



Regulations for the 2018 Event

September 11, 2018

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The organizer reserves the right to modify these regulations at any time.

0.1 Acknowledgment

We would like to thank Chris Selwood and the World Solar Challenge for their great cooperation. They shared their hard work and brilliant expertise with the European Solar Challenge, as well as enabling us to found the following technical regulations on those of the World Solar Challenge. This collaboration stands for joint work and mutual interest in creating a well-functioning and fair event for every participating team.

1 Administration

1.1 Event Organizer

Green Technology Events VZW
Ambachtstraat 18
BE-3980 Tessenderlo
info@europeansolarchallenge.eu
www.europeansolarchallenge.eu

1.2 Cancellation of Event

The organizer reserves the right to cancel or abandon the event for any given reason. The organizer's liability for costs sustained by an entrant are limited to the amount of the entry fee received. In the event that teams are unable to compete in the event despite signing up and already having paid the application fee the application fee will not be refunded. Should the iESC organizers have to cancel the event, any application or shipping fees will not be refunded.

1.3 Insurance

All team members need to be personally insured for any physiological or property damage that may arise. Please also note that all drivers participate at their own risk and are not insured via the iESC organizers.

1.4 Third Party Property Damage

Cover has been arranged for any claims against the organizer for damage done by your Solar EV during the event. All arising costs are responsibility of the entrant.

1.5 Entry Fees

Application fees amount to 2250 euro, exkl. 6% taxes. Application fees cover up to 20 team members. For every additional team member, teams will be charged 20 euro. Application fees cover participants' usage of the camping grounds plus the barbecue on Thursday night.

There are no vehicles allowed on the campground other than: SolarCars during pre-scrutineering, support vehicles during buildup and teardown, campervans(as long as their footprint is in proportion to the number of people sleeping inside). Teams who need a Supportvehicle on the campground should contact the organizers in advance. Keep in mind that the campground might be very crowded. Vehicles may not leave or enter the campground during the main-event

2 Technical Regulations for the Solar EV

Explanatory notes are displayed in shaded boxes.

Notes added 6 Weeks prior to the event are displayed in orange boxes

2.1 Vehicle Classes

2.1.1 Challenger Class

Vehicles conforming to the Challenger Class specifications defined in these technical regulations.

2.1.2 Cruiser Class

Solar EVs are designed primarily for practicality. They are designed to carry two or more occupants, each facing forwards.

They will be judged on external energy use, the time taken to complete the course, payload carried, and practicality.

Every vehicle belonging to the Cruiser Class must be occupied by no less than two people at all times throughout the race.

The combined mass of the driver and its ballast must be at least 80 kg.

The combined mass of a passenger and its ballast must be at least 60 kg.

2.2 Physical Specifications

The following Regulations are compulsory for all participating vehicles, no matter which class they compete in.

2.2.1 Dimensions

When in motion, the maximum size of the vehicle is 5000 mm in length and 2200 mm in width.

When seated 'road ready' (helmet on, hatch closed), minimum height for driver's eyes is 700 mm above the road.

2.2.2 Construction

All sharp edges, chains and sprockets must be covered when in use, and internal components or cargo must be secured.

Adequate ventilation must be provided to all occupants.

All vehicles shall be constructed or adapted to protect, as far as is reasonably possible, the occupant(s) in the event of collision or vehicle roll-over. Steps should be taken to ensure that vehicle components, accessories or other components do not impinge on the occupant space.

The design and construction of the vehicle must be such that, in the event of a front-end collision, any part of the vehicle structure (especially the solar array) will be deflected away from the driver/passenger compartment.

Drivers of Challenger Class Solar EVs must be enclosed in a safety cage capable of protecting the driver from an impact of 5 G from any direction.

Cruiser Class Solar EVs must be fitted with roll bars or roll cages which meet or exceed the intent of of the Technical Regulations.

All rollbars have to withstand a 5G impact from any direction. For further details refer to [subsection 8.1](#).

2.2.3 Vision

The driver must be able to see the shaded areas shown in the diagram using the rear vision system (UNECE Regulation 46, Section 15)

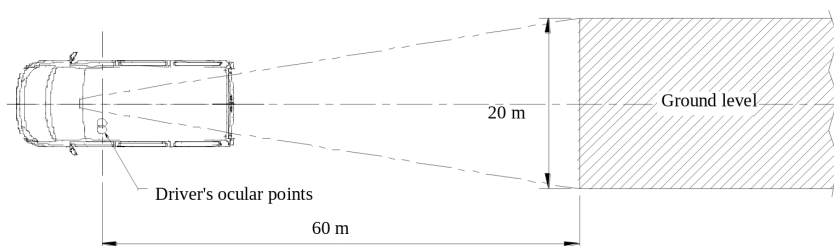


Figure 1: Vision rear mirror

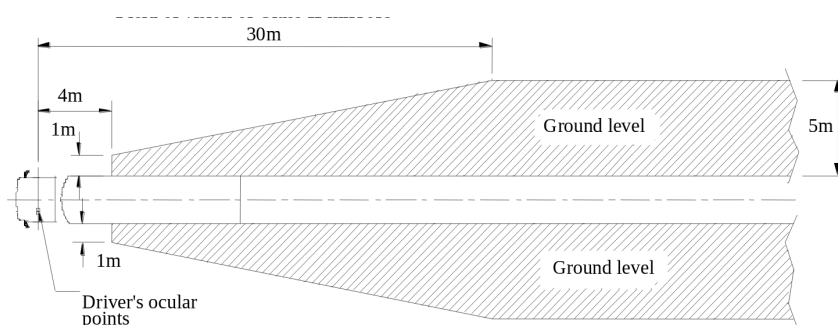


Figure 2: Vision side mirrors

Rear vision may be electronic and/or mirror. Electronic rear- vision systems must operate whenever the vehicle is in motion under its own power.

2.2.4 Windows and Windscreen

All windows must be made of a material that is highly resistant to breaking or major damage. Windows that are necessary to ensure the driver's vision must be made of glass or similar transparent material that does not distort vision.

The window may not be tinted or coloured to the extent that the condition of the driver cannot be easily observed from outside the vehicle.

Windows must have an optical transmittance not less than 75% (UNECE Regulation 43)

2.2.5 Seats

Each occupant must be provided with an appropriately constructed seat consisting of a base (squab) and backrest.

Challenger Class vehicles: The angle of the (driver's) seat must not be greater than 27°. Drivers must demonstrate the ability to sit, road ready (helmet on, hatch closed), with their back flush against the seating elements measured in accordance with the provisions of [subsection 8.2](#) of these Regulations.

The seating angle of a cruiser-class driver-seat has to comply with these regulations.

Seatbelts must be compliant with UNECE Regulation 16 or US FMVSS 571.209 and have an E or equivalent compliance marking.

