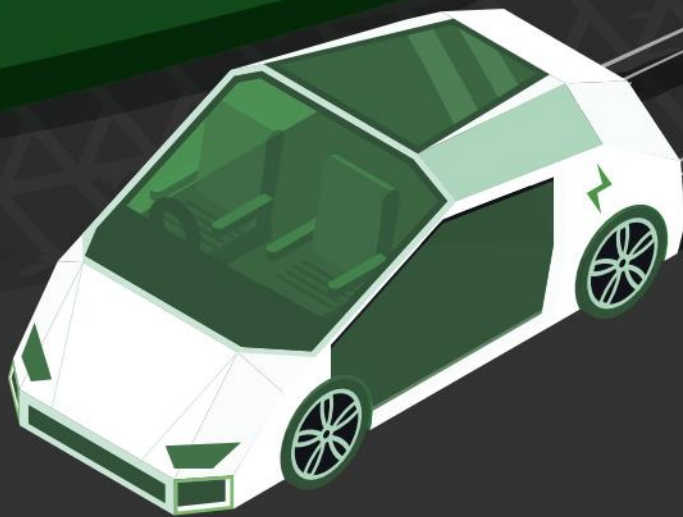




EVER V



DYNAMIC TRACK - CHAPTER 1

This document contains chapter 1 of the Electric Vehicle Rally V (Fifth Edition) rules and regulations for the dynamic track. 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
AND TECHNOLOGY

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- **New rules will be marked in RED.**
- **Existing modified rules will be marked in GREEN.**

ARTICLE 1: EQUIPMENT AND MATERIALS

Teams are required to provide and use the following at the event:

- Leather or canvas gloves for general work.
- Chemical resistant gloves.
- Safety glasses for all participants.
- Hearing protection for all participants.
- Duct tape to secure cords or cables lying on the pit floor.
- Lift stands or appropriate raised platform for vehicle tuning and repairs.
- Tools and materials.
- All electrical equipment used must be properly fused.
 - Electrical cables must be in good condition and appropriate for the equipment it is intended for.
 - High wattage electrical appliances should not be plugged into a multiple plug strip. If teams are using a multi plug strip each must have internal overcurrent protection.

ARTICLE 2: DRIVER CLOTHING

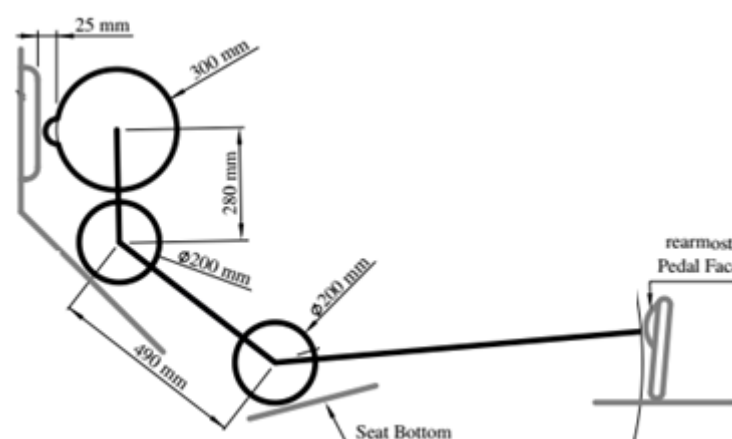
- For practice and competition, Drivers must wear full-face or three-quarter helmets suitable for motorsport activities.
- Bicycle/riding/skating/luge type helmets are not permitted. Helmet certification labels must be clearly readable.
- Helmets worn by all Drivers will be subject to inspection. Helmets should not have any indentations or cracks and should be in proper working condition as intended by the helmet manufacturer.



- All helmets must be affixed with a face shield (or visor). The face shield (or visor) must cover from the top of the face down to below the driver's nose. Tinted face shields or sunglasses to be worn under the face shield are permitted.
- The helmets must correctly fit the Driver and be secured by a chin strap. Visors should be free from scratches and have clear visibility.
- All Drivers must wear a one-piece racing suit as the outermost layer of clothing, and the racing suit must be classified as Flame Retardant Clothing (FRC).
- Drivers are not allowed to wear synthetic clothing underneath the race suit because synthetic material may melt if exposed to flames.
- Cotton shirt and underwear are recommended.
- Socks (made from cotton or FRC material) and shoes are required.
- Fire retardant gloves are required and must completely cover all fingers.
- No bare skin should be visible when the Driver is wearing the racing suit, gloves, socks, shoes and helmet.

ARTICLE 3: DRIVER WEIGHT AND COMFORT

- When seated normally (upright position) and restrained by the driver's restraint system, the helmet of a 95th percentile (shown in the fig.) male and all of the team's drivers must obey the following:





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- 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 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.
- Only the registered drivers are allowed to drive the car, no external drivers are allowed to drive.
- 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.
- Ballasts to meet minimum weight are forbidden.
- Drivers (in full driving gear, including communication devices) may be weighed before or after each attempt.
- In case of hot weather conditions, please note the following:
 - It is recommended to properly ventilate the inside of the vehicle to provide cooling to the driver.





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- It is recommended to provide sufficient drinking liquids to the driver for the duration of an attempt.
- If fluid containers are provided to the driver(s), these containers must be hands free.
- It is recommended to equip the vehicle with an effective shield from the sun.
- Regarding driver health or comfort, organizers reserve the right to restrict individual driving time by any means at their sole discretion, e.g., Shortening the distance, requesting driver change (pit stop), limit maximum number of attempts per driver per day, etc.

ARTICLE 4: VEHICLE SAFETY

- 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.
- The vehicle maximum weight excluding the driver is 320Kg. The includes the vehicle with all components and fluids, addition of any components after vehicle inspection may lead to disqualification.
- 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.
- 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.
- **Access to the energy compartment components must not be covered with plates that are unremovable or difficult to remove.**
- All parts of the drive train, including batteries, controllers, motors, converters, etc. must be within the confines of the body cover.





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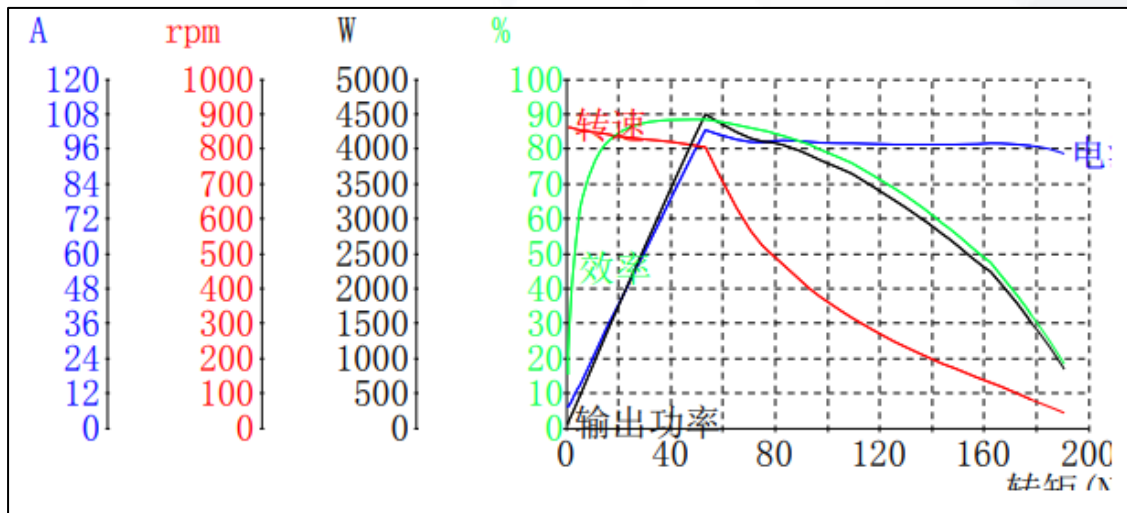
- All objects in the vehicle must be securely mounted. Bungee cords or other elastic material are not permitted for securing heavy objects like batteries.
- All vehicles must have a solid floor and frame that prevent any part of the driver's body from contacting the ground.
- It is prohibited to use any commercially available vehicle body parts, this includes headlamps, taillights that corresponds to a certain manufacturers model.

