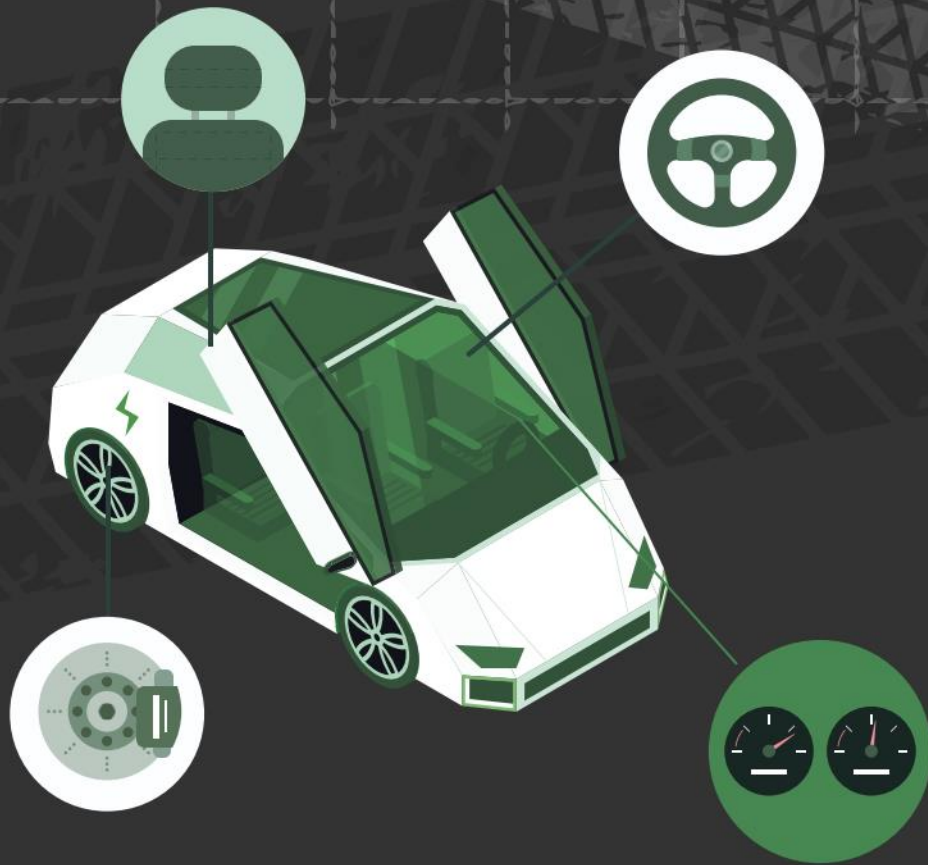




EVER V



CONCEPT TRACK

This document contains rules and regulations for the concept track of the Electric Vehicle Rally V (Fifth Edition). This will be your guide on what to know before the vehicle design process. The rules contains articles on vehicle chassis, body, powertrain, suspension, brakes, steering and several other systems.

Under the auspices of:



The Arab Republic Of Egypt
The Cabinet

Owned by:



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ACADEMY OF SCIENTIFIC RESEARCH
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VEHICLE DESIGN

ARTICLE 1: GENERAL

- Vehicles must have a two-seat design, meaning two separate seats one for the driver and one for the passenger.
- Vehicles must have exactly four wheels that are in constant contact with the road with urban styling in mind (3 – wheel or formula style vehicles (Open wheel)) are forbidden.
- Vehicle bodies must not include any external appendages that might be dangerous to participants; this includes pointed parts of the vehicle body. Sharp points must have a radius of 50 mm or greater; or covered with foam or a deformable material.
- The vehicle interior must not contain any objects that might injure the Driver in the event of a collision.
- The vehicle must contain a speedometer, a battery's state of charge indicator and control buttons for all vehicle functions (lights, hazards, horn.... etc.).
- Vehicles must contain an external charging port that allows battery charging without accessing the energy compartment.
- Windows must not be made of any material which may shatter into sharp shards (for example, acrylic (e.g. Plexiglass) is not allowed). Polycarbonate (e.g. Lexan) is the recommended window material.
- The energy compartment (engine/motor/transmission/battery, etc.) should be easy to access for quick inspection.
- All parts of the drive train, including batteries, controllers, motors, converters, etc. must be within the confines of the body cover.
- All objects in the vehicle must be securely mounted. Bungee cords or other elastic material are not permitted for securing heavy objects like batteries.
- All vehicles must have a solid floor and frame that prevent any part of the driver and passenger's bodies from contacting the ground.





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- It is prohibited to use any commercially available vehicle body parts, this includes headlamps, taillights that corresponds to a certain manufacturers model.

ARTICLE 2: VEHICLE PROPULSION SYSTEM

- Teams must choose their propulsion system individually according to the following rules:
 - Motor specifications:
 - Motor Type: Hub or regular.
 - Rated Power: minimum of 4000W – maximum 20000W in total.
 - 4-wheel drive is not allowed.
 - Battery Specifications:
 - Maximum voltage 96v
 - Batteries must be sourced as a package, cells that are connected together and then cased are not allowed.
 - Batteries must contain a BMS that protects against the following:
 - Over-current during charging or discharging.
 - Over-voltage (during charging).
 - Under-voltage (during discharging)
 - Over-temperature
 - Under-temperature
 - Ground fault or leakage current detection
 - Batteries must also have built-in high-quality connectors i.e. (Andersons).





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ARTICLE 3: POWER TRAIN AND ENERGY SOURCES

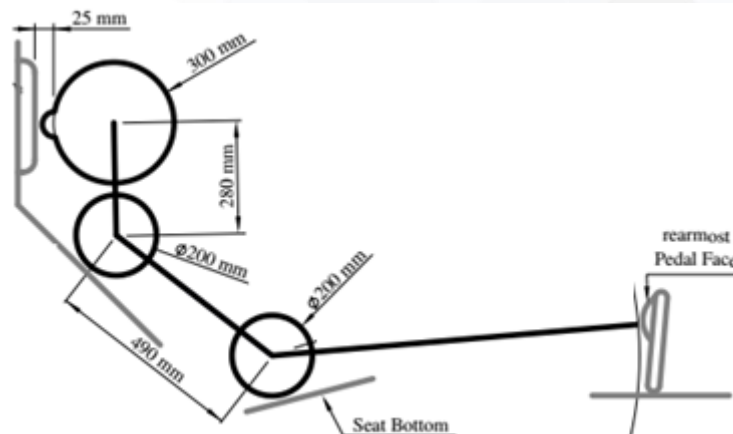
- The vehicle must be completely electric, all power must be provided through the batteries.
- No hybrid powertrains are allowed.
- Solar panels are prohibited.
- Teams must provide proper documentation for the electric kit that meet set specifications.

DRIVER AND PASSENGER COMPARTMENT

ARTICLE 4: ERGONOMICS AND COMFORT

- The vehicle must have two seat design one for the driver and one for the passenger.
- There must be a minimum distance of 200 mm between the driver and passenger when seated in an upright position.
- Driver and passenger seats must be identical in shape and to have at least 500 mm in width.
- The passenger compartment width should be at least 1200 mm.
- The passenger compartment height should be at least 850 mm.
- When seated normally (upright position) and restrained by the restraint system, the helmet of a 95th percentile (shown in the fig.) male and all of the team's drivers must obey the following:





- All the dimensions and the regulations of the 95th percentile must apply to the driver and passenger seats.
- Be a minimum of 50 mm away from the top of the main hoop.
- The 95th percentile male is represented by a two-dimensional figure consisting of two circles of 200 mm diameter (one representing the hips and buttocks and one representing the shoulder region) and one circle of 300 mm (representing the head with helmet).
- The two 200 mm circles are connected by a straight line measuring 490 mm. The 300 mm circle is connected by a straight line measuring 280 mm with the upper 200 mm circle.
- The Drivers 95th percentile must be positioned in the vehicle following:
 - The seat adjusted to the rearmost position.
 - The pedals adjusted to the front most position.
 - The bottom 200 mm circle placed on the seat bottom. The distance between the center of the circle and the rearmost actuation face of the pedals must be minimum 800 mm.
 - The middle circle positioned on the seat back.
 - The upper 300 mm circle positioned 25 mm away from the bulkhead.
- Both drivers' weight must be more than 60kg, the driver weight is defined as the weight of the person driving the vehicle including full driving gear and communication devices. If the driver weight does not



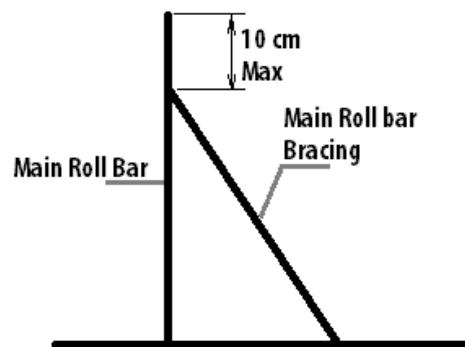
meet the minimum weight requirement he will not be allowed to drive.

ARTICLE 5: CHASSIS AND MONOCOQUE

- Teams must ensure that the vehicle chassis or monocoque is designed wide and long enough to effectively protect the driver and passenger bodies in the event of a collision including front impact, side impact, and/or vehicle rollover. The Organizers will not allow any vehicle whose construction appears unsafe.
- The vehicle chassis must be equipped with an effective roll bar that extends 50 mm above the occupants' helmets when seated in normal driving position with the safety belts fastened.
- If this position impairs the driver visibility it will be deemed that the roll bar is not adequate. The effectiveness of the roll bar and driver's visibility will be validated simultaneously, i.e., the driver must not be in such position that he or she must raise their head or torso above the roll bar to pass the visibility test.
- The roll bar must extend in width beyond the driver and passenger shoulders when seated in normal position with the safety belts fastened.
- Teams may use a tubular or panel roll bar. If a tubular roll bar is used, it must be made of metal. A panel roll bar is the rigid partition separating the cockpit from the energy compartment, and it must be integrated into the vehicle chassis or monocoque.
- The roll bar must be able to withstand a static load of 10KN in the vertical direction F_z , 6KN in both lateral F_y and longitudinal F_x directions, without notable deformation.
- If the vehicle must be lifted at a specific place on its body, it should be clearly marked with a rectangular box stating, "LIFT HERE".
- Minimum Area moment of Inertia for the tubes used in chassis is 7800 mm^4 .
- Roll Bar must be fabricated from one continuous steel tube, with a minimum thickness of 2 mm.



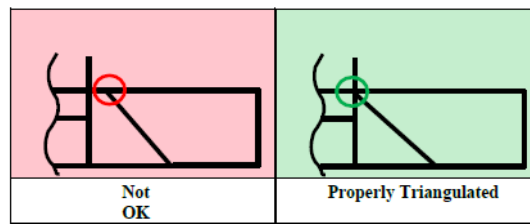
- Aluminum roll panels are allowed given that the roll hoop is covered from the front and rear with an aluminum sheet with thickness that can withstand required forces proven by the SER. The panel welding must be continuous stitch welding with welds of 10 cm long and separations.



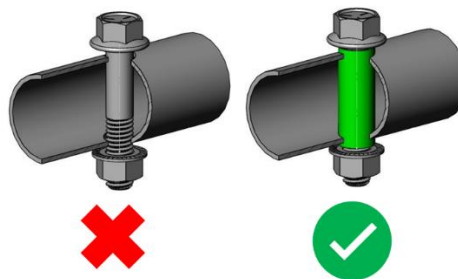
- As shown in the above Figure, the maximum distance between the top of the main roll bar to the top of the bracing support tube, MUST not exceed 10 cm.
- The chassis tubes must follow the following minimum dimensions for each section (or as recommended by the SER)
- For a specific application using tubing of the specified outside diameter but with greater wall thickness, or of the specified wall thickness and a greater outside diameter or replacing round tubing with square tubing of the same or larger size to those listed below, are NOT rules deviations requiring approval.

ITEM or APPLICATION	OUTSIDE DIMENSION x WALL THICKNESS
	Metric
Main & Front Hoops, Shoulder Harness Mounting Bar	Round: 25.0 mm x 2.50 mm
Side Impact Structure	Round: 25.0 mm x 1.75 mm
Roll Hoop Bracing	Square: 25.0 mm x 25.0 mm x 1.25 mm
Front Bulkhead	Square: 26.0 mm x 26.0 mm x 1.2 mm
Driver's Restraint Harness Attachment (except for Shoulder Harness Mounting Bar)	
Main Hoop Bracing Supports	Round: 25.0 mm x 1.5 mm
Front Bulkhead Supports	Round: 26.0 mm x 1.2 mm
Protection of Tractive System Components	

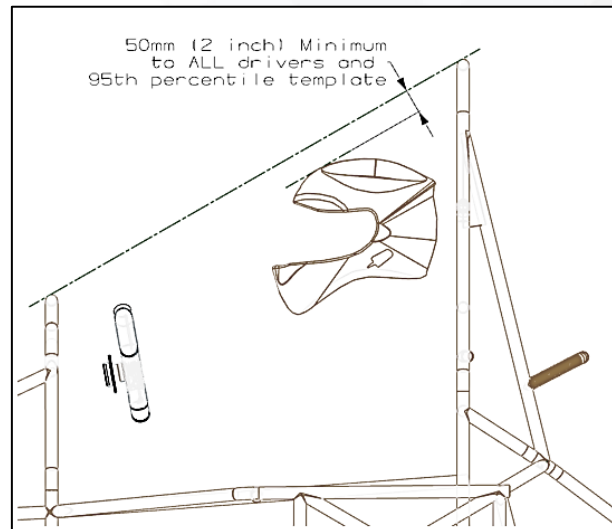
- All chassis triangulations must be done properly as shown in the image below.



- All holes drilled through the main chassis structure must be supported by a welded bushing through the hole as shown in the figure below.



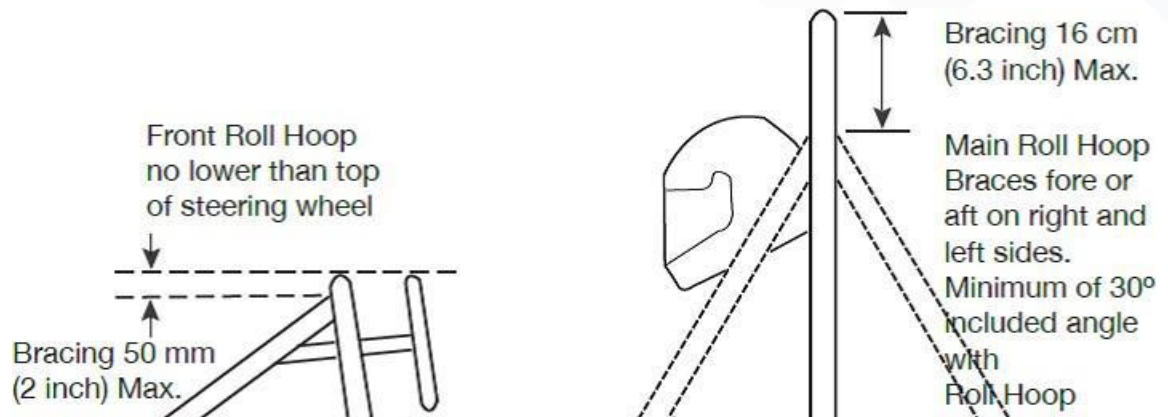
- All teams must submit a Structural Equivalency Spreadsheet (SER) (exact document will be communicated) even if they are not planning to use alternative materials or tubing sizes to those specified.
- Main hoop design:
 - The occupants head and hands must not contact the ground in any rollover attitude.
 - The Frame must include both a Main Hoop and a Front Hoop
 - The helmet clearance must follow the shown image.



- In the side view of the vehicle, the portion of the Main Roll Hoop that lies above its attachment point to the Major Structure of the Frame must be within ten degrees (10°) of the vertical.
 - In the side view of the vehicle, any bends in the Main Roll Hoop above its attachment point to the Major Structure of the Frame must be braced to a node of the Main Hoop Bracing Support structure with tubing meeting the requirements of Roll Hoop Bracing.
- Front hoop design
 - The Front Hoop must be constructed of closed section metal tubing.
 - The Front Hoop must extend from the lowest Frame Member on one side of the Frame, up, over and down to the lowest Frame Member on the other side of the Frame.
 - The top-most surface of the Front Hoop must be no lower than the top of the steering wheel in any angular position.
 - The Front Hoop must be no more than 250 mm forward of the steering wheel. This distance shall be measured horizontally, on the vehicle centerline, from the rear surface of the Front Hoop to the forward most surface of the steering wheel rim with the steering in the straight- ahead position.
- Main hoop bracing
 - Main Hoop braces must be constructed of closed section steel tubing.
 - The Main Hoop must be supported by two braces extending in the forward or rearward direction on both the left and right sides of the Main Hoop.
 - In the side view of the Frame, the Main Hoop and the Main Hoop braces must not lie on the same side of the vertical line through the top of the Main Hoop,

i.e. if the Main hoop leans forward, the braces must be forward of the Main Hoop, and if the Main Hoop leans rearward, the braces must be rearward of the Main Hoop.

- The Main Hoop braces must be attached as near as possible to the top of the Main Hoop but not more than 160 mm below the top-most surface of the Main Hoop. The included angle formed by the Main Hoop and the Main Hoop braces must be at least thirty degrees (30°).



- The Main Hoop braces must be straight, i.e. without any bends.
 - The attachment of the Main Hoop braces must be capable of transmitting all loads from the Main Hoop into the Major Structure of the Frame without failing. From the lower end of the braces there must be a properly triangulated structure back to the lowest part of the Main Hoop and the node at which the upper side impact tube meets the Main Hoop. This structure must meet the minimum requirements for Main Hoop Bracing Supports or an SES approved alternative. Bracing loads must not be fed solely into the motor or through suspension components.
- Front impact structure
 - The driver's feet and legs must be completely contained within the Major Structure of the Frame. While the driver's feet are touching the pedals, inside and front views no part of the driver's feet or legs can extend above or outside of the Major Structure of the Frame.
 - Bulkhead
 - The Front Bulkhead must be located such that the soles of the driver's feet, when touching but not applying the pedals, are rearward of the bulkhead plane. (This plane is defined by the forward-most surface of the tubing.) Adjustable pedals must be in the forward most position.
 - The Front Bulkhead must be securely integrated into the Frame.

- The Front Bulkhead must be supported back to the Front Roll Hoop by a minimum of three (3) Frame Members on each side of the vehicle with one at the top, one (1) at the bottom, and one (1) as a diagonal brace to provide triangulation.
- Side impact structure
 - The Side Impact Structure for tube frame cars must be comprised of at least three (3) tubular members located on each side of the car while seated in the normal driving position.
 - The upper Side Impact Structural member must connect the Main Hoop and the Front Hoop. With a 77 kg driver seated in the normal driving position all of the members must be at a height of at least 300 mm above the ground.
 - The lower Side Impact Structural member must connect the bottom of the Main Hoop and the bottom of the Front Hoop. The lower frame rail/frame member may be this member if it meets the diameter and wall thickness requirements.
 - The diagonal Side Impact Structural member must connect the upper and lower Side Impact Structural members forward of the Main Hoop and rearward of the Front Hoop.

ARTICLE 6: OVERALL DIMENSIONS

- The total vehicle height must be a minimum of 1100 mm.
- The total vehicle width, excluding rear view mirrors, must be a minimum of 1300.
- The total vehicle length must be between 2200 mm and 3500 mm.
- The track width must be at least 1000 mm for the front axle and 1000 mm for the rear axle, measured between the midpoints where the tires touch the ground.
- The wheelbase must be at least 1400 mm.
- The ground clearance must be at least 100 mm with the driver and passenger in the vehicle.
- All vehicle dimensions must not be achieved by body extensions such as 'stuck-on' appendages or cut-outs.



ARTICLE 7: BODY AND ACCESS

- The vehicle body must be on-par with the urban style vehicles with respect to the general dimensions rules, ex:



- **The vehicle body must be made out of panels. The panels should have at least, hood, trunk, two doors and at least three other panels.**
- **Single shell body is not allowed.**
- **The gaps between the body panels must not be more than 15 mms in width throughout the intersection of any two or more panels with all the panels in closed position.**
- **The flush between each two adjacent panels must be no more than 5 mm.**
- **There must be at least 50 mm tolerance between the wheels and body parts at resting position.**
- **The edges of the body panels must remain inside the overall shape of the body.**
- **All body panels should be attached to the frame, some panels maybe attached to other panels If they can withstand the forces mentioned below within deformation limitation.**
- **The upper bound of the bumpers must not be extended more than 100mm from the headlights/taillights vertically.**
- **The outer most bounds of the front bumpers shall not be extended more than 600 mm longitudinally from the fronts of the front tires.**

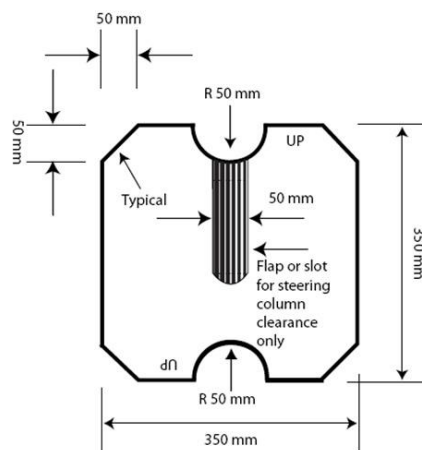




- **The outer most bounds of the rear bumpers shall not be extended more than 400 mm longitudinally from the rearmost part of the rear tires.**
- **Rear or front fenders covering the outer bound of the wheels are not allowed.**
- **Rear and front fenders are not allowed to be a single part.**
- **Hood must not be extended laterally outbound of the side front fender.**
- **Any body panel must be able to withstand a force of 50N applied in any direction at any point and not deflect more than 25mm.**
- **If any vehicle on track is observed to have large, uncontrolled movements of bodyworks, the car may be excluded from that run and prevented from further running until any issue identified is rectified.**
- The body must cover all mechanical parts whether the vehicle is viewed from the front, the rear, the sides or from above. In addition, the wheels and suspension must be fully covered by the body when seen from above and up to the axle center line when seen from front or rear. The covering for the wheels and suspension must be a rigid integral part of the vehicle body.
- Access to the vehicle by the Driver or passenger must be as easy and practical as typically found in common production type passenger cars. All vehicles must have a two side-door design. The door opening must have a minimum dimension of 500 x 800 mm. A rectangular template of this dimension must be able to pass through the door opening, and it will be measured at the scrutineering. The door opening includes all areas accessible to the driver or passenger on vehicle entry or exit.
- Both doors must be equipped with a metallic sub-frame attached to the vehicle main chassis in two hinging points and with a positive locking mechanism accessible from inside and outside the vehicle and a handle to open and close the door.



- The doors subframe must be designed to withstand a static load of 700N from inside or outside without any notable deformation.
- Any access opening mechanisms must be firmly attached to the door subframe by means of operable opening and locking mechanism similar to commercially available urban vehicles. Adhesive tape, Velcro, or similar materials are not permitted for this purpose.
- The cockpit in both driver and passenger sides must provide a free internal cross section sufficient for the template shown in the following figure to pass from the cockpit opening to a point 100 mm rearwards of the face of the rearmost pedal in an inoperative position. The template may be moved up and down. Adjustable pedals must be in their most forward position.



- Space must be available for a rectangular rigid luggage with dimensions of 500 x 400 x 200 mm (L x H x W) or equivalent volume. This space must be easily accessible from the outside and must include a floor and sidewalls to hold the luggage in place when the vehicle is moving. The luggage must be supplied by the Participant and must be placed in this space during inspection and competition.
- A towing hook or ring is mandatory at the front and rear of the vehicle. It should be easily accessible. It must be used to tow the vehicle in case of breakdown on the track. It must have a traction resistance equivalent to the weight of the vehicle and have an opening width of at least 30 mm.

- Strap towing hook are not allowed, towing hooks must be of rigid construction and must be rigidly fixed to the vehicle chassis.
- Towing hooks are recommended to be as in the following image:



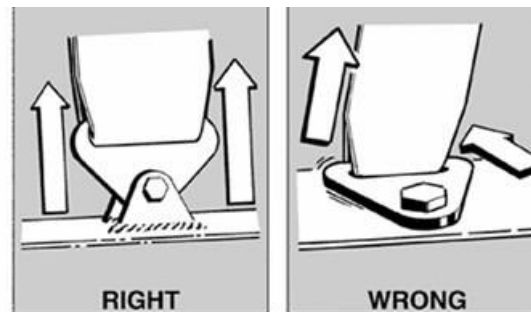
- Aerodynamic appendages, which adjust or are prone to changing shape due to wind, are not allowed.
- Vehicle body panels must be rigid and may not change shape due to wind.

ARTICLE 8: HARNESS

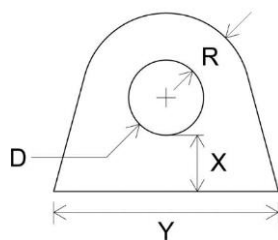
- All drivers must use a 6-point restraint harness meeting the following specifications:
 - The material of all straps must be in perfect condition.
 - There must be a single release common to the lap belt and shoulder harness using a metal-to-metal quick release type latch.
 - To accommodate drivers of differing builds, all lap belts must incorporate a tilt lock adjuster (“quick adjuster”). A tilt lock adjuster in each portion of the lap belt is highly recommended. Lap belts with “pull-up” adjusters are recommended over “pull-down” adjusters.
 - The six independent belts must be firmly attached to the vehicle’s main structure and be fitted into a single buckle, specifically designed for this purpose.
- The mounting points should be fitted so that the belts will self-align with the direction of the load.



- The mounting point must meet the required bolt dimensions specified by the seatbelt manufacturer.
- The mounting point must be at least twice the thickness of the harness mount If made from steel and four times If made from aluminum.
- The mounting point must not be in shear loading.
- The mounting point must be as in the image below or a similar concept.

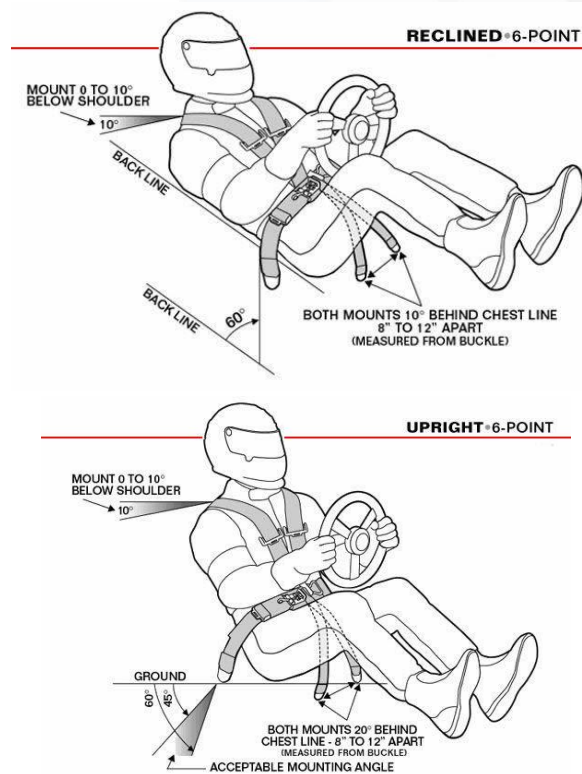


- Mounting point brackets must be within the dimensions in the following image (for latch type seatbelts dimension (D) must be followed. However, for bolted connections dimension (D) must be as per seatbelt manufacturer recommendation):