Operating a vehicle in an extremely inclined position induces fatigue, prevents the driver from securing sufficient visibility, and may interfere with the effective functioning of the seatbelt in the event of collision.

Cruiser Class Solar EVs must have two or more seats, each facing forwards.

2.2.6 Doors and Openings

Challenger Class vehicles must be designed to allow occupants to enter and exit the vehicle without assistance. The doors must be able to be secured and released from both inside and outside the vehicle. Teams will be required to demonstrate that occupants can enter and exit the vehicle unassisted in no more than 15 seconds for each action.

Defining the time of entry is to encourage practicality in the chosen design.

Cruiser Class Solar EVs must be designed to allow occupants to enter and exit the Solar EV without assistance. Doors must be able to be secured and released from both inside and outside the Solar EV. Entrants will be required to demonstrate that all occupants (one per seat) can enter and exit the Solar EV unassisted in no more than 15 seconds for each action.

Passengers are not allowed to help each other when exiting the Solar EV

Emergency opening points must be clearly indicated on the exterior of the vehicle.

Securing of any egress route, canopy or hatch with adhesive tape is not permitted.

2.2.7 Emergency recovery

EV must be equipped with towing eyes mounted as close as practicable to the front and rear extremities of the vehicle, each of which, together with their mountings, must hold sufficient strength to enable the vehicle to be recovered or moved from an inoperable or dangerous situation.

The minimum inner diameter of the towing eye shall be 50 mm. Towing eyes must be painted yellow, orange or red. Covers may be used, provided they are removable without the use of tools; and endorsed either with the legend 'Recovery Point' or a graphic representation of a 'hook'. The words or graphic must be in a contrasting color to their background.

It is unlikely that the 'roll bar' would meet these requirements.

2.2.8 Brakes

The braking systems for the vehicle should be designed and modeled in accordance with sound automotive engineering practice. Experience has shown that, in general, bicycle type brakes are inappropriate to the application and are unlikely to pass ring. Note that regenerative braking does not contribute to the requirement of a dual-braking system.

The vehicle must have a balanced, dual-braking system so that if one system should fail, the vehicle can still be stopped. Mechanical (i.e. not regenerative) braking effort must be applied to at least two of the wheels.

The vehicle must be able to stop with an average deceleration of $3.8m/s^2$ from any speed that the vehicle is capable of traveling. The vehicle must demonstrate the ability to stop in 25m from 50km/h and in 12.5m from 35km/h.

All Solar EV's must be equipped with parking brakes capable of holding the vehicle (including driver) on an incline of 18°.

2.2.9 Steering

For EV's, the steering system must be controlled by a steering wheel which has a continuous circumference/perimeter (q.v. [subsection 8.3](#)).

Hip lever type steering systems are not permitted in any vehicle.

The vehicle must be able to make a U-turn in either direction within a 16 m lane (kerb to kerb).

2.2.10 Tyres

Tyres must be suitably designed and rated to withstand the loads and forces imposed by the vehicle mass, speed capability, and braking.

Tyres must have a tread pattern across the section width that normally comes into contact with the road, at least 1.5 mm deep in a band that runs continuously around the circumference of the tyre, and must be free of any apparent defect.

Tyres must, at all times, be used in accordance with their respective manufacturer's recommendations.

2.2.11 Lights and Indicators

Rear brake lamps, front and rear turn indicators, and front and rear hazard lamps are required. These must be visible in sunlight by other road users at a distance of 30 m.

Headlights and red taillights are required and must be visible in sunlight by other road users at a distance of 30m.

Solar EV's without appropriate head- or taillights are not allowed to drive during nighttime.

It is insufficient to use hazard lights as head- or taillights

2.2.12 Horn

An audible warning device (horn, hooter, klaxon, etc.) must be permanently fitted to the vehicle and demonstrated to the satisfaction of the scrutineer.

2.2.13 Compulsory Signs

The Organiser shall supply signs that carry Event and Event sponsor logos.

Unbroken, rectangular spaces, 200 mm in height x 500 mm in width must be provided on the right and left sides of the competing vehicle, clearly visible to a person standing 5 m from the vehicle.

Unbroken space 200 mm x 200 mm must be provided on the right and left sides of the competing vehicle for the purpose of competition number, clearly visible to a person standing 5m from the vehicle.

These are mandatory requirements. If, in the opinion of the Chief Scrutineer, no suitable place is provided, the vehicle will not qualify for the Event.

2.3 Electrical

All electrical equipment must be well constructed according to sound engineering practice. Where the system voltage exceeds 32 V, the vehicle must be constructed in such a way that it is impossible for any occupant of the vehicle to touch live wires or terminals, or for any person working on the vehicle to touch live wires or terminals without having first removed a protective cover.

2.3.1 Isolation

The driver must be able to electrically isolate the solar panel from the rest of the vehicle while seated in a driving position and without releasing the seat belt. Soft (e.g., MOSFET) switching is permissible.

The driver must be able to isolate electrically the battery from the rest of the vehicle while seated in a driving position and without releasing the seat belt. Soft switches are not permitted; the isolation switch must be a circuit- breaker, contactor, or other mechanical type.

2.3.2 Emergency Cutoff

For emergency use, a means of electrically isolating both the solar panel and the battery from each other and from the rest of the vehicle must be provided on the exterior of the vehicle. The activation device must be able to be operated instantly and without hesitation by someone unfamiliar with the vehicle, and without removing any panels or tape. Soft (e.g., MOSFET) switching is permissible for the solar panel. Battery isolation must be effected through the use of a mechanical device internal to the battery pack(s) (as defined in [subsubsection 2.3.8](#)).

When the battery isolation switch is 'open', the only live wires permitted to emerge from the battery packs(s) are low voltage control and sensing wires that are short- circuit protected under any reasonably foreseeable fault condition.

2.3.3 Signage

'High Voltage' warning signs must be fitted throughout the vehicle adjacent to all covers which, when removed, expose live wires or terminals where a potential of more than 32V may be present.

The activation position of the emergency isolation device must be placed within a yellow disc (minimum 180 mm diameter) clearly marked with a blue equilateral triangle containing a red flash (minimum side length 150 mm), with the legend 'Emergency Electrical Isolation'. In addition, there must be a clear instruction on how to operate the device (e.g., 'PULL' or 'PRESS'). The isolation device must be located within 50 mm of the lower edge of the windscreen on the left side of the Solar EV.



Figure 3: Emergency Electrical Isolation Sticker

2.3.4 Charging Equipment

- A Residual Current Device (RCD) must be used

- The charger's output must be electrically isolated from the input
- Charging must be stopped as soon as a single cell is above its' maximum voltage (e.g 4.2V)
- The battery monitoring system must be in operating status while charging
- The charger's output must be either permanently wired to the Solar EVs' high voltage system or connected to the energy storage system using an appropriate connector

A battery monitoring system has to monitor all cell-/module-voltages and temperatures and provide a human readable interface.

2.3.5 Energy Sources

Natural solar irradiation received directly by the vehicle is the only external energy source that may be used by the vehicle.

For charging with an external power supply see Challenge Regulations [subsection 3.10](#)

Energy recovered from the motion of the vehicle may be used.

Auxiliary panels that are deployed only when the vehicle is stationary, are not permitted.

2.3.6 Solar Array Area

For Challenger Class and Cruiser Class Solar EVs, if the solar collector uses photovoltaic cells the allowable area of photovoltaic cells is:

Class	PV Cell Chemistry	Available Total Cell Area
Challenger	Si	6.000
	Thin Film GaAs	3.560
	Multijunction	2.640
Cruiser	Si	6.000
	Thin Film GaAs	4.440
	Multijunction	3.300

Challenger Class and Cruiser Class Teams wishing to use other types of photovoltaic cells, a mix of photovoltaic cell types, or other types of solar collectors, must contact the organizer.

The area of the array will be determined by summing the exposed surface area of the component cells. Entrants must supply sufficient information to enable the scrutineers to determine compliance with this regulation. The minimum requirement is documentation showing the size and number of the component cells; the calculations summing the total area; a map with dimensions of the cells as fitted to the vehicle and a written declaration by a licensed professional in the country of origin (e.g., professional consulting engineer) that the array complies with the regulation.

2.3.7 Energy Storage

The following electrochemical terminology is used within both the General and the Technical Regulations of the 2018 European Solar Challenge.

Cell: A device that converts chemical energy into electrical energy by passing a current (a reverse flow of electrons) between a positive and a negative electrode, through an ionically-conducting electrolyte medium.

Module: A number of cells assembled as the basic unit of a battery pack.

Pack: A number of cells or modules connected together to provide the required power and energy for a given application. (No more than two packs are permitted.)

Traction Battery: The total number of cells, modules or packs connected in series or parallel.

Any energy storage device may be used. The total stored energy of these devices must meet the approval of the Chief Energy Scientist.

Temporary storage devices other than batteries (e.g., supercapacitors) must be shown to be in a fully-discharged state at the Start Line.

For Challenger Class EVs, if the energy storage system is a secondary electrochemical battery then the sum of the nominal cell masses, as specified by the cell manufacturer, may not exceed the following limits:

Li-ion	21.0 kg
Li-polymer	22.0 kg
LiFePO ₄	40.0 kg
Ag-Zn	40.0 kg
Ni-MH	70.0 kg
Ni-Zn	75.0 kg
Ni-Fe	100.0 kg
Pb-acid	125.0 kg

Ni-Cd batteries, other than those used in devices with internal batteries approved by the manufacturer, are not permitted.

If the energy storage system is not made from commercially-available secondary cells, the allowable configuration and mass will be determined by the Chief Energy Scientist.

Commercially-available instruments, computers and digital multimeters may use ancillary batteries provided that the battery is internal to the instrument and complies with the specifications set by the manufacturer of the given instrument. No external connection is allowed to such an instrument battery.

Batteries powering vehicle systems and ancillary devices (including computers, telemetry equipment, and non-commercial instrumentation) are considered to be part of the overall energy storage system and will be subject to Technical Regulation [subsubsection 2.3.7](#).

Entrants considering mixing dissimilar batteries or using more than two battery packs should contact the organizer.

2.3.8 Battery Isolation

For the purpose of the event, battery packs are defined as the outer container (box) holding a complement of cells/modules, associated internal control equipment, and safety isolation described in these Regulations.

Battery packs must be housed in boxes with lids (preferably transparent). The boxes must be removable from the vehicle in which they are installed.

Battery packs must be constructed in such manner that tamper-evident devices and seals can be applied to ensure that no cell or battery can be removed without breaking the seal.

The design of the battery box must facilitate the application seals by the provision of 3 mm holes through which strings can be passed across the top of the cells within the box. (an example of how this may be achieved is shown in the photograph in [subsection 8.4](#)).

Cell/battery monitoring must be conducted by an internal or a remote battery-management system.

Battery packs must be securely fixed to the vehicle.

Fixing by the use of cable ties is unlikely to meet this requirement.

Chemical spill-proof barriers must exist between the vehicle occupants and each battery pack.

Battery packs shall be provided with adequate airflow vented to the exterior of the vehicle.

The traction battery must not exceed two packs.

Entrants with a traction battery that consists of more than two packs should contact the organizer prior to the event.

3 Race Organization

3.1 Announcements

Official announcements (e.g. race commission meetings) can be found at the infodesk whiteboard throughout the event.

Every team is required to check for new announcements once per hour.

3.2 Race Commission

Each team needs to pick one member each to join the race commission. As detailed below, the commission will consist of one member from each team and at least one event organizer at all times. Decisions put before the race commission will be decided by majority vote, whereas the race control always holds exactly one vote.

One race control member will organize and lead the race commission, but not participate in any voting.

Failure to provide a team member to the race commission may result in a team's immediate disqualification.

The task of the race commission is to clarify discrepancies regarding the regulations.

Furthermore, the race commission will make all decisions concerning unpredictable influences on the race, such as its termination or interruption due to unfavorable weather conditions.

Each team may call for a meeting of the race commission no more than once during the event. For every further summoning, the concerning team will be charged a fee of 500 Euro each.

The only exception to the above mentioned requires all participating teams to voice the same objection. For an official application form see [subsection 8.6](#).

3.3 Race Control

The task of the race control is the event's surveillance.

Therefore, all communication channels used during the event are required to include the race control.

The race control is also in charge of decisions concerning the status of the race track, status of the flags, time penalties, and whether or not a safety car is to be present on the track at any given time.

If discrepancies arise teams may contest time penalties through the race control.

If the race control decides in favor of the team the existing penalty will be adjusted or withdrawn.

Once again the issue will be examined together.

The race control may summon the race commission at all times.

Informal complaints not concerning the Race Commission may be directly forwarded to the Race Control. These complaints need to be submitted in written form. A special letterbox for submitting will be made available at the Infodesk.

3.4 Support Vehicles

Without permission from the race control no support vehicles are allowed on the race track.

3.5 Safety Vehicles

Safety vehicles will be driven by the official event organizers of the iESC or by employees of the race track themselves (ambulance).

If a safety car is required it will drive on the track's "slow side." No two race contestants may overtake one another or the safety car on the track until the safety car reopens the track and returns to the pit lane. In the case of the yellow flag being displayed, overtaking is also not allowed.

3.6 Radio Communication

Each team has to provide a two-way channelled radio, which allows communication between the pit lane and the solar car.

The event organizers will provide an additional handheld radio for each Solar EV for communication between the race control and solar EV drivers.

All drivers should understand English sufficiently to understand essential radio commands.

