles are taken from the driver's body, not the slots in the seat.

Figure 7

Not applicable to 1st Category Automobiles

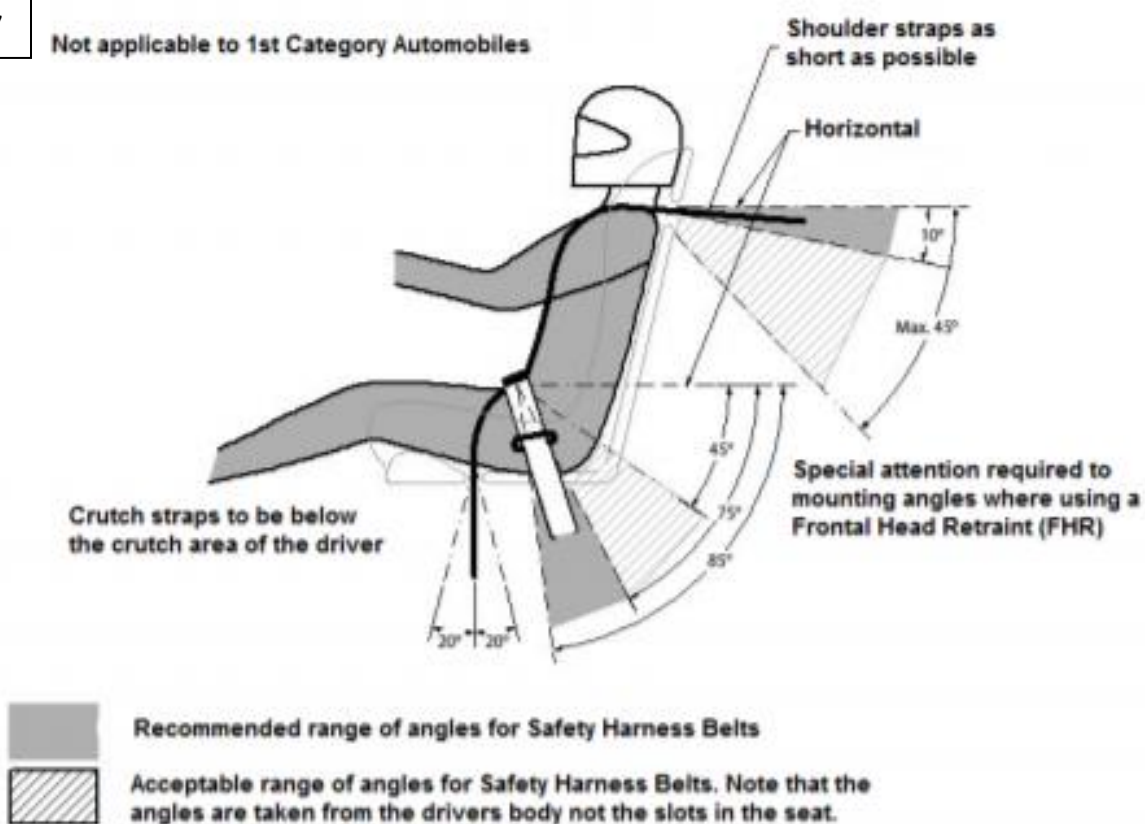


Figure 8: Sticker location for number and Class stickers (16.3 and 16.4)



In both of these examples the number and Class stickers are clearly visible. Teams must ensure they have adequate space on the sides of their vehicles for stickers to be located where they will not be obscured by wheels and suspension or steering components.

21. Regulation Introduction, Modification & Change Rationale:

2.1, 2.2, 2.3 Event classes have been renamed to reflect more accurately the divisions within the eV Challenge.

3.1 and removal of 3.5 In order to ensure comparability between the Senior and Open classes an increased documented budget limit of \$2000 has now been applied to all vehicles competing in the eV Challenge.

8.7 The adjustment of this regulation has been as a result of a common sense approach to teams which have used off-the-shelf motorsport seats – such as go-kart moulded seats – which do not require padding for the driver.

9.1 This adjustment to ensure drivers are protected by chassis/bodywork up to shoulder level was outlined with advance notice in the 2020 regulations, and is introduced to ensure vehicles provide increased protection for the drivers.

11.4 This adjustment has been made to assist teams meet the braking force requirement. The committee considered the Greenpower F24 braking regulation requirements of 300N total force for both brakes as a guide and have relaxed the brake force requirement for each system in eV Challenge vehicles. Total combined force shall therefore be >400N when both brakes are applied.

12.10 This regulation change had advance notice given in the 2020 regulations and brings the roll structure regulations in line with Motorsport Australia Schedule J more fully.

12.11 2020 saw a number of vehicles with inadequate or marginal methods of securing roll bar braces and this rewording addresses this issue.

13.2 2020 saw a number of vehicles running multiple systems, including horns, on a single circuit. When this circuit failed those vehicles also had no operational horn. This regulation addresses this issue.

13.3 Kill switch marking is traditionally blue on racing cars but traditionally yellow in the eV Challenge. Either format has been deemed satisfactory.

13.5 Teams must ensure date compliance for harnesses/seatbelts

13.6 Teams must use minimum specification bolts for mounting harnesses as per Motorsport Australia Schedule J.

13.12 With a number of vehicles in 2020 presenting with sharp, trimmed cable ties in positions where the driver's body could come into contact, this regulation has been clarified.

16.2 In order to better ensure communication devices cannot drop either on to the track surface or into the cabin of vehicles this regulation has been revised.

18.1 Logbooks were mentioned in the 2020 regulations however due to a number of factors they were not implemented. In 2021 the committee will introduce these to vehicles in a gradual manner prior to full implementation from 2022 onwards.