ARTICLE 5: VEHICLE PROPULSION SYSTEM

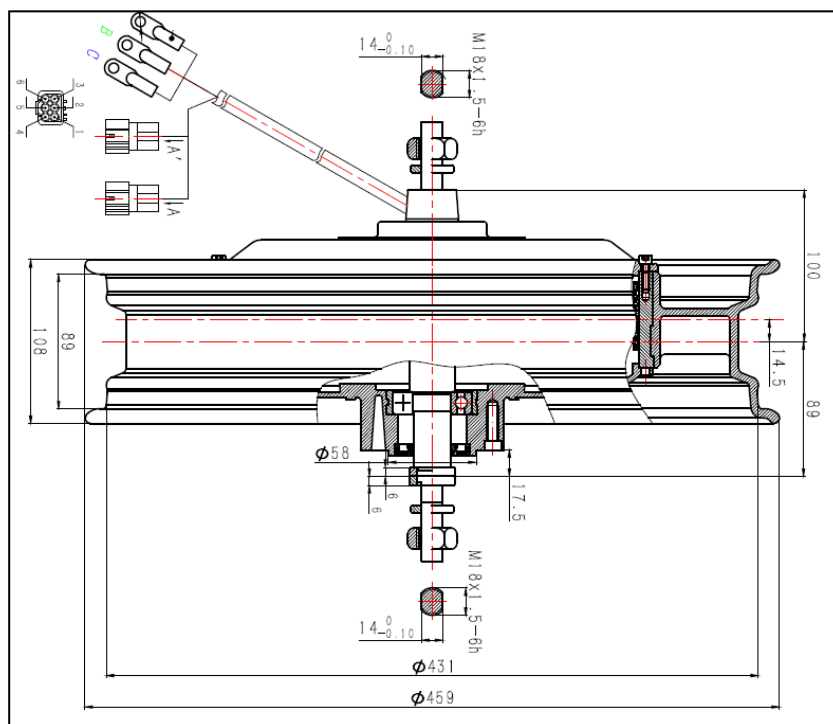
- Motor specifications:
 - Motor Type: BLDC Hub Motor with Permanent Magnets
 - Motor design: Double axel with 17inch Aluminum rim
 - Rim size:3.5×17
 - number of Pole Pairs: 16 pairs
 - Rated Power: 4000W.
 - Rated Voltage: 48v.
 - Max No-load RPM:1000RPM
 - Max Torque: 190N.m
 - Max Efficiency: 90%
 - Continuous current:67A
 - Max current:80A Peak 140A
 - Rear Fork width for installation: 200mm
 - Winding Core material: Aluminum
 - Cross Section of Phase wire: 16 mm²
 - Hall sensor phasing angle: 120 degree
 - Working Temperature: 70 degree, Peak 120 degree
 - Waterproof Grade: IP54



- G.W.: 22kgs
- Motor curves:



特征点	电压	电流	输入功率	转矩	转速	输出功率	效率
	V	A	W	N.m	rpm	W	%
不加载点(No_Load)	48.57	7.230	351.2	0.6	861	54.09	15.4
最高效率点(Eff_max)	49.48	102.7	5081	53.4	805	4501	88.6
最大输出功率点(Pout_max)	49.48	102.7	5081	53.4	805	4501	88.6
最大转矩点(Torque_max)	48.29	94.36	4557	190.6	42	838.1	18.4
结束点(End)	48.29	94.36	4557	190.6	42	838.1	18.4





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- Controller specifications:
 - Programmable
 - With regen function
 - Motor Current Limit, 10 seconds: 280A
 - Motor Current Limit, continuous: 110A
 - Battery Voltage: 24V-72V rated, 18V-90V work
 - Thermic Probe: KTY83-122
 - Operating Temperature Range: -30 to 90 (controller case temperature)
 - Shutdown Temperature: 100 (controller case temperature).
 - Single controller weight: 1.91kg
 - Single controller size: 200mmx146mmx62mm
 - Assembly Dimension: 330mmx400mm



- Battery Specifications (two batteries per vehicle):

No.	Items	Specifications
1	Nominal Voltage	25.6V
2	Nominal Capacity	80Ah
3	Cell Inside	LiFePO4 3.2V 80Ah
4	Configuration	8S1P
5	Standard Charge Current	16A (0.2C)
6	Max. Charge Current	120A
7	Battery management System (BMS)	BMS-SM8S100100-C49 (230*140*35mm) Smart BMS with Bluetooth 4.0 (Read Voltage, Current, Temperature, cycles etc)
8	Continuous Discharge Current	100A
9	Peak Discharge Current	200A
10	Full Charged Voltage	29.2V(3.65V per cell)
11	Charge Cut-off Voltage	27.5V (3.9V any single cell)
12	Discharge Cut-off Voltage	16V (2.0V per cell)
13	Net Weight	19.3kg
14	Dimensions	376*256*171mm(158mm)
15	Connector	Anderson connector
16	Operating Temperature	Charging: 0°C ~ 45°C Discharging: -20°C ~ 55°C
17	Storage Temperature	(Recommended to store 20 ± 5°C for long term storage)
18	Cycle Life	2000 times (80% of initial capacity at 0.2C rate, IEC Standard)

ARTICLE 6: 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.
- All teams will be provided with the same batteries and the same powertrain kit.





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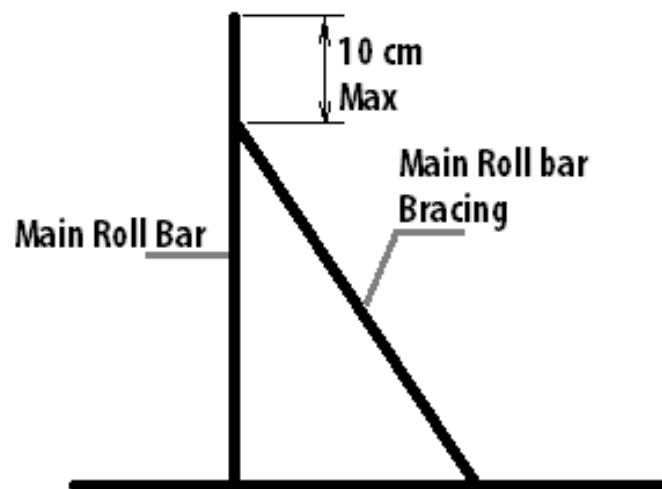
- Self-funding teams must meet the exact specifications set by the technical team.
- Teams must provide proper documentation for the electric kit that meet set specifications.
- The kit will be inspected during the pre-scrutineering phase.

ARTICLE 7: CHASSIS AND MONOCOQUE

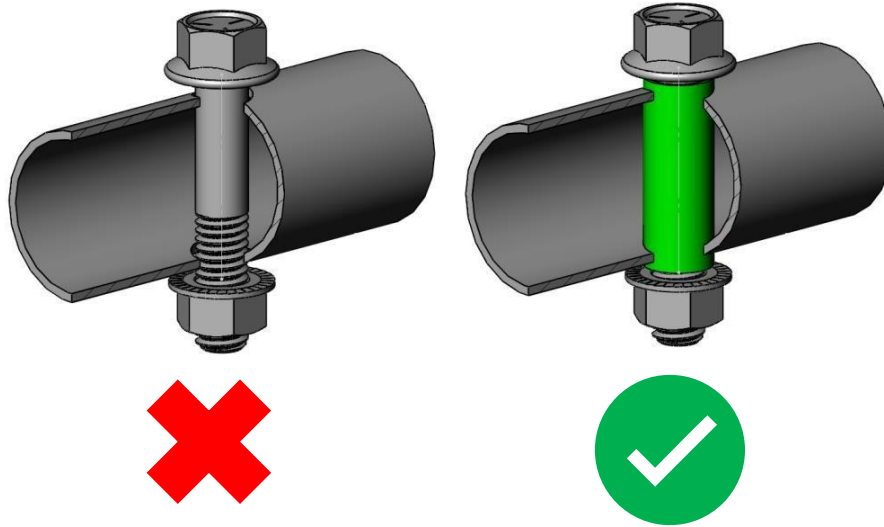
- Teams must ensure that the vehicle chassis is designed wide and long enough to effectively protect the driver's body in the event of a collision including front impact, side impact, and/or vehicle rollover. The Organizers will not allow any vehicle whose construction appears unsafe.
- **Monocoque chassis is not allowed.**
- The vehicle chassis must be equipped with an effective roll bar that extends 50 mm around the driver's helmet 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's shoulders when seated in normal driving 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 6KN in the vertical direction F_z , **3KN in both lateral F_y and longitudinal F_x directions**, without notable deformation.
- 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 5 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.
- All holes drilled through the main chassis structure must be supported by a welded bushing through the hole as shown in the figure below.
- 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".



ARTICLE 8: OVERALL DIMENSIONS

- The total vehicle height must be between 1000 mm and 1300 mm.
- The total vehicle width, excluding rear view mirrors, must be between 1200 mm and 1300 mm.
- 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 800 mm for the rear axle, measured between the midpoints where the tires touch the ground.
- The wheelbase must be at least 1200 mm.
- The Driver's compartment must have a minimum height of 880 mm and a minimum width of 700 mm at the Driver's shoulders.
- The ground clearance must be at least 100 mm with the **driver (and necessary ballast) in the vehicle.**
- All vehicle dimensions must not be achieved by body extensions such as 'stuck-on' appendages or cut-outs.

ARTICLE 9: EXTERIOR AND ACCESS

- The vehicle body must be on-par with the urban style vehicles with respect to the general dimension's 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.**



Hub

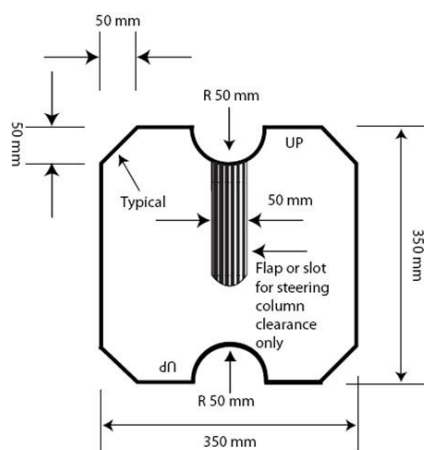


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- **Rear or front fenders covering the outer bound of the wheels are not allowed.**
- **Rear and front fenders are not allowed to be a single part.**
- **Hood must not be extended laterally outbound of the side front fender.**
- **Any body panel must 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 bodywork, 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 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 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 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.



- **The door should be rigid enough to prevent movement vertically, play of 20 mm maybe allowed.**
- Any access opening mechanisms must be firmly attached to the vehicle body 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 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.

ARTICLE 10: INTERIOR

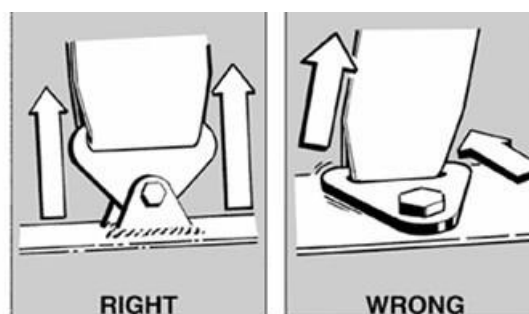
- **The interior must contain a display with at least the following information:**
 - **Vehicle speed.**
 - **Range available.**
 - **Distance travelled.**
 - **Current draw and voltage**
 - **Indicator lights**
- **The interior of the vehicle must contain a dashboard with all the control switches mounted to it.**
- **Steering wheel switched are allowed. However, a dashboard must be present as well.**
- **The driver's seat must be designed and manufactured by the team and must contain lap, shoulder and head supports.**



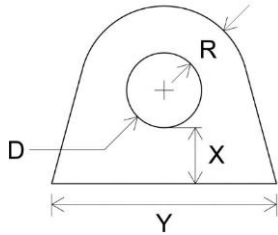
- **The dashboard panel must be able to withstand 50 N of force with maximum deformation of 25 mm.**

ARTICLE 11: 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.

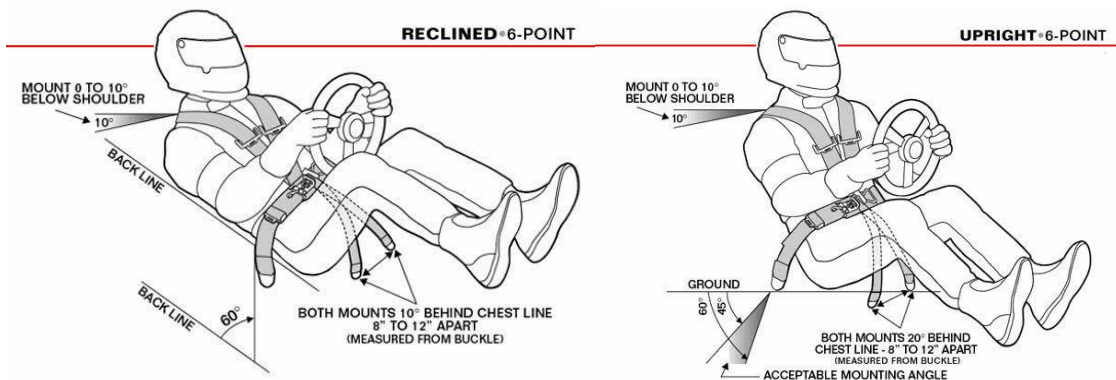


- Mounting point brackets must be within the dimensions in the following image (for latch type seatbelts dimension (D) must be followed. However, for bolted connections dimension (D) must be as per seatbelt manufacturer recommendation):



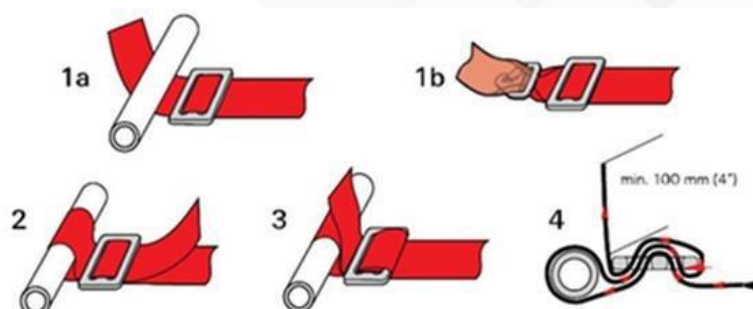
Dimension	Symbol	Minimum	Maximum
Tab Thickness	None	8 mm (0.31 in)	9.5mm (0.375 in.)
Hole Diameter	D	25.4 mm (1.0 in.)	31.75 mm (1.25 in.)
Hole-to-Tube Offset	X	19.0 mm (0.75 in.)	25.4 mm (1.0 in.)
Edge Distance	R	15.9 mm (0.625 in.)	25.4 mm (1.0 in.)
Width at Frame Connection	Y	76.2 mm (3.0 in.)	Unrestricted
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 safety harness must be tucked using the next steps.



ARTICLE 12: 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.
- **The bulkhead must be made from metal sheeting.**
- A bulkhead is an upright partition separating the driver's compartment from the energy compartment.
- All batteries, motors, controllers must be placed outside the driver's 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 driver.
- 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 driver from an open flame in the energy compartment.
- 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 13: 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 14: 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 Driver's opening from the outside.

ARTICLE 15: 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).

ARTICLE 16: 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.
- 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 17: 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 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 18: 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 19: WHEELS AND TIRES

- The rims must be between 15 to 17 inches in diameter.
- The wheels located inside the vehicle body must be made inaccessible to the Driver by a bulkhead.
- 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 at least **80** mm, measured from tire sidewall to tire sidewall. The width is measured with the tire fitted on its rim at its rated pressure.

ARTICLE 20: LIGHTING

- 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.





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ARTICLE 21: 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.
- 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.
- A dynamic inspection will be performed on the vehicle-handling course to test the brakes.
- 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 22: VEHICLE ELECTRICAL SYSTEMS

- Only Lithium-based batteries are permitted as electric storage devices.
- The vehicle must be equipped with an onboard Battery Management System (BMS) to control and protect the battery against risk of fire.
- The BMS must provide cell balancing, overvoltage, over-discharge, overcurrent, and over-temperature protection.





- The maximum voltage on board of any vehicle at any point must not exceed 48 Volts nominal and 60 Volts max (This includes on-board batteries, motor regeneration, etc.)
- Batteries must never be left to charge unattended.
- 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).
- 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 location and placement of the energy meter will be verified during technical inspection.

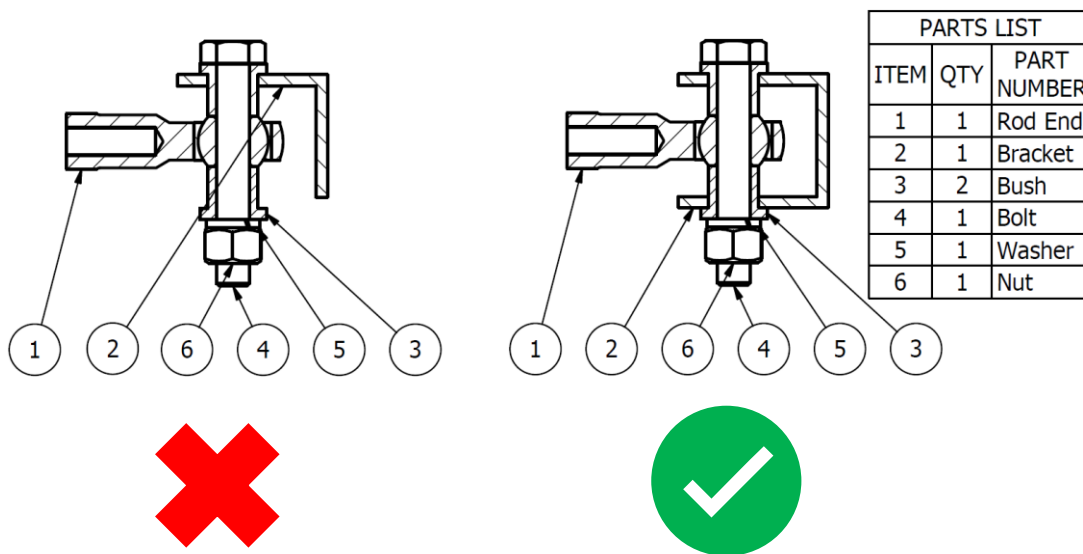


- A professional electrical engineer will be patrolling the paddocks to inspect the equipment to ensure compliance. In the event the Organizers are of the view that such tools and equipment is unsafe, the Organizers have the sole and absolute right to penalize or disqualify the team.

ARTICLE 23: 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.

ARTICLE 24: DESIGN REPORT

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





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- 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.)
- 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.
- Teams must include a simplified pie chart of the expected cost breakdown of their vehicle components.
- 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.
- Design reports must at least reflect the teams understanding of the Mentorship and Workshops sessions.





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