Should a driver's skills in English not be sufficient for the above, the driver's team should contact the organizers prior to the event.

Due to the racetrack's topography consumer radio hardware will not be able to cover the entire track.

3.7 Entering the Race Track

Team members are prohibited from entering the track unless access is explicitly granted by the race control. Everyone entering the race track is required to wear a reflective vest at all times.

When in danger, passengers are allowed to leave the car immediately.

3.8 Pushing

Manually moving the solar car by either pushing or pulling after placing it on its starting position is not allowed. Manual movement is allowed only in the area between the pit boxes and the red line dividing the pit lane.

In case of an emergency situation, technical failure, or vehicle damage, the concerning vehicle has to be removed from the racetrack as soon as possible. In this case, teams may manually move their vehicle for the purpose of removing it from the track.

Again, teams are not allowed to enter the track without an permission. In most cases the vehicle will be removed using a tow truck provided by the iESC Organizers

3.9 Damage and Vehicle Failure

If a solar car becomes unable to continue the race, either by breaking down on the track or encountering any mechanical or electrical issues, it has to be removed from the race track as soon as possible. Any necessary repairs can only take place inside the team's pit box.

Each solar car has to carry a towrope at all times, so it may be towed by a safety car in case of it breaking down.

Every vehicle which is towed off the race track has to be reinspected before entering the race track. If a car stops on the track, the currently unfinished lap will not be counted.

3.10 Charging With an External Power Supply

During the 24-hour race each team may charge their car from mains twice. Each charging stop has to last no less than one hour. The event organizers will provide a 3 Phase 16A CEE Power Outlet (IEC 60309) for each team.

While charging it is not allowed to fix technical problems or to modify the car.

While charging, a solar car's battery containers must remain closed. All High Voltage parts must be protected from physical contact.

All single cell voltage and temperature values measured while charging need to be visible to the present observer.

Teams may actively cool their vehicle's batteries only after proving the measured temperature to be the highest of all cells.

The sentence above has lead to misunderstandings. During scrutineering teams have to prove that an airflow won't interfere with the temperature measurements in such a manner that a temperature sensor might read a lower temperature than the actual cell temperature.

Teams have to hand in a technical documentation of the battery that is going to be cooled including the following information:

- cell type and manufacturer
- cell configuration (number of cells in parallel an series)
- number and type of temperature sensors
- technical drawing or photo of the battery pack
- technical drawing of a module (including temperature sensors)

All parts that are used to cool the battery have to be fixed to the vehicle and have to stay inside during the entire event.

Teams are required to provide their battery safety equipment (including a fire extinguisher). No more than three team members may be present while charging the team's car.

Compliance with the regulations concerning cooling the batteries will be ensured during the scrutineering process.

Charging time is measured from the time at which the vehicle stops in the designated spot.

3.11 Solar Charging

Teams may charge their vehicle's batteries using solar power at any time. Any alignment of the panels is only allowed in the designated charging area. The charging area's location will be announced during the event.

3.12 Driver Changes

Changing a vehicle's drivers has to last no less than 5 Minutes.
Within this time an observer checks the function of the vehicle's horn and lights.

Teams should report their driver changes to the observers one lap in advance.
No more than four teams may switch their vehicles' drivers at a time.
Once a team announces a driver change to the observers, one of the four existing changing slots is immediately reserved for that team. Once a team announces a driver change to the observers, the team's solar car may not cross the finish line once more.

Teams are themselves responsible for avoiding delays caused by all changing slots being occupied. Teams are furthermore responsible for appropriately scheduling their driver changes, ensuring no driver will drive for more than two hours at a time. Teams may extend two of their stints by a maximum of 15 minutes each or instead one stint may be extended by 30 minutes.

4 Safety

All occupants have to wear a helmet at any time.

4.1 Safety Equipment

The teams have to provide the following equipment:
First-aid-box, ABC fire extinguisher (10 kg or more), reflective vests for all team members, battery datasheet, battery safety container and a safety method to extinguish a battery fire.
The battery safety container and first-aid-box have to be ready for use in the pit lane. Every team member is required to wear a reflective vest when inside the pit lane or on the race track.

The solar evs' battery has to fit into the container. The container has to be fireproof

4.2 Battery Safety

During the event, all battery parameters must be within the limits specified by the manufacturer.
The vehicle's power supply has to meet the electrical safety guidelines of the team's home country.
During the 24h-race each team has to inform the race control hourly about the following values of their traction battery:

- highest cell temperature
- lowest cell temperature
- highest cell voltage
- lowest cell voltage

4.3 Visitors

We're always trying to keep iESC an event with lots of room for socializing and exchange of knowledge or expertise. However, private visitors may only enter the pit boxes or pit lanes when registered with the organizers.

Additionally, all media correspondents need to register with the organizers in advance. They need to check in at the infodesk on arrival.

Visitor passes will be available at the infodesk for free.

Again, teams are not allowed to give unregistered persons access to the pit lane.

4.4 Pit Lane Safety

The area limited by the pit boxes on one side and the red line on the opposite side is mainly reserved for repairs and modifications, and should be kept clear by private visitors. The area beyond the red line should be kept clear at all times. No tables, chairs, or other temporary constructions may be placed directly alongside the wall dividing racetrack and pit lane. All private visitors to the pit lane are to stay inside the designated pedestrian area. No vehicle driving inside the pit lane may exceed the maximum speed of 20 km/h.

4.5 Clothing

Every person entering the pit-lane has to wear high visibility reflective clothing.

Wearing solid shoes will be mandatory inside the pit lane at all times.

Drivers are especially requested to comply with this rule.

The driver's clothing should cover the entire body.

Clothing should be made of natural fibers and cover the occupants' legs, arms and upper body. Natural fibers are flame-retardant by themselves whereas synthetic fibers can melt and cause dangerous burns on the skin when catching fire.

Overalls or racing suits are highly recommended for drivers.

4.6 Drugs and Alcohol

During the entire event, no participant may consume or be under the influence of any soft or hard drugs.

Furthermore, nobody participating in the event may consume or be under the influence of alcohol during the time of the main event.

5 Scrutineering

Qualification must be achieved in road ready configuration. Vehicles which are unable to present at the designated time or are not ready to start may fail to qualify.

Each team must provide appropriate tools and personnel to facilitate the inspection of structural

components.

Checks and inspections with the solar car in a road-ready configuration will include, but not be limited to:

- Signage
- Solar EV size
- Solar collector type and size
- Vision (shortest and tallest driver required)
- Lights, indicators, horn
- Ability to tow the car
- electrical compliance

The weight of all drivers must exceed 80 kilograms.

Teams are responsible for providing additional penalty weights should one or more of their drivers weigh less than 80 kilograms.

These penalty weights should be presented inside a container which can easily be sealed by the organizers.

e.g. water-bottles filled with sand

The maximum number of team members participating in the scrutineering is limited to 7 people.

Qualification must be achieved in road-ready condition. Teams unable to present at the designated time in road-ready condition may fail to qualify.

Teams who fail scrutineering due to a non safety aspect may possibly participate in the event out of competition. The decision will be taken by the iESC Organizers.

6 Penalties

The race commission may contest any arising penalties.

Penalties range from official warnings to disqualification from the event.

All penalty times listed are suggested minimums.

Driving conduct may double with each subsequent infraction.

Mathematical penalties will normally be the same for each infraction.

If the inspectors believe that teams are deliberately violating regulations for strategic advantage, they may impose more penalties up to and including potential disqualification.

The race commission has the possibility to protest against the penalties.

Penalties including disqualification from the event may be imposed for improper conduct or the use of alcohol or illegal substances. Improper conduct may include but is not limited to:

- unsafe behavior
- speeding in the pit-lane
- cheating
- improper language
- unsportsmanlike conduct
- violation of traffic rules around the racetrack
- driving without properly fitted safety belt
- distracting Race Control

Teams or team members may be penalized for disregarding any instructions given to them by the event organizers.

Teams are responsible for the conduct of all persons associated with the team, whether or not they are officially registered.

Pushing A penalty of one lap will be given to every team who es a solar car while on the track. (Except in an emergency).

Improper Ballast A five lap penalty may be assessed each time a team operates their solar car with ballast not matching the one assigned to the car's driver.

Unauthorized Drivers Any solar car driven by an unauthorized driver will be required to return to the pit lane and drive with an authorized driver. Unauthorized driving will not be counted.

Disturbing Official Battery Seals Solarcar batteries will be marked by an official seal. Disturbing these seals in a manner that prevents proper identification by an observer may be penalized as though all of the battery modules affected had been replaced as in Reg. 4.4.8.

Replacement of Batteries Decisions to exchange all or part of a battery must be communicated formally to the team's observer. The penalty will be computed as follows:
One Lap penalty for each single physical cell.

Exceeding Size Specifications Oversize solar arrays will be penalized one lap per excess centimeters in each dimension beyond the allowed size specification.

Oversize solar arrays will be penalized one lap per excess squarecentimeter beyond the allowed size specification.

Restriction on Overtaking On the track there are three dangerous turns. The restriction on overtaking will be marked with red tire stacks (details will be published in the team meeting). Dangerous overtaking in these curves will be penalized with a penalty of three laps.
Shortcut curves on the green areas beside the track will be penalized with one lap penalty.

Stopping Stopping on the racetrack will result in a penalty of one lap. Obstructing other teams will increase this penalty.

Slow Vehicles Slow vehicles not driving on the slow side of the track will be penalized with at least one lap. Obstructing other teams will increase this penalty.

Blocking Cars The blocking or hindering of other vehicles out of deliberation or negligence will be penalized with one lap.

Drugs and Alcohol Consuming any drugs or alcohol inside the pit lane may result in disqualification of the concerning team member or team.
People participating in the event must not be under the influence of alcohol at any time.

Night's Rest During the main event, all participants are to keep quiet on and around the campsite. In addition, all participants are required to respect a period of rest every day of the event between midnight and 7 a.m. During these hours, any noise disturbing the other participants will not be tolerated on and around the campsite.

Pit-Box Key Return Teams have to leave a 200 Euro deposit for the pit-box key. The deposit will be returned on Sunday when the team hands their key to the event organizers.
For deposit return the pit-box has to be clean and empty.

Paragraph "Pit-Box Key Return has been added.

iESC takes place during a low noise weekend at Circuit Zolder. Participants are required to keep excessive noise which may disturb the neighborhood to a minimum.

Further Penalties The Race Control may enforce further penalties during the event. Further penalties will commonly be enforced in accordance with a Race Commission.

"main-event time" begins at Friday 7 am and ends at Sunday 3 pm.

7 Challenges

7.1 Challenger Scoring

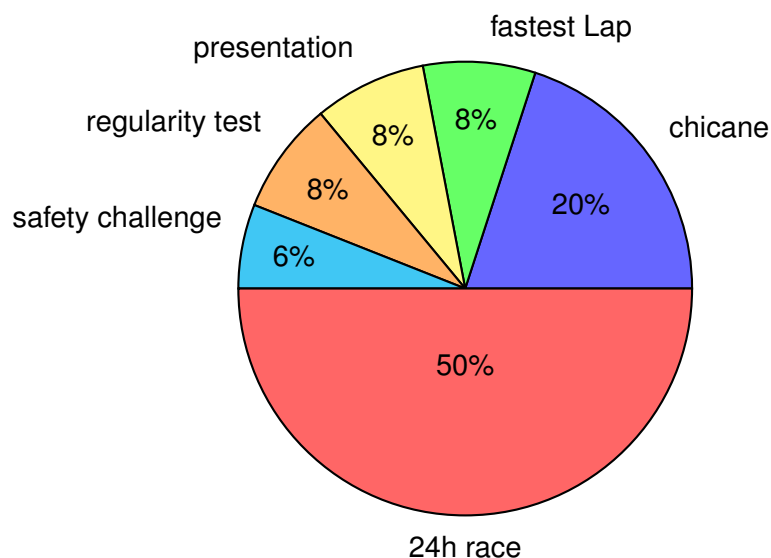


Figure 4: Scoring

7.2 Cruiser Scoring

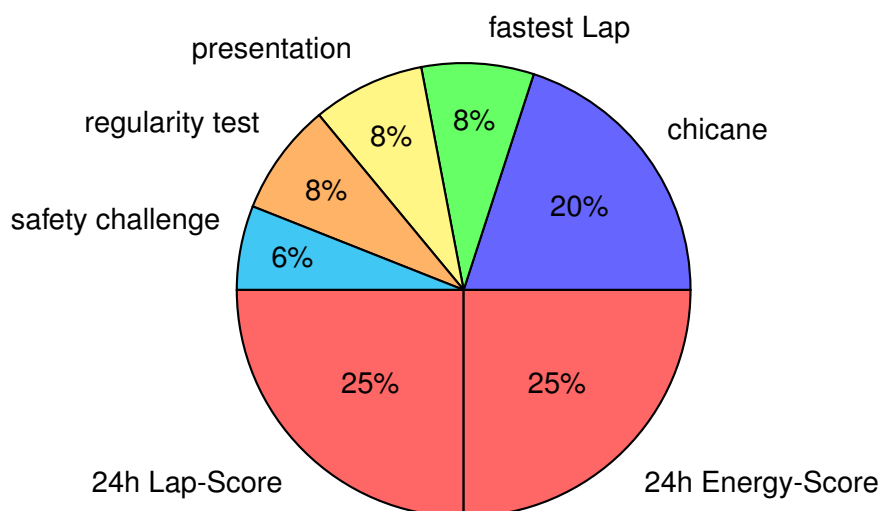


Figure 5: Scoring

7.3 24-Hour Race

The 24-hour race starts on Saturday, September 22, 2018 at 13h00, and concludes on Sunday, September 23, 2018 at 13h00.

The following sentence has been removed: "The race consists of 22 hours of driving time and two charging periods of at least one hour each."

The race begins with a Le Mans-style start.

In order to line up for the start, teams are allowed to drive backwards through the pit lane. The line up will be overseen by the observers.

At the start, every team may assign one team member to aid the driver while entering the solar car. Every team needs to take their position in the line up no later than ten minutes before the official starting time of the race.

Teams failing to arrive in time for the line up will start from the pit lane and will be penalized. Depending on strategy, all teams may decide for themselves when their solar car exits and enters the track during the duration of the race. During the duration of the race, all repairs or modifications conducted on participating vehicles need to comply with iESC regulations.

7.3.1 Challenger Class

The Team with the most laps driven wins this challenge, for details see [8.5 Detailed Scoring](#)

7.3.2 Cruiser Class

The 24h-Race-scoring is divided into two scoring-parts. The Points mentioned in [8.5 Detailed Scoring](#) will be divided 50/50 for each part.

Energy-Score

$$\frac{\text{battery capacity} * \text{number of charging stops}}{\text{laps} * (0.5 * \text{passengers} + 0.5)} \quad (1)$$

This formula calculates the energy consumption per lap and takes the number of passengers in account. The Team with the lowest score wins this challenge, for details see [8.5 Detailed Scoring](#)

Passengers is the number of people in the vehicle, the denominator of the formula will be evaluated for each stint.

The number of charging stops cannot be zero, the initial charge will be counted aswell.
Cruiser-class vehicles are not limited to two charging stops.
The scoring formula had to be changed

Lap-Score The Team with the most laps driven wins this challenge, for details see [8.5 Detailed Scoring](#)

7.4 Chicane

The chicane will take place on Friday, September 21, 2018. It will begin at 9h00 and conclude at 13h00. Each team will consecutively maneuver their vehicle through a predefined segment of the race track. The latter will include a chicane (Turn 14 and 15).

The chicane will begin at 8h00.

The distance to accelerate will be larger than 100m.

The distance to accelerate will be approximately 300m.

The actual time measurement will take place between the start and the end of the chicane.

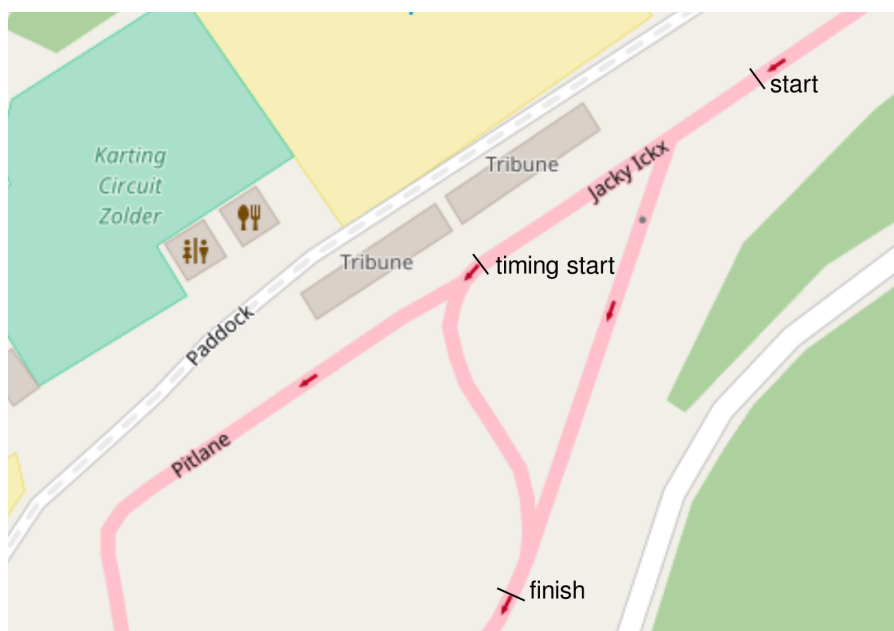


Figure 6: Chicane, not to scale

7.4.1 Qualifying

All teams will cross a prescribed part of the course, one-by-one.

Every team will be required to cross the given course section up to three times, depending on the number of participants. The best result of each team will get recorded.

Following each attempt, each driver will cross the courses' remainder, until returning to the qualifying section's start. A volunteer will then assign their position.

The fastest four teams of each class qualify for the knockout stage, the remaining teams are eliminated automatically.

The qualifying is to be completed within one hour. Arising technical issues may be resolved by the concerning team, also within that time frame. Attempts launched or completed after the end of one hour will not be recorded.

Completion of the pre-stage will be followed by a half-hour break.

The qualifying will take 120 minutes. Knockout begins immediately afterwards.

7.4.2 Knockout

Each duel completed during the knockout phase will see one attempt per team. The faster team advances to the next round.

Should both teams produce identical results, they will be granted another attempt.

Should unforeseen results be produced in any other way, measures to be taken will be determined

by the race commission (see chapter “Race Commission.”)

After each attempt during the knockout stage each solarcar enters the pitlane at the exit and drives to its entrance. This is the only time during the entire event where it is allowed to drive with a vehicle in the wrong way in the pit-lane or on the racetrack.

7.5 Fastest Lap

The fastest lap challenge will take place as a part of the 24-hour race.

After the race has ended the fastest lap for each team will be detected. The team with the fastest lap wins the challenge.

7.6 Regularity Test

During the the 24-hour race, each team will be tested for consistency of speed. To accomplish this, teams will estimate an average lap duration in accordance with their vehicle’s abilities. They will then complete eight laps while aiming to stay as close to their average as possible.

The five laps closest to the team’s average will be counted. The remaining inconsistencies with a team’s average will be added up; the team with the lowest inconsistencies wins the challenge.

Teams are required to inform the race control before completing this challenge. See [subsection 8.7](#).

7.7 Technical Presentation

Each team has to give a 10-minute presentation on the subject of a particular exception or a technical innovation which their vehicle represents.

The presentation has to be held in English. Teams can decide for themselves how many of the team’s members will be involved in the presentation. The order in which these presentations are held will be related to the raffle of the line up.

Every team has to hand over a copy of their presentation to the organizers during the scrutineering. This needs to be in the form of a PDF file. The organizers will ensure that a laptop and video projector will be in place for the presentations. All presentations handed in during the scrutineering will be saved on said laptop. This presentation laptop will have a version of Adobe Acrobat X Pro and Microsoft PowerPoint 2010 preinstalled; both of them may be used. Other programs are not supported. Any team requiring different software for their presentations should contact the organizers in advance.

Any presentation not handed in before the deadline will not be regarded in the overall evaluation. All presentations will be evaluated by an independent jury of five specialists.

The assessment criteria are:

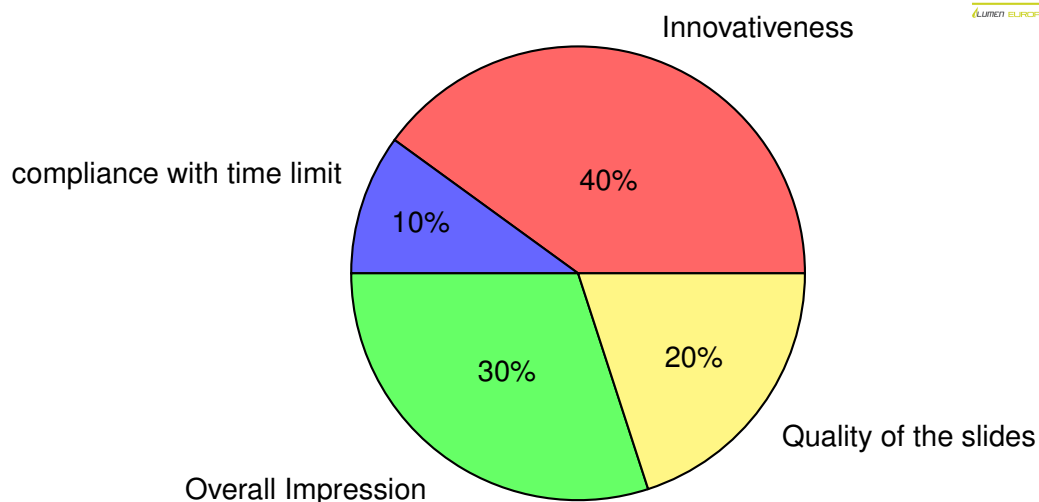


Figure 7: Scoring Presentation

7.8 Safety Challenge

The safety challenge will take place at a random time during the 24-hour race, which the organizers will determine on short notice. Teams will not be notified in advance.

The aim is to ensure each team's sufficient preparations to meet hazardous situations.

The safety challenge will take place during a time at which it won't disrupt the team's response to any important issues that may arise.

Teams should respond to the safety challenge the same way they would to an actual emergency. Should the team's actions during the challenge include any consumable materials, the application of such equipment should merely be simulated.

8 Appendix

8.1 ISF Roll Bar Specifications

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All vehicles must be equipped with the first and second roll bars (as shown in the specifications below) to prevent direct damage to the driver and serious cockpit deformation in the event of a collision or of a car turning over.

The first and second roll bars form the basic element of the rollover structure. These structures must be made of steel tubes or other material of sufficient tensile strength to protect the occupant from a force of $4w$ (w =weight of vehicle) The structure must be bolted, welded or otherwise structurally incorporated to the vehicle according to sound engineering practice. For vehicles whose bodywork fulfills the function as the first and second roll bars, the installation of additional roll bars is not necessary.

Roll bars shall meet the following dimensional criteria:

- The line extended from the top of the first roll bar to the top of the second roll bar must be above the driver's helmet when he/she is seated normally in the vehicle.
- The top of the first roll bar must be higher than the top of the steering device.
- The first roll bar must cover the steering device with steered wheel(s) in the straight position ahead when the vehicle is viewed from the front.
- The second roll bar must cover the driver's shoulder when the vehicle is viewed from the front. In case that the bodywork of the vehicle covers the driver's shoulder, the second roll bar may cover only the driver's head.
- The second roll bar must have enough strength for lifting or towing with the driver on-board. General descriptions Roll bars must be designed and constructed so that, when correctly installed, they minimize the risk of injury to the occupant. The responsibility to secure the necessary strength rests with competitors. No part of roll bars must hamper the entry/exit of the occupant or take up the space designed for the occupant.

General descriptions

- Roll bars must be designed and constructed so that, when correctly installed, they minimize the risk of injury to the occupant.
- The responsibility to secure the necessary strength rests with competitors.
- No part of roll bars must hamper the entry/exit of the occupant or take up the space designed for the occupant.

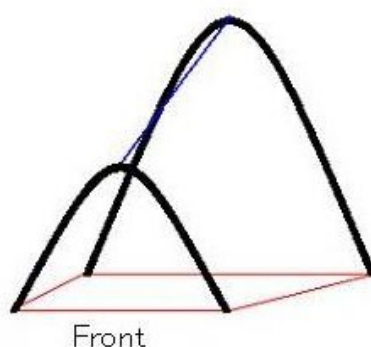


Figure 8: Rollbar: general view

The driver's helmet must, when seated normally, be contained within the defined area

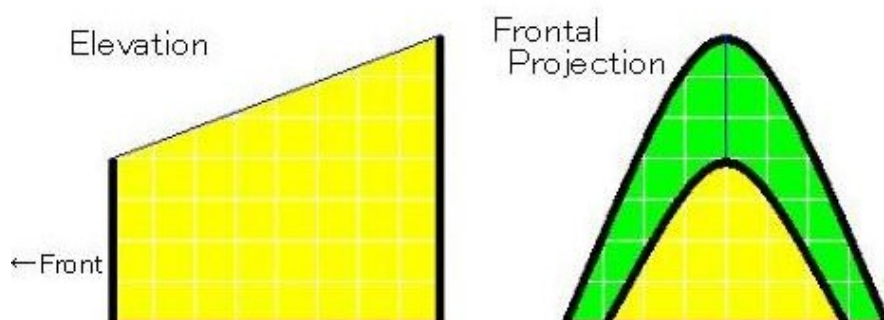


Figure 9: Rollbar: side view

All driving controls must be capable of being accessed and operated within the defined area

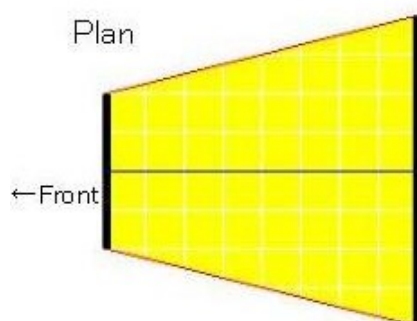


Figure 10: Rollbar: plan

All parts of the driver's body (including any protective clothing and equipment, must, when seated normally, be contained within the defined area)

8.2 ISF Standard Measurement of Seating Angle

- The seating angle must not exceed 27 degrees.
- The concept of determining the seating angle is based on the measurement of torso angle in accordance with ISO/JIS Standards.
- JIS D4607 is the standard that shows the three-dimensional seated human model for measurement of automotive body interiors.
- JIS D0024 establishes the H points (hip point: rotational center of body and thigh in the three-dimensional human model) and indicates measurement methods including the torso angle based on D4607.

For ISF scrutineering purposes, measurement is effected by using a template based on the hip and shoulders of a two-dimensional form derived from the JIS D0024 standard.

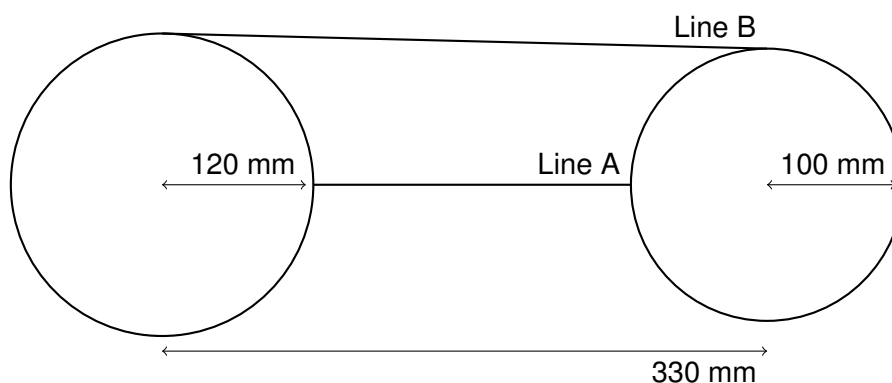


Figure 11: Measurement Template

Making a Template

- Draw a circle with a radius of 120mm.
- At a point 330mm from the centre of the circle, draw another circle with a radius of 100mm
- Draw a line connecting the centre of the two circles (Line A).
- Draw a tangent to connect the circumferences of two circles (Line B)
- Cut the shape using suitable material
- Attach a plumb line to the measurement point
- The angle is measured between line A and the perpendicular.

8.3 ISF Steering Wheel Specifications

To reduce the possibilities of driver injury in the event of collision and to minimise impediments to emergency egress, the steering system must be controlled by a steering wheel which has a continuous perimeter.

A circular shape is preferred, however the upper part above 2/3 and/or the lower part below 2/3 of the circumference of the steering wheel may be flat as depicted in the diagram below).

permitted

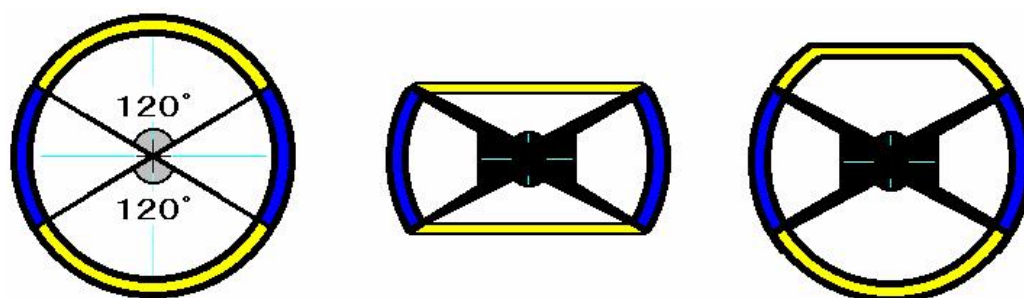


Figure 12: Examples of permitted steering-wheels

not permitted

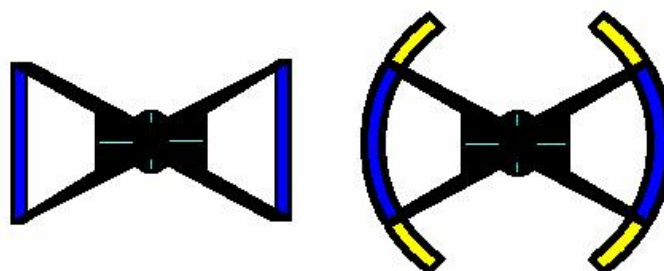


Figure 13: Examples of prohibited steering-wheels

8.4 Battery Seals

8.5 Detailed Scoring

8.5.1 4-7 Participants

Ranking	24h 50.00%	chicane 20.00%	fastlap 8.00%	presentation 8.00%	safety challenge 6.00%	regularity test 8.00%
1	50	20	8	8	6	8
2	28	10	5	5	4	5
3	12	5	3	3	2	3
4	0	0	0	0	0	0

8.5.2 8-11 Participants

Ranking	24h 50.00%	chicane 20.00%	fastlap 8.00%	presentation 8.00%	safety challenge 6.00%	regularity test 8.00%
1	50	20	8	8	6	8
2	32	14	6	6	4	6
3	21	8	4	4	3	4
4	14	4	2	2	2	2
5	9	2	1	1	1	1
6	5	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0

8.5.3 12-15 Participants

Ranking	24h 50.00%	chicane 20.00%	fastlap 8.00%	presentation 8.00%	safety challenge 6.00%	regularity test 8.00%
1	50	20	8	8	6	8
2	38	15	6	6	5	6
3	28	11	4	4	4	4
4	21	7	3	3	3	3
5	15	5	2	2	2	2
6	11	3	1	1	1	1
7	8	2	0	0	0	0
8	5	0	0	0	0	0
9	3	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0

8.5.4 16-19 Participants

Ranking	24h 50.00%	chicane 20.00%	fastlap 8.00%	presentation 8.00%	safety challenge 6.00%	regularity test 8.00%
1	50	20	8	8	6	8
2	39	16	6	6	5	6
3	33	12	4	4	4	4
4	27	9	3	3	3	3
5	22	6	2	2	2	2
6	18	4	1	1	1	1
7	14	3	0	0	0	0
8	11	2	0	0	0	0
9	8	1	0	0	0	0
10	6	0	0	0	0	0
11	4	0	0	0	0	0
12	2	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0	0	0

8.5.5 20+ Participants

Ranking	24h 50.00%	chicane 20.00%	fastlap 8.00%	presentation 8.00%	safety challenge 6.00%	regularity test 8.00%
1	50	20	8	8	6	8
2	40	16	6	6	5	6
3	32	13	4	4	4	4
4	26	10	3	3	3	3
5	22	8	2	2	2	2
6	19	6	1	1	1	1
7	16	4	0	0	0	0
8	13	3	0	0	0	0
9	11	2	0	0	0	0
10	9	1	0	0	0	0
11	7	0	0	0	0	0
12	5	0	0	0	0	0
13	3	0	0	0	0	0
14	2	0	0	0	0	0
15	1	0	0	0	0	0
16	0	0	0	0	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0

8.6 Race Commission Application Form

Team:

Subject:

Additional Information:

Time of Submission:

Hand this form to an iESC Official at the Race Control.

Person handing in this Document:

Signature:

Team Manager:

Signature:



8.7 Regularity Test Application Form

Team:

Lap-time target:

First lap number:

Hand this form to an iESC Official at the Race Control before the first lap has begun.

Person handing in this Document:

Signature:

Team Manager:

Signature:

[illegible]