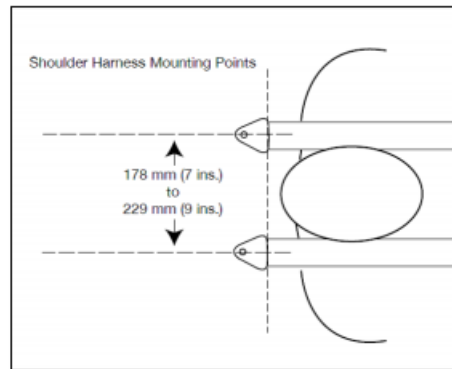


Dimension	Symbol	Minimum	Maximum
Tab Thickness	None	8 mm (0.31 in.)	9.5mm (0.375 in.)
Hole Diameter	D	25.4 mm (1.0 in.)	31.75 mm (1.25 in.)
Hole-to-Tube Offset	X	19.0 mm (0.75 in.)	25.4 mm (1.0 in.)
Edge Distance	R	15.9 mm (0.625 in.)	25.4 mm (1.0 in.)
Width at Frame Connection	Y	76.2 mm (3.0 in.)	Unrestricted
Material	None	Steel 1018	

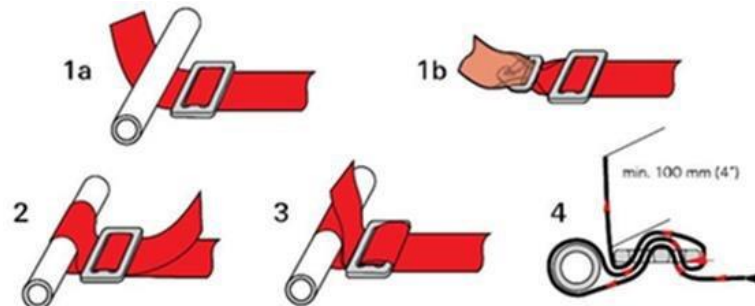
- The seat belt mounting points should follow the directions in the following photos:



- The safety harness must prevent any upward or forward motion of the Driver's torso. Any slack in the harness must be adjusted by using the seat belt length adjuster. The adjuster must be located as close as possible to the connection point. The crotch strap mounting point should be underneath the body and the topmost straps should be at an angle of approximately 10° below the top of the Driver's shoulder.
- The safety harness must always be worn tight and fastened to prevent the Driver from having free movement when the vehicle is in motion.
- The shoulder harness width must be as follows:



- The safety harness must be tucked using the next steps.



ARTICLE 9: PROPULSION AND ENERGY STORAGE SYSTEM ISOLATION

- A rigid Bulkhead must completely separate and seal the vehicle's propulsion and energy storage systems from the driver's compartment.
- A bulkhead is an upright partition separating the passenger compartment from the energy compartment. All batteries, motors, controllers must be placed outside the passenger compartment behind the bulkhead. The purpose of this bulkhead is that in the event of a fire or battery release incident, it prevents liquids and/or flames from reaching the passengers. Avoid having any gaps or holes between the body and the bulkhead. It is recommended to seal gaps with materials such as metal/aluminum sheeting or aluminum tape.
- The bulkhead must be able to protect the occupants from an open flame in the energy compartment.





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- The bulkhead must prevent manual access to the energy compartment by the Driver.
- If holes are made in the bulkhead to pass through wires or cables it is essential that the wires and cables are protected by a grommet or similar protective material to prevent chafing or damage. All gaps and holes must be filled.

ARTICLE 10: VISIBILITY

- The Driver must have access to a direct arc of visibility ahead and to 90° on each side of the longitudinal axis of the vehicle. The Driver's field of vision must be achieved without aid of any optical or electronic devices. Movement of the Driver's head within the confines of the vehicle body to achieve a complete arc of vision is allowed, but the driver's helmet must always be 50 mm below the roll bar.
- The vehicle must be equipped with a rear-view mirror on each side of the vehicle, each with a minimum surface area of 2500 mm² (e.g. 50 mm x 50 mm). An electronic device may not replace a rear-view mirror.

ARTICLE 11: VEHICLE ACCESS

- It is imperative for Drivers, fully harnessed, to be able to vacate their vehicles at any time without assistance in less than **5** seconds.
- The opening release mechanism of the driver compartment must be easily and intuitively operable from both inside and outside the vehicle. The method of opening from the outside must be clearly marked by a red arrow and must not require any tools.
- The opening mechanism must not be prone to self-opening due to vehicle vibration or movement.
- It is forbidden to use adhesive tape to close the doors opening from the outside.



ARTICLE 12: HORN

- Each vehicle must be equipped with an electrically powered horn typically used in current automobiles. Bike or cycling horns are not permitted.
- The horn must be mounted at the front of the vehicle without obstruction.
- When the vehicle is in normal operating condition, it must emit a sound greater than 85 dBA when measured 4 meters horizontally from the vehicle. The horn must produce a continuous single tone sound when activated (chirping or siren like tones are not permitted).

ELECTRICAL SYSTEM

ARTICLE 13: EMERGENCY SHUTDOWN

- The purpose of the emergency shutdown system is to disable the propulsion system of the vehicle.
- The emergency shutdown mechanism must provide a physical isolation of the propulsion battery from the vehicle electrical system. If relays are used, the relays must be a normally open contact type. The use of a power controller or other logic systems to drive an isolation device is not permitted.
- There must be both an internal and an external shutdown mechanism.
- The internal emergency shutdown mechanism is for driver operation and may be designed in any effective way.
- The external emergency shutdown mechanism must be at the rear of the vehicle and permanently installed on a non-detachable part of the bodywork.
- A standard sticker (Blue triangle with red electrical arc) must be positioned on the vehicle body to clearly indicate the exterior position of the emergency shutdown actuator.





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- The external emergency shutdown mechanism must be achieved by means of a latching red push button, which can only be re-activated by rotating it. Push/pull levers are not accepted.
- In addition to the above devices, all vehicles must be equipped with a “dead man’s safety device” or sometimes referred to as “operator presence control.” The purpose for this device is to ensure that in case the driver becomes incapacitated the vehicle’s propulsion power is automatically. This device may consist of a spring-loaded hand operated accelerator or foot pedal lever. An electric dead man switch is permissible if the switch is located on the steering wheel. If an electric dead-man switch is used the driver must directly (for example by thumb or index finger) engage the switch continuously while driving.

ARTICLE 14: VEHICLE ELECTRICAL SYSTEMS

- Only Lithium-based batteries are permitted as electric storage devices.
- Batteries must never be left to charge unattended.
- Electrical schematics must be presented in the design report.
- All electrical circuits must be fuse protected.
- Electrical wiring should be in good condition, neat, clearly labeled, secured and not close to any moving object (e.g. wheels, chains, driver).
- Front head light and rear running light must be active whenever the driver turns on the motor controllers (propulsion system).
- The tractive system or High Voltage (any voltage greater than 40VDC) must be completely isolated from chassis (do not use the chassis as the negative terminal).
- The accessory circuit may be grounded to chassis.
- All wiring associated with the accessory circuit must be clearly distinguishable from the propulsion system by physical isolation or





the use of different wire colors. all wires and cables joints should be well isolated.

- The Lithium based battery must be equipped with a solid metal containment tray under the battery OR the battery must be enclosed in a battery charging bag. Either the tray or bag must be suitable to prevent the battery, in the event of a battery fire, from burning through the battery mounting or the vehicle body and dropping to the ground.
- The battery temperature must be within its operation limits during driving and charging by either ventilation (passive cooling) or fans (active cooling).
- Energy meter should be located between the vehicle electrical system and the battery, the energy meter must be inaccessible to the driver and will be reset by the organizers only during the event.
- The tractive system motor(s) shall be connected to the battery through a motor controller.
- Commercially available motor controllers containing boost converters that have internal voltages greater than 300 VDC may be used provided the unit is approved by the rules committee.
- The accelerator control must be a right-foot-operated foot pedal and the Traction Motor controller must be actuated by a foot pedal.
- Housings and/or covers must prevent inadvertent human contact with any part of the tractive system circuitry. This includes people working on or inside the vehicle. Covers must be secure and adequately rigid. Body panels that must be removed to access other components, etc. are not a substitute for enclosing tractive system conductors.
- The location and placement of the energy meter will be verified during technical inspection.
- Tractive system components and wiring must be mechanically protected from damage by rotating and/or moving parts.





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- Every housing or enclosure containing parts of the tractive system must be labeled with the words “Danger”, “High Voltage” and a black lightning bolt on a yellow background. The label must be at least 4 x 6 cm.
- All tractive system wiring must be done to professional standards with adequate strain relief and protection from loosening due to vibration etc.
- Soldering in the high current path is prohibited.
- All tractive system wiring that runs outside of electrical enclosures must be either: Orange/Red shielded, dual-insulated cable rated for automotive application, at least 5 mm overall cable diameter. Or Enclosed in ORANGE non-conductive conduit.
- All wires, terminals and other conductors used in the tractive system must be sized appropriately for the continuous rating of the fuse which protects them. Wires must be marked with wire gauge, temperature rating and insulation voltage rating.
- The low voltage system must not be more than 13.5V.
- An accessory 12V battery may be used to operate all the auxiliaries.
- The accessory voltage battery must be completely separate from the HV system.
- Interaction between tractive system and low voltage accessories must be by means of galvanically isolated devices such as opto-couplers, transformers, digital isolators or isolated dc-dc converters.
- The vehicle must have a functional external lighting system, including:
 - Two front headlights
 - Two front turn indicators
 - Two rear turn indicators
 - Two red brake lights in the rear
 - Two red rear running lights





- The center of each headlight unit must be located at an equal distance and at least 300 mm from the centerline of the vehicle.
- A Hazard light function must be included in the vehicle system.
- Rear running lights and front headlights must always be turned on when the propulsion system is active. Propulsion systems must always be turned off in the paddocks and the surrounding area. Propulsion systems may be only active on the track.
- The front and rear lighting systems must provide enough visibility at night.

VEHICLE DYNAMICS

ARTICLE 15: TURNING RADIUS AND STEERING

- Vehicle steering must be achieved by one system operated with both hands using a turning motion. It must be precise, with no play or delay. Steering must be operated only through the front wheels.
- Steering must be achieved using a steering wheel or sections of a wheel with a minimum diameter of 250 mm.
- Steering bars, tillers, joysticks, indirect or electric systems are not permitted.
- The steering system must not have any free play.
- The turning radius of the vehicle must be like a regular commercial urban sedan. The turning radius is the distance between the center of the circle and the external wheel of the vehicle. The vehicle must be able to navigate a slalom set up by the organizers. The steering system must be designed to prevent any contact between tire and body or chassis.
- The Organizers reserve the right to set up a vehicle handling course to verify the following when the vehicle is in motion: driver skills, turning radius and steering precision.



ARTICLE 16: SUSPENSION SYSTEM

- The vehicle must be fitted with a suspension system that is operable in the front and rear axle.
- The wheels must have at least 50 mm effective travel, and a minimum of 25 mm jounce with the driver seated.
- All suspension system mounts must be visible to the inspectors.
- All suspension system components must be inaccessible to the driver.

ARTICLE 17: WHEELS AND TIRES

- The rims must be between a minimum of 13 inches.
- The wheels located inside the vehicle body must be made inaccessible to the Driver by a bulkhead. Any handling or manipulation of the wheels is forbidden from the moment the vehicle arrives at the starting line until it crosses the finish line.
- Tires must fit the type and size of rims recommended by their manufacturers and have a minimum tread of 1.6 mm. The tire/rim assembly must have a width of 80 mm at least, measured from tire sidewall to tire sidewall. The width is measured with the tire fitted on its rim at its rated pressure.

ARTICLE 18: BRAKING

- The vehicle must be equipped with a hydraulic brake system with actuation on each wheel, with a single brake pedal, which has a minimum surface area of 2500 mm². The brake pedal must operate the master cylinders either directly or through a rigid mechanical link. Wires/cables are not allowed.
- The brake pedal shall be designed to withstand a force of 2000 N without any failure of the brake system or pedal box. This may be tested by pressing the pedal with the maximum force that can be exerted by any official when seated normally.



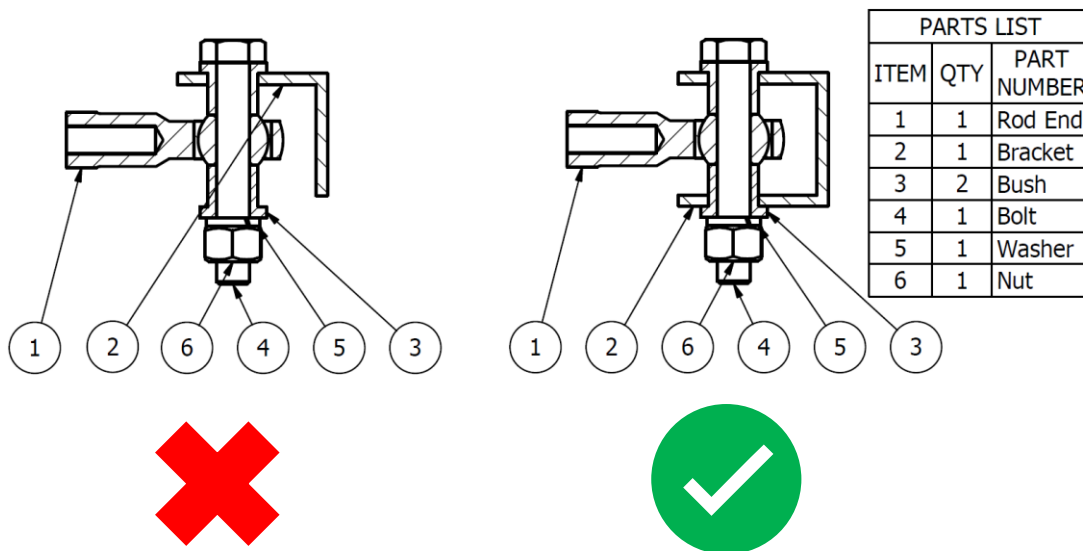
- Commercially available brake systems (discs and calipers) with a minimum disc thickness of 3 mm are mandatory. Bicycle brakes are not allowed.
- Teams may only design and manufacture the REAR discs, the FRONT disc must be commercially available.
- The brakes must operate independently on the front and rear axles or in an X pattern (i.e. right front wheel with left rear wheel and left front wheel with right rear wheel).
- A single master cylinder may be used provided it has a dual circuit. A maximum of two master cylinders is allowed.
- The effectiveness of the brake system will be tested during vehicle inspection. The vehicle must remain immobile with the Driver inside when it is placed on a 20 percent incline with the main brake in place. Moreover, a dynamic inspection will be performed on the vehicle-handling course.
- The brake system will be dynamically tested and must demonstrate the capability of locking all four (4) wheels and stopping the vehicle in a straight line at the end of an acceleration run specified by the brake inspectors.
- A parking brake function is required to keep the car stationary during technical inspections. It must provide a brake force of at least 50 N.

ARTICLE 19: FASTENERS

- Critical systems fasteners including suspension, braking, steering driver harness, primary structure must be grade 8.8 or higher.
- All fasteners must be in original condition (Grinding, cutting, removing threads are not permitted).
- Bolts may be shortened as long as a minimum of two threads are project from the lock nut.
- All fasteners of the vehicle must be secured by the use of positive locking mechanism.



- The locking mechanisms accepted are as follows
 - Safety wire
 - Cotter pins
 - Nylon or metal locknuts
 - Locking plates
 - Double nuts.
- All spherical rod ends and spherical bearings on the steering or suspension must be in double shear or captured by having a screw/bolt head or washer with an outer diameter that is larger than the spherical bearing housing inner diameter.
- All spherical rod ends must follow the exact construction of the following image:



- Adjustable tie-rod ends must be constrained with a jam nut to prevent loosening.

SUBMISSIONS

ARTICLE 20: DESIGN REPORT (DR)

- The Design Report should contain a brief description of the overall vehicle with a review and derivation of the team's design objectives.



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Any information to scope, explain or highlight design features, concepts, methods, or objectives to express the value and performance of the vehicle to the judges shall be included at the teams' discretion.

- The DR must not exceed nine pages (8-A4 and 1-A3), consisting of not more than five pages of content (text, which may include pictures and graphs) and four pages of drawings.
- The first three DR drawings (no renderings) must show the vehicle from the front, the top and the side. Each drawing must appear on a separate page.
- The final drawing page must include exploded views of:
 - Front wheel assembly
 - Motor mounting assembly (Attachment of the electrical motor to vehicle chassis)
 - Pedals assembly
 - Initial wiring diagram
- Any measures to facilitate reviewing the drawings (e.g. measurements, details, colors) may be utilized at the teams' discretion.
- Any portions of the DR that exceed five pages of content and/or four pages of drawings will not be evaluated.
- If included, cover sheets and tables of contents will count as text pages.
- The DR will be used to qualify the teams into the support package based on the quality of its review.
- Evidence of information mentioned in the DR should be brought to the competition and be available, on request, for review by the judges.
- Name the report in the form of (Uni Name_Team Name.)





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- The body of the design report must not contain any items that may identify the team other than the file name. The reader must not be able to identify the origin of the submission.
- The team faculty advisor must review and confirm that all the data simulated by the team are valid and properly evaluated.
- All teams including the previously funded teams should note:
 - Teams that fail to submit the design report will be considered forfeit.
 - Submission of poor design reports will be considered as forfeit.
 - Design reports must meet minimum engineering considerations.





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