Shell
Eco-marathon

2026 Official Rules

Chapter I

Foreword

Welcome to the 2026 Shell Eco-marathon Season.

Following the celebration of our 40th anniversary last year, we now open a new chapter in the story of Shell Eco-marathon. For four decades, this competition has been a global stage for innovation and energy efficiency, where bright minds from around the world have pushed the boundaries of what is possible. Our mission remains the same: challenging future engineers to answer a powerful question, *how can we go further with less?*

The 2026 season introduces a refreshed competition format and sets the stage for a brand-new Global Championship in 2027, which will bring together top teams from around the world to compete across multi-disciplinary challenges, testing not only vehicle design and on-track performance, but also advanced engineering, data science, and problem-solving. If you are participating in the Mileage Challenges or the expanded Autonomous Driving Competition, now open to both Urban Concept and Prototype vehicles, you will have the opportunity to qualify, with details to be announced in due course.

We continue to explore the potential of hydrogen-fuelled internal combustion engines, offering teams at any event the chance to apply to demonstrate a Hydrogen ICE vehicle, subject to a technical feasibility review. While not part of the official competition, this builds on last season's demonstration and reflects our interest to formally integrate Hydrogen ICE into the programme in future seasons.

Real-time data has become a powerful tool for improving vehicle performance. Building on the success of the systems previously provided to Urban Concept vehicles, we are taking the deliberate step in 2026 of no longer supplying the on-board computer. This change reflects the move away from Regional Championships and shifts the responsibility for data systems to your team, encouraging you to design your own solutions for capturing and analysing performance. Beyond its value on the track, innovative use of data can also strengthen Off-Track Award submissions.

As we step into the fifth decade of Shell Eco-marathon, this season carries the momentum of all those that came before it. Each change reflects a shared ambition to evolve the competition in meaningful ways, guided not only by rules but also by the collective vision of a community determined to inspire the engineers and innovators of tomorrow.

What's new for 2026

- Qualification for the first Global Championship in 2027, based on 2026 results.
- Autonomous Driving Competition now includes both Urban Concept and Prototype vehicles.
- Hydrogen ICE demonstration opportunities available at all events.
- Telemetry kit removed, with teams encouraged to develop their own systems.
- Updated registration rules to allow more teams per institution.

Last but not least, thank you to our volunteers, partners, and, above all, the students and educators who bring Shell Eco-marathon to life. Wishing every team success this season as we take the next step in shaping the future of Shell Eco-marathon together.

Kind Regards,
Melle de Wit
Shell Eco-marathon Global Technical Director

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1. Organisation

Article 0: About the Rules

a) The rules for Shell Eco-marathon 2026 competitions can be downloaded from the Shell Eco-marathon website. They comprise of:

   i. Chapter I – global Shell Eco-marathon Official Rules (referred to as "Official Rules" in this document).

   ii. Chapter II – specific rules for each of the Shell Eco-marathon on-track events.

   iii. Chapter III – rules for the Shell Eco-marathon Championship Series.

   iv. Chapter IV – rules for the Shell Eco-marathon Autonomous Competitions.

b) It is the responsibility of participating Teams to read and understand the Official Rules. Participants should pay particular attention to guidance on the protection of your personal data (in Article 100), and guidance on protection of your and other people's intellectual property (in Article 102 and Article 103).

   To highlight rule changes and aid the understanding of frequently misunderstood rules:

   i. Red text indicates a change, addition, or amendment to the previous year's Official Rules.

   ii. *Italic text* is an explanation of a rule for better understanding.

c) Links are used throughout this document for navigation and are indicated by underlined text.

d) In this document functions and roles are defined as follows:

   i. 'Organisers' – the specific Shell company that organises the Shell Eco-marathon event in a country stated in Chapter II, and all persons acting on its behalf.

   ii. 'Educational Institution' – the university, college, or secondary school (preparing students for higher education degrees, vocational training certificates, professional certificates or official second-level school-leaving examinations) that endorses and oversees the participation of a Shell Eco-marathon Team.

   iii. 'Team' – a group of individuals affiliated with an Educational Institution with a team name and one vehicle that has been accepted for entry to the Shell Eco-marathon competition.

   iv. 'Participant' – a member of a Team.

   v. 'Team Manager' – a Participant that has been appointed on the event registration document as a single focal point for their Team for the Organisers, who assumes overall responsibility for the Team, including the Duty of Care for the Team members, and who is responsible for their behaviour and compliance with the competition rules. This person may be a Faculty Advisor or adult Team member (see Article 2h), but they must be over 18 years old and competent to assume the responsibility.

   vi. 'Faculty Advisor' – a professional staff member of the Educational Institution which the Team represents, also a Participant of the Team.

   vii. 'Chaperone' – a person related to a Participant or affiliated with the Educational Institution, responsible for the supervision of young students of that institution.

   viii. 'Race Director' – a person appointed by the Organisers, who is responsible for managing and sanctioning all on-track activities.

ix. 'Track Marshal' – person appointed by the Race Director to act on their behalf, to ensure on-track safety and observe on-track rule compliance.

x. 'Technical Director' – a person appointed by the Organisers, who is responsible for managing and ensuring the technical standards and integrity of the Shell Eco-marathon competition.

xi. 'Technical Team' – persons operating under the guidance and supervision of the Technical Director, responsible for ensuring that all participating vehicles meet the required technical standards and adhere to the integrity of the competition.

xii. 'Safety Team' – persons appointed by the Organisers whose role is to maintain off-track safety and ensure compliance with the safety rules of the competition.

xiii. 'Leading Institution' - Educational Institution with the majority of students in a Team with members from more than one institution.

xiv. 'Competition' or 'Event' – Shell Eco-marathon event held at a physical location or virtual environment, with rules and conditions of participation as defined in this document.

e) Any decision by the Organisers is final, independent of whether it is explicitly identified in Chapter I or not.

Article 1: Acceptance

a) Applications to enter the competition must be made via the Shell Eco-marathon registration site. Registration consists of the following two phases:

i. Technical Phase: Teams specify their vehicle category and energy class, and demonstrate the design and build of their vehicle, submitting documentation and photos.

The Organisers will review all applications and will select Teams based on the quality of their proposed entry, historical successes from previous Shell Eco-marathon events. The criteria for the historical successes will include achieving valid runs, completing the technical inspection, and demonstrating a readiness to compete upon arrival at the event. In addition, the Organisers reserve the right to invite Teams who represent the spirit of this competition. Approval in this phase confirms official selection for the competition, provided that all required legal documentation is submitted in the logistics phase.

ii. Logistics Phase: approved Teams complete logistics and final preparations for the event.

b) By the fact of their entry, Participants accept all provisions of the Official Rules and agree to abide by all decisions made by the Organisers. The Organisers reserve the right to add, modify or delete any Article of the Official Rules. In such an event, the Teams will be notified. The Organisers are solely empowered to pronounce in cases not provided for in the Official Rules.

c) The Organisers reserve the right to modify, postpone or cancel the competition for any reason including for reasons of force majeure due to, including but not limited to, adverse or extreme weather conditions, the occurrence of a natural disaster, acts of terrorism or safety concerns. No claims for compensation will be accepted.

Article 2: Entries

a) Shell Eco-marathon is an academic educational programme. All Teams wishing to enter must be affiliated with an educational institution and their participation must be endorsed by it as evidenced by an Institutional Waiver signed by a competent authority of the Educational Institution submitted at the end of the Technical Phase Registration.

b) Educational Institutions eligible for Shell Eco-marathon participation are universities, colleges and secondary schools preparing students for higher education degrees, vocational training certificates, professional certificates or official second-level school-leaving examinations.

c) Participants must be at least 16 years of age on the first day of the competition, however 14 and 15-year-olds may be allowed if appropriate safety and supervision plans are agreed in advance with the Organisers. Any Team wishing to include members aged 14 and 15 should contact the Organisers prior to registration where additional information on the requirements and limitations relevant to their country can be provided.

d) All members of a given Team must be currently affiliated with the Educational Institution or have been affiliated within 12 months prior to the date of the event, either as a student or as a member of faculty.

e) By prior agreement with the Organisers, Teams can be made up of Participants from different Educational Institutions. The institution with the majority of the students will act as the Leading Institution. The Leading Institution must assume full responsibility for the external students making up the Team. The Team Manager must come from the Leading Institution.

f) Each Participant must be associated with one Team only.

g) Multiple vehicles per Educational Institution may be considered for any given Shell Eco-marathon event, granted they are of (i) different vehicle categories or (ii) different energy classes. The vehicle categories available are Prototype and Urban Concept, as defined in Article 25a. The energy classes available are Internal Combustion Engine, Battery Electric, and Hydrogen Fuel Cell, as defined in Article 53.

h) For each entry, a Team Manager, a Driver and a Faculty Advisor must be designated. A Reserve Driver may also be designated.

i) The Team Manager must be a student member of the Team currently enrolled at the Educational Institution. In case all Participants are legal minors at the date of registration, the Faculty Advisor must act as Team Manager.

j) The Team Manager may also be a Driver or Reserve Driver for their Team's vehicle.

k) The Team Manager is the Team's sole official liaison with the Organisers. All information will be addressed to him/her. For the purposes of the project, he/she will be responsible for the Team, must speak on behalf of the Team and must be able to understand and speak English.

l) Both the Driver and the Reserve Driver must be at least 16 years old. The Driver and Reserve Driver must be students of the Educational Institution in question. If all the student Team members are under 16 years of age, the Team must contact the Organisers in writing for a review of the situation. Both Drivers must be able to speak and understand English.

m) Participation in any Shell Eco-marathon event is subject to acceptance by the Organisers. Each country has been nominally allocated to an event location. Teams may request to participate in an alternative location, with prior approval of the organisers.

n) Teams that wish to drop out from the competition must inform the Organisers as soon as possible but no later than 35 calendar days prior to on-site student registration opening. Failure to notify the Organisers may result in a suspension of their institution from Shell Eco-marathon competitions globally for one year.

o) Teams are required to select a creative and engaging name for their Team that is showcasing the Teams' innovation and creativity. Names should be original and in the spirit of their research, their

Educational Institution, and Shell Eco-marathon. Names should be written in basic Latin script, optionally with accents, and must be a maximum of 64 characters. Names that are a repetition of the Educational Institution's name, that include an existing company name, or that are considered offensive or disrespectful to others will not be allowed. The Organisers reserve the right to require Teams to change their name.

p) Shell Eco-marathon provides an inclusive and collaborative platform for its participants to engage in STEM Learning, science, and research into low carbon mobility solutions in a friendly and respectful environment. Participants are expected to act in accordance with the Organisers' core values of honesty, integrity, and respect at all times. The Organisers reserve the right to remove participants and teams from the competition who abuse this platform for political, religious, and social purposes that are likely to distract, polarise, upset or offend others.

Article 3: Track Access Conditions

Whenever a vehicle enters the track, the vehicle body must be in place and bear all the competition numbers, sponsor stickers and Shell logos required by the Official Rules. Organisers will supply these numbers and logos.

Article 4: Identification

a) Logos, official sponsor stickers, racing numbers and emergency stop sticker will be provided by the Organisers as appropriate for each Shell Eco-marathon event. They must be fixed to the vehicle body in accordance with the specifications provided (see Appendix 1) such that they can be clearly read during any public presentation, in promotional films and on all photographs.

b) Under no circumstances may the Shell logo, the sponsor stickers or racing numbers be modified, either on the vehicle or on any documentation. It is prohibited to cut the supplied stickers without prior approval from the Organisers.

c) A mandatory 50 mm space must be left free on all four sides of the Shell logo, and it should be placed with the base parallel to the ground (not at an angle).

d) Any other sponsor names/logos must be smaller than the Shell logo. Each sponsor sticker must fit within a maximum area of 400 cm^2 (empty space included).

e) The trademarks or logos of tobacco companies and alcoholic drinks producers are prohibited. Trademarks and logos of other energy companies require the prior written approval of the Organisers.

f) In the event of a breach of this rule, the Organisers reserve the right to deny entry to the competition.

g) All vehicles are subject to the Organisers' approval concerning these provisions.

Article 5: Compliance

a) Only vehicles that comply with the present Official Rules can participate. No vehicle will be allowed on the track for practice or competition until the Organisers have approved it. The decisions of the Organisers are final in all matters concerning the compliance of vehicle design and construction with the Official Rules.

b) The Organisers reserve the right to rescind vehicle approval upon further or more detailed evaluation. The Organisers must be notified of any modifications to the vehicle after inspection. Non-compliance with this rule may lead to vehicle disqualification.

c) Vehicles complying with all safety rules, but not all technical rules will not be allowed to compete. However, they may be allowed on the track for practice or demonstration at the discretion of the Technical Director.

d) For any vehicle that produces a result outside of the typical values for the competition, the Organisers reserve the right to withhold this value until a similar result is achieved with the same vehicle and configuration, and the result has been verified by the Organisers.

Article 6: Protests

The Team Manager is the only person authorised to lodge protests. Protests must be brought to the attention of the Technical Director via the results desk. Protests must be lodged within the following times:

a) Vehicles: before track closure on the current day.

b) Team and Driver behaviour: within 30 minutes following the end of the attempt.

c) Results: within 1 hour after the result of an attempt has been posted.

Article 7: Disputes

In the event of any disputes, all decisions made by the Organisers are binding and final.

Article 8: Penalties

a) Non-compliance with the rules or direct instructions from the Organisers will result in the penalties as described in Article 8d. Notwithstanding this, the Organisers reserve the right to make decisions on a case-by-case basis depending on the severity of the breach. At the discretion of the Organisers, a breach of safety, either on or off track, or refusal to rectify an action which is disrespectful or likely to cause offence to other participants, may be considered 3rd infraction and result in disqualification.

b) The Organisers may exclude, disqualify, or penalise any Participant or Team who has cheated, gained an unfair advantage, hindered other Participants or Teams, or has committed any act or omission capable of misrepresenting performance, especially regarding energy consumption or method of propulsion.

c) During the competition, the Driver or Team Manager must report to the Organisers any movement made or attempted by means other than the vehicle's own propulsion system. In such an event, the attempt in question will be invalid. If this type of incident is not reported, all the Team's attempts will be invalidated.

d) The following general penalties apply:

1st infraction:	Formal warning.
2nd infraction:	Best overall attempt invalidated at the end of the competition.
3rd infraction:	Immediate Team disqualification.

2. Safety

Article 9: Safety Rules

a) As with any motorsport activity there should be an understanding that certain inherent risks will be present. Recognising and controlling these risks is vital for the well-being of people and local surroundings. Safety both on- and off-track is an essential consideration for the Organisers. These Rules are to protect all individuals and surrounding areas and are in no way intended to curtail the spirit of the competition. Any activity deemed by the Organisers unsafe or outside of the spirit of the event will be met with appropriate action.

b) Compliance with safe driving rules, as well as any instructions given by Track Marshals, or the Organisers is mandatory for everyone. All Participants must comply with the safety measures and must notify Organisers about any anomalies or incidents. In case of dangerous conditions, leave the area immediately. During the event, the paddock area will be monitored by the Organisers to assist Teams to comply with safe practices.

c) The Race Director is responsible for and has the final authority in determining the safe conditions for track operations.

d) Non-compliance with any of these Rules, on track or off track, may lead to disqualification from the competition at the sole and absolute discretion of the Organisers.

e) Electrical safety in the paddocks is an especially important topic in Shell Eco-marathon events. Teams must read and comply with the safety concerns in Article 24, Article 57, and their event specific Chapter II Rules.

f) Teams understand and agree that approval in Technical Inspection only accredits them to operate on the Event Site track for testing or competition purposes, and not to drive on public roads.

2A - Driving Rules

Article 10: Driving Knowledge and Test

a) Only the registered Driver and the Reserve Driver will be authorised to drive the vehicle.

b) Drivers may be questioned about their knowledge of the driving rules during the inspection. The Organisers reserve the right to deny track access to Drivers with insufficient knowledge of the Rules.

c) Driving on-track: Drivers must use smooth, safe driving techniques for example thinking ahead, avoiding sudden directional changes, and being fully aware of vehicles around them.

d) Drivers must have a minimum of two hours of driving experience with their vehicle. Drivers will be asked to evidence their skill level:

   i. Do you have prior experience driving in a Shell Eco-marathon competition?

   ii. Do you have prior experience driving in a similar mileage competition?

   iii. Do you have a minimum of 2 hours driving experience in your Team vehicle?

   iv. Have both drivers driven the current vehicle?

   Drivers may be required, at the discretion of the Technical Director, to verify their skill level on a test track as part of passing Technical Inspection.

Article 11: Driving under the Influence of Alcohol/Illegal Substances

a) Driving under the influence of alcohol or illegal substances is forbidden. This applies to all Drivers.

b) Any Participant taking any over the counter or prescription medication which may impair their ability to drive or operate machinery (as detailed on the drug information sheet) must declare this to the Organisers who will determine any restrictions.

c) Any breach will be penalised in line with Article 8 and the following additional penalties:

   i. Any alcohol or substance-related breach of the rules will be treated at least as a '2nd infraction' of the Team, even if no prior violation has occurred.

   ii. In addition, the affected Driver is immediately banned from track access if he/she is under the influence. A Reserve Driver may substitute the Driver if he/she is eligible to drive.

   iii. Any second alcohol and/or substance-related infraction will lead to the immediate disqualification of the entire Team.

Article 12: Briefing

Attendance of the daily Drivers' briefing is mandatory for the Team Manager and all registered Drivers every day. If the Team Manager is not present at this briefing, their Team's vehicle will not be authorised on track for that day. If the Team Manager attends the briefing, but not all Drivers in their Team, only the Driver attending the briefing will be authorised on track for that day.

Article 13: Access to the Track

a) Vehicles must pass a safety inspection prior to accessing the track for practice runs. A safety sticker will be clearly affixed once the vehicle has passed the inspection.

b) For practice runs on both the test track and the competition track, only vehicles with a safety sticker will be allowed on the track.

c) For the competition, only vehicles with safety and technical inspection stickers will be allowed to compete.

d) The Organisers will allow the opportunity for Team Managers and Drivers to survey the track before any vehicles are allowed on the track. For further details please refer to Chapter II.

e) After pre-start measurements have been completed, Teams must be ready to start their attempt within two minutes or return to the paddock.

f) Access to the track for pedestrians is strictly prohibited.

Article 14: On-track Vehicle Movements

Propulsion of the vehicle must be achieved solely by means of the propulsion system. Pushing the vehicle, manipulating the wheels, or using any other external or auxiliary means of propulsion is strictly prohibited at any time on the racetrack, including during the start of a run and when crossing the finish line.

Article 15: Race Direction

It is forbidden to drive in reverse gear or to drive against the race direction.

Article 16: Driver Communications

Only handsfree communication devices are allowed, provided both hands of the driver remain on the steering system.

Article 17: Overtaking

a) Drivers are required to give clear passage for other vehicles wishing to overtake.

b) Drivers in overtaking vehicles must sound their horn and pass with caution. The Driver of the overtaking vehicle is responsible for the safety of the manoeuvre.

c) Drivers of the vehicles being overtaken must use their mirrors and must not change course suddenly.

d) On the track, overtaking is authorised on both the right and the left, provided the above-mentioned safety rules are followed.

Article 18: Breakdowns and Other Incidents

a) Intentional stopping on the track is forbidden unless it is required by the competition, e.g. for Urban Concept vehicles, or is needed to prevent a safety incident.

b) The Driver is allowed 30 seconds to attempt to re-start the vehicle.

c) If a vehicle breaks down or is involved in a minor disabling accident on the track, the Driver must immediately make every attempt to drive the vehicle to the side of the track and wait in the vehicle for the Track Marshals to arrive.

d) In an emergency, the Driver must get out of the vehicle and wait in a safe place off the track for the Track Marshals to arrive and recover him/her and the vehicle.

e) It is forbidden to carry out repairs on the track.

Article 19: Off-track Vehicle Movements

All vehicles must be parked inside the designated paddock area or directly in front of it. When off the track, vehicles must be moved without the use of the engine. They must be pushed or pulled at walking pace by an accompanying Team Member wearing gloves. This also applies to the pit lane and the paddock area. Test-driving in the paddock area is forbidden.

2B – Driver and Equipment

Article 20: Driver Weight

a) The minimum Driver Weight is:

- Prototype vehicles – 50.0 kg
- Urban Concept vehicles – 70.0 kg

b) 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 ballast needs to be fitted to the vehicle. This ballast must be provided by the Team, in form of weightlifting discs or rectangular metal plates. No other form of ballast is permitted. The ballast must be effectively secured to the vehicle, outside the driver compartment, to ensure Driver safety in the event of collision or roll-over. A seal will be installed around the ballast by a technical

inspector and must remain in place during the Competition. If the seal has been tampered with or removed the vehicle will no longer be valid to compete. The ballast must be placed in a maximum of three locations.

c) If a Team has two Drivers and one or both Drivers are underweight, the ballast weight will be based on the lightest driver.

d) Drivers (in full driving gear, including communication devices) and their ballast may be weighed before or after each attempt. A weight loss of up to 1 kg during an attempt will be tolerated.

Article 21: Helmets

a) For Urban Concept vehicles, drivers must wear a full-face or three-quarter helmet suitable for motorsport activities.

b) For Prototype vehicles, drivers must use a three-quarter helmet suitable for motorsport activities.

c) 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. See Appendix 2 for examples of accepted standards.

d) All helmets must be affixed with a face shield or visor, which must cover from the top of the face down to below the driver's nose. When a three-quarter helmet is used, goggles are permitted. Tinted face shields or sunglasses to be worn under the face shield are permitted. Visors should be free from major scratches and have clear visibility.

e) The helmet must correctly fit each individual Driver and be secured by a chin strap.

f) Long hair should be secured and concealed within the helmet or clothing.

g) To allow for proper inspection, all helmets must be free from stickers.

Article 22: Driver Clothing

a) 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) according to a recognised standard for motorsport activities. Drivers are not allowed to wear synthetic clothing underneath the race suit because synthetic material may melt if exposed to flames. See Appendix 2 for examples of accepted standards.

b) Socks (made from cotton or FRC material) and flat, closed-toe shoes are required.

c) Fire retardant gloves are required and must completely cover all fingers.

d) If Drivers wear balaclavas, they are required to be made from FRC material.

e) No bare skin should be visible when the Driver is wearing the racing suit, gloves, socks and shoes.

f) The clothing must be correctly sized to the individual Driver.

Article 23: Driver Comfort

Please note that in the event of hot weather conditions, high temperatures may affect Driver comfort and potentially cause heat stress.

a) It is recommended to properly ventilate the inside of the vehicle to provide cooling to the Driver.

b) 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.

Hydration vests or bottles secured inside the driver's compartment with flexible feed straw are recommended.

c) It is recommended to equip the vehicle with an effective shield from the sun.

d) For driver comfort, Teams can install fans or air-cooling type systems that are not included in the electrical measurement of the vehicle. Any fans or air-cooling systems must be self-powered by internal batteries (see Article 57i).

2C – General Safety

Article 24: Equipment and Materials

Teams are required to provide and use at the Competition:

a) Leather, canvas or other cut resistant gloves for general work, including movement of vehicle

b) Chemical resistant gloves for fuel or motor oil handling

c) Safety glasses

d) Safety goggles for handling liquid fuels

e) Hearing protection

f) Closed shoes (sandals and flip-flops are not permitted)

g) Means to secure cords or cables lying on the pit floor

h) Lift stands or appropriate raised platform for vehicle tuning and repairs

i) Tools and materials

j) Effective equipment suitable to mitigate and/or control Lithium-based battery fires must be used during battery charging. The equipment must prevent or contain the spread of fire or a battery event during charging. Equipment that may be used includes:

   i. A battery charging bag that is designed specifically for the containment of a Lithium battery fire.

   ii. A fireproof blanket that can be placed over AND under the lithium battery being charged. The blanket must be big enough to fully cover and contain any potential battery fire.

   iii. A vented metal box that entirely encompasses the battery.

k) Vehicle Crates and Transportation

   i. Commercial transportation regulations have increased significantly in recent years. Teams need to understand the ramifications of non-compliance. Individual Teams are responsible for commercial shipments.

   ii. Dangerous Goods include, but are not limited to, flammable liquids, batteries, and pressurized containers (e.g. fire extinguishers).

   iii. Shipments made by air freight are the most stringent compared to road freight.

   iv. Participants are required to seek early guidance regarding shipment of any Dangerous Goods material from a commercial freight company to obtain the latest shipping legislation.

v. Dangerous Goods shipping and packing information will be provided in Chapter II for each on-track Competition.

vi. For general guidance on how to ship your crate safely and efficiently, refer to Appendix 3.

l) Electrical safety

i. All electrical equipment used must be properly fused.

ii. Electrical cables must be in good condition and appropriate for the equipment it is intended for.

iii. Teams are only allowed to use the supplied single multi-plug strip with internal overcurrent protection. No further multi-plug strips or other adaptors may be used.

m) Compressed Gas safety

i. Safety glasses shall be worn when working with pressurised gas.

ii. Gas cylinders must be secured in an appropriate location, as agreed with the Organisers.

n) Hydrogen Cylinder safety

i. Participants are not allowed to keep any cylinders in their possession overnight. The cylinders must be stored in a location designated by the Organisers suitable for hydrogen storage in the paddock. Upon arrival at the circuit, Team Managers must contact the Technical Team, who will organise all relevant logistics.

A suitable location would include proper ventilation, distance away from any possible ignition sources, secured to avoid accidental damage.

ii. When the cylinder is not installed in the vehicle, a blind cap shall be installed on the cylinder outlet.

o) Guards for rotating equipment (chassis dynamometers, etc.), such as gears, transmission chains, and belts, are mandatory.

3. Vehicle Design

3A – General

Article 25: Vehicle Design

a) During vehicle design, construction and competition planning, participating Teams must pay attention to all aspects of safety, including the safety of the driver, participants, volunteers and spectators.

   i. Prototype vehicles must have three or four running wheels that are in constant contact with the road.

   ii. All vehicles must have a minimum crumple zone of 100 mm between the front of the vehicle body and the driver's feet.

   iii. Urban Concept vehicles must have exactly four wheels that are in constant contact with the road.

b) Aerodynamic appendages, which adjust or are prone to changing shape due to wind, are not allowed.

c) 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 be covered with foam or a deformable material.

d) Vehicle body panels and windows must be constructed from materials that maintain their shape and structural integrity under aerodynamic forces expected during competition.

e) The vehicle interior must not contain any objects that might injure the Driver in the event of a collision.

f) Windows must not shatter into sharp shards. Protective film covering the windows is allowed but must not distort the driver's visibility.

g) The energy compartment (engine/motor/transmission/battery, etc.) should be easy to access for a quick inspection.

h) All parts of the drive train, including fuel tank, hydrogen system components, etc. must be within the confines of the body cover.

i) All objects in the vehicle must be securely mounted. Bungee cords or other elastic materials are not permitted for securing heavy objects.

j) All vehicles must have a solid floor and frame that prevent any part of the driver's body from contacting the ground.

k) All vehicles must be fully covered. Open top vehicles are not allowed. Vehicles that look like bicycles, tricycles or wheelchairs are not acceptable.

l) The use of asbestos and asbestos-containing materials is forbidden.

Article 26: Chassis/Monocoque Solidity

a) Teams must ensure that the vehicle chassis or monocoque will safely protect the driver's body, including crumple space in the event of a front, side, or rollover collision.

A monocoque is a construction that supports structural load by using an object's external skin as opposed to using a frame.

b) 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.

c) 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 of a material structurally capable of protecting the driver. 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.

d) The roll bar must be able to withstand a static load of 700 N applied in a vertical, horizontal, and/or perpendicular direction, without deforming in any direction.

e) 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 not protrude in the impact area in the event of a rollover.

f) If the vehicle must be lifted at a specific place on its body, it must be clearly marked with a red arrow sticker, provided by the Organisers. See Appendix 1.

Article 27: Propulsion and Energy Storage System Isolation

a) A rigid Bulkhead must safely isolate and seal the vehicle's propulsion and energy storage systems from the driver's compartment.

A bulkhead is an upright partition separating the driver's compartment from the energy compartment. This means engines, fuel cells, fuel tanks, batteries (propulsion or accessary), hydrogen cylinders, supercapacitors, etc. must be placed outside the driver's compartment behind the bulkhead. The purpose of this bulkhead is that in the event of a fuel leak, fire or battery release incident, it prevents liquids and/or flames from reaching the driver.

b) The bulkhead must be able to protect the driver from an open flame in the energy compartment.

c) The bulkhead must prevent manual access to the energy compartment by the Driver.

d) If holes are made in the bulkhead to pass components like wires, cables, or seatbelts through, it is essential that these components are protected by a grommet or similar protective material to prevent chafing or damage. All gaps and holes must be sealed with a fire-resistant material.

Article 28: Visibility

a) 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. If applied, window tint must be light enough to allow the driver to be seen from outside the vehicle.

b) The vehicle must be equipped with a rear-view mirror on each side of the vehicle, to be able to identify hazards behind the vehicle, each with a minimum surface area of 2500 mm^2 (e.g. 50 mm x 50 mm).

c) The rear-view mirrors may be substituted with rear-view devices providing visibility comparable to

conventional mirrors. These devices may include electronic displays, but must meet the following safety considerations:

i. They must provide continuous real-time video feed with no noticeable delay while the vehicle is powered.

ii. The devices must be weather resistant and mounted securely.

iii. Adequate brightness and clarity must be maintained in various lighting conditions, including direct sunlight.

iv. The installation must not obstruct the Driver's field of view or create distractions.

d) For Urban Concept vehicles wet weather visibility is also mandatory (see Article 52).

Article 29: Safety Belts

a) The Driver's seat must be fitted with an effective safety harness with at least five mounting points to maintain the Driver securely in his/her seat. The five independent belts must be firmly attached to the vehicle's main structure and be fitted into a single buckle, specifically designed for this purpose.

b) 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 adjustor must be located as close as possible to the connection point. The crotch strap mounting point must be underneath the body, and the topmost straps must be mounted below the top of the Driver's shoulder.

c) The safety harness must always be worn sufficiently tight and fastened to prevent the Driver from having free movement when the vehicle is in motion.

d) Each safety harness mounting point must be strong enough to protect the Driver in the event of a collision, with a minimum force of 200 N in any direction.

e) All mounting points should be clearly accessible for technical inspection.

f) The safety belt should be in a straight line between the mounting point and the shoulders of the Driver.

g) The safety belt or any part thereof must be designed for motorsport activities.

h) Modification of the safety belts between the mounting point and the latch is not allowed.

Article 30: Vehicle Access

a) It is imperative for Drivers, fully harnessed, to be able to vacate their vehicles at any time without assistance in less than 10 seconds. For Urban Concept vehicles, this is applicable for both doors.

b) The driving position including access must be designed so that emergency services can easily extract the Driver from their vehicle, if necessary.

c) Access to the driver compartment must be able to be opened with a single action. This must be easily and intuitively operable from both inside and outside the vehicle without the use of tools.

i. A standard sticker, provided by the Organisers, must be positioned on the vehicle body to indicate the position and method of opening. See Appendix 1.

d) It is forbidden to use adhesive tape to close the Driver's opening from the outside.

Article 31: Horn

a) Each vehicle must be equipped with an electrically powered horn typically used in current

automobiles. Bike or cycling horns are not permitted.

b) The horn must be mounted at the front of the vehicle without obstruction.

c) The horn must emit sound greater than 85 dBA when measured 4 meters in front of the operating vehicle. The horn must produce a continuous single tone sound when activated – chirping or siren-like tones are not permitted.

d) The horn must be powered by the vehicle battery. The power consumed by the horn is not required to be measured by the Joulemeter (see Article 56c:iv).

Article 32: Steering

a) Steering must be operated predominately through the front wheels.

b) The steering mechanism must be precise and intuitive.

c) For Urban Concept vehicles, the steering mechanism must be operated with both hands.

d) Electrically operated indirect steering systems are permitted providing they are operated by a steering wheel or similar device.

   i. Wireless operation is not permitted.

   ii. The Team must be able to demonstrate its use and present documentation during Technical Inspection.

   iii. In the event of a fault detection, the steering system must automatically default to a safe state.

   iv. In the event of an emergency shutdown, where vehicle electric power is removed, the steering system must automatically default to a safe state.

   v. All components of the electrically operated steering system must be responsive and capable of executing the full lock-to-lock range of motion smoothly with the driver seated inside the vehicle.

e) The Organisers 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. For example, the Organisers will verify that steering is precise, with no play.

Article 33: Driver Position

For safety reasons, the head-first driving position is prohibited.

Article 34: Clutch and Transmission

a) All vehicle propulsion must be achieved only through the friction between the wheels and the road.

b) All vehicles with internal combustion engines must be equipped with a clutch system.

c) For centrifugal/automatic clutches the starter motor speed must always be below the engagement speed of the clutch.

d) Only Urban Concept ICE vehicles are required to have idling capabilities. This means the vehicle must be able to remain stationary while the engine is running.

e) For manual clutches the starter motor must not be operable with the clutch engaged. An interlock is required to facilitate this functionality.

f) Please refer to Article 64b regarding starter motor requirements.

g) Guards for rotating equipment, such as gears, transmission chains, and belts, are mandatory, to

shield against accidental contact during vehicle operation and maintenance. They must be robust enough to withstand potential failures of rotating parts. It must also protect from accidental access to these parts while the vehicle is stationary.

Article 35: Exhaust System

a) The exhaust gases must be evacuated outside the vehicle body.

b) Exhaust pipes must not extend beyond the rear or the side of the vehicle body.

c) Exhaust pipes must be solid with no signs of fatigue or leaks.

d) Exhaust pipes must be appropriate for high temperatures.

Article 36: Environmental Considerations

All vehicles are expected to comply with reasonable environmental conditions including smoke, odour, and sound level emitted.

Article 37: Emergency Shutdown

a) The purpose of the emergency shutdown system is to disable the energy supply and the propulsion system of the vehicle. Different energy classes require different measures to accomplish this.

b) The emergency stop circuit must be designed as fail-safe.

A fail-safe design makes the emergency shutdown system as tolerant as possible to likely wiring or component failures. The most common type of wiring and component failure is an "open" circuit, or broken connection. Therefore, a fail-safe design should default to its safest mode of operation in the case of an open circuit.

c) Spark ignition engines (gasoline, ethanol) will require the emergency shutdown mechanism to shut down the ignition. It is not necessary to isolate the accessory battery.

d) Compression ignition engines (diesel) will require the emergency shutdown mechanism to shut off the fuel or air flow. It is not necessary to isolate the accessory battery.

e) For Battery Electric vehicles, the emergency shutdown mechanism must provide a physical isolation of the propulsion battery from the vehicle electrical system. The emergency shutdown mechanism must be located after the short circuit protection device and before the vehicle electrical system. The use of a power controller or other logic systems to drive an isolation device is not permitted. If relays are used, the relays must be a normally open contact type.

A physical isolation means an air gap in the electrical circuit. An air gap is provided by a set of contacts controlled by a relay or a physical switch.

f) For Hydrogen Fuel Cell vehicles:

i. The hydrogen supply circuit must be equipped with a normally closed solenoid emergency shutdown valve. The emergency shutdown mechanism must provide a physical electrical isolation of the hydrogen shutdown valve from its power source.

ii. The vehicle propulsion power must be automatically removed at the same time as the above emergency shutdown valve is deenergised. The emergency shutdown must be activated through hydrogen sensor detection or either of the internal/external emergency shutdown mechanisms. This is to be achieved by a suitable fail-safe relay(s) or similar system.

g) There must be both an internal and an external emergency shutdown mechanism.

i. The internal emergency shutdown mechanism must be accessible by the Driver in driving position.

ii. The external emergency shutdown mechanism must be at the rear of the vehicle and permanently installed on a non-detachable part of the bodywork.

iii. A standard sticker (see Appendix 1), provided by the Organisers, must be positioned on the vehicle body to indicate clearly the exterior position of the emergency shutdown actuator.

h) The external emergency shutdown mechanism must be a latching red push button that protrudes from the body, regardless of its state. The button must only be able to be re-activated by rotating it.

i) 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." 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.

i. This device is a separate switch from the required "emergency shutdown" mechanisms, unless the function of the device is identical to the internal emergency shutdown mechanism in which the dead man switch, and the internal emergency shutdown can be combined into one switch.

ii. If a vehicle is designed with a wide-open throttle, operation of the dead-man switch must switch off the ignition system.

The purpose for this device is to ensure that in case the driver becomes incapacitated the vehicle's propulsion power is automatically disengaged (returns to an idle condition). 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.

Article 38: Additional Inspections

a) After passing technical inspection, any alternation must be re-approved by the Organisers.

b) After any significant incident to the vehicle, it must be re-inspected.

c) At any time, the Organisers may perform unannounced inspections on the vehicles.

3B – Prototype Category

Article 39: Dimensions

a) The vehicle maximum height must be less than 1000 mm.

b) The vehicle track width must be at least 500 mm, measured between the midpoints where the tyres of the outermost wheels touch the ground.

c) The ratio of height divided by track width must be less than 1.25.

d) The vehicle wheelbase must be at least 1000 mm.

e) The maximum total vehicle width must not exceed 1300 mm.

f) The maximum total length must not exceed 3500 mm.

g) The maximum vehicle weight (excluding the Driver) is 140 kg.

h) None of the body dimensions above must be achieved by design singularities such as 'stuck-on' appendages or cut-outs.

Article 40: Not Used

Article 41: Tyres, Wheels, Axles and Wheel Hubs

a) Teams using self-fabricated wheels must provide evidence that the wheels have been properly designed, manufactured, and verified to safely withstand expected operational loads. This evidence must demonstrate appropriate consideration of material properties, structural integrity, and manufacturing quality. Acceptable forms of verification include, but are not limited to, physical testing, validated simulations, or other engineering methods. Documentation must be submitted during technical inspection (see Article 67).

b) Any type of wheel rim may be used. Rims must be compatible with the dimensions of the selected tyres to satisfy safety standards.

Bicycle wheels are not generally designed to support substantial lateral cornering forces, such as may be found in Shell Eco-marathon vehicles at certain speeds.

The wheel axles must be designed for cantilever loads (like in wheelchairs) rather than for load distributed equally on both sides (like in bicycles).

c) Wheels located inside the vehicle body must be isolated from the Driver by a bulkhead and must not touch the chassis or body.

d) All installations must be carried out in a way that there is no likelihood the wheels will touch other parts of the vehicle (i.e. cables, wires, hoses, and energy compartment components like batteries, etc.). These must be safely mounted/secured so that they cannot interfere with the turning wheel during driving and cause accidents.

e) Tyres must be in good condition, free from cracks, cuts, excessive wear, or other signs of degradation that could compromise safety.

f) Teams must not exceed the manufacturer's maximum tyre pressures.

g) The tyre valve needs to be easily accessible to the Technical Team during the competition.

h) The use of historical Michelin radial tyres, including the Michelin Radial 45-75 R16 designed for Shell Eco-marathon until 2018, and any earlier variants no longer commercially available, is not permitted.

Article 42: Turning Radius

The turning radius must be 8 m or less. The turning radius is the distance between the centre of the circle and the external wheel of the vehicle. The external wheel of the vehicle must be able to follow a 90° arc of 8 m radius in both directions. The steering system must be designed to prevent any contact between tyre and body or chassis.

Article 43: Braking

a) Vehicles must have two hydraulic braking systems, one per axle. Brakes that act on the tyres are not permitted.

i. The front brake(s) must have a single foot operated pedal controlling front wheel(s).

ii. The rear brake(s) must have a single lever action attached to the steering wheel or a single pedal.

iii. For each axle, a maximum of two master cylinders is allowed, but each must act on single hydraulic circuit to ensure a proper balance between right and left wheel. One master cylinder per wheel is not allowed. The brake pedal must operate the master cylinders either directly or through a rigid mechanical link. Wires/cables are not allowed.

iv. It must be possible to activate the two brake systems at the same time without taking either hand off the steering system.

v. Brake pedals must have a minimum surface area of 10 cm2, with a minimum width of 3 cm.

b) The effectiveness of the braking systems will be tested during vehicle inspection. Each brake system will be activated separately, and each individual brake system must stop the vehicle on a 20 percent incline.

c) During Technical Inspection, the whole brake system must be visible.

d) During practice or competition runs, the brakes must be protected against any adjustments made by the driver. The effectiveness of the protection will be evaluated during technical inspection and rechecked before entering the track. In addition, vehicles will be checked at the start and/or finish area. Any system that has been compromised will invalidate that run and a penalty may be issued by the Organisers.

3C – Urban Concept Category

Article 44: Definition

The Urban Concept category offers an opportunity to design and build energy efficient vehicles that are closer in appearance to modern passenger cars. Urban Concept vehicles must comply with the specific Shell Eco-marathon rules for this vehicle category. Vehicles competing in this category will focus on "stop and go" driving.

During practice and competition driving at Shell Eco-marathon events, only the Driver is allowed inside Urban Concept vehicles, regardless of the number of seats installed.

Article 45: Dimensions

a) The total vehicle height must be between 1000 mm and 1300 mm.

b) The total vehicle width, excluding rear view mirrors, must be between 1200 mm and 1300 mm.

c) The total vehicle length must be between 2200 mm and 3500 mm.

d) 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 tyres touch the ground.

e) The wheelbase must be at least 1200 mm.

f) The Driver's compartment must have a minimum height of 880 mm and a minimum width of 700 mm at the Driver's shoulders.

g) The lowest point of the vehicle, excluding the wheels, must be at least 100 mm above the ground surface, with the Driver (and necessary ballast) in the vehicle.

h) The maximum vehicle weight (excluding the Driver) is 225 kg.

i) All vehicle dimensions must not be achieved by body extensions such as 'stuck-on' appendages or cut-outs.

Article 46: Vehicle Body

a) Teams must submit technical drawings, photographs or animations of their entire vehicle design to the Organisers for approval at their earliest opportunity.

b) The vehicle body must cover all mechanical parts when viewed from all sides. The wheels and suspension must be fully covered by the body when seen from above, and the wheels must be covered up to the axle centre line when seen from front or rear. The covering for the wheels and suspension must be a rigid, integral part of the vehicle body.

c) Teams may NOT use commercially available vehicle body parts.

d) All Urban Concept vehicles must have two doors, one on each side of the driver compartment. Each door opening must provide access exclusively to the Driver compartment, and must have a minimum dimension of 500 x 800 mm.

This will be verified with a rectangular template of 500 x 800 mm with 50 mm radius corners vertical or horizontal.

e) Any access opening mechanisms must be firmly attached to the vehicle body by means of hinges or sliding rails. Adhesive tape, Velcro, or similar materials are not permitted for this purpose.

f) The vehicle must have a fixed roof covering the Driver's compartment.

g) A windscreen with effective wiper(s) is mandatory. Please refer to Article 52b.

h) Space must be available for a rectangular rigid luggage with dimensions of 500 x 400 x 200 mm (L x H x W). 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.

i) Vehicle bodies must not include any external appendages that might be dangerous to other Team members, e.g. sharp points must have a radius of 50 mm or greater, alternatively they should be made of foam or similar deformable material.

j) A towing hook or ring is mandatory at the front of the vehicle. It can be rigid or flexible (cable or strap). If it is rigid, it must be placed fully under the body for safety reasons. Alternatively, it may be retractable or removable as in a regular car but 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.

Article 47: Turning Radius

The turning radius must be 6 m or less. The turning radius is the distance between the centre of the circle and the external wheel of the vehicle. The external wheel of the vehicle must be able to follow a 90° arc of 6 m radius in both directions.

Article 48: Wheels

a) The rims must be between 14 to 18 inches in diameter.

b) The wheels located inside the vehicle body must be made inaccessible to the Driver by a bulkhead and must not contact the chassis or body.

c) Teams using self-fabricated wheels must provide evidence that the wheels have been properly designed, manufactured, and verified to safely withstand expected operational loads. This evidence must demonstrate appropriate consideration of material properties, structural integrity, and

manufacturing quality. Acceptable forms of verification include, but are not limited to, physical testing, validated simulations, or other engineering methods. Documentation must be submitted during technical inspection (see Article 67).

Article 49: Tyres

a) Both tyres on a single axle must have identical specifications.

b) Tyres must fit the rims recommended by the manufacturer and have a minimum tread of 1.0 mm in the tyre surface in contact with the ground.

c) The tyre/rim assembly must have a width equal to or greater than 80 mm, measured from tyre sidewall to tyre sidewall. The width is measured with the tyre fitted on its rim at its operating pressure.

Caution: The manufacturer's size indications should not be taken as measure, as the width of the rim directly impacts the width of the rim/tyre assembly.

d) Tyres must be in good condition, free from cracks, cuts, excessive wear, or other signs of degradation that could compromise safety.

e) Teams must not exceed the manufacturer's maximum recommended tyre pressures.

f) The tyre valve needs to be easily accessible to the Technical Team during the competition.

Article 50: Lighting

The vehicle must have a functional external lighting system, including:

a) Front headlight(s)

b) Front turn indicators

c) Rear turn indicators

d) Red rear brake light(s)

e) Red rear running light(s)

f) All individual light elements must emit sufficient light to ensure they are clearly visible and easily distinguishable under typical daylight and nighttime conditions. Lights must be symmetrically positioned on the vehicle.

g) The outermost edges of the headlight, brake light, and running light units must be a maximum of 300 mm from the outer edges of the vehicle.

h) A hazard light function must be included in the vehicle system.

i) Innovative and modern lighting designs are permitted, provided they meet the functional requirements for visibility and safety. For instance, rear lighting that covers the entire back of the vehicle is acceptable if it clearly fulfils the roles of brake lights, running lights, and turn indicators.

Article 51: Braking

a) The vehicle must be equipped with a four-disc hydraulic brake system, with a single brake pedal, which has a minimum surface area of 2500 mm^2. 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 callipers) with a minimum disc thickness of 3 mm are mandatory. Manufacturer's documentation is required to demonstrate authenticity. Bicycle brakes are not

allowed.

b) 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). Each individual brake circuit must be balanced to enable the vehicle to stop in a straight line.

c) A single master cylinder may be used provided it has a dual circuit. A maximum of two master cylinders is allowed.

d) A parking brake function is required to keep the vehicle stationary as and when required. The parking brake must be in a position that enables the Driver to operate it while in their normal driving position with seat belts on. Any removable parking brake must be secured when not in use.

e) The vehicle must come to a complete halt when the main brake is operated on a maximum incline of 20 percent.

Article 52: Wet Weather Running

a) Vehicles must be suitable for running in light rain.

b) The vehicle must be equipped with an effective electric windscreen wiper arm assembly typically found in a production car.

c) The operation of the wiper assembly must be activated by an independent switch easily accessible to the driver.

d) The wiper operation must provide the driver a clear view.

e) The vehicle must be adequately ventilated to prevent driver's compartment from fogging.

4. Energy Sources

4A – General

Article 53: Energy Classes

Vehicles may only use one of the energy classes listed below, which each have individual prizes.

a) Internal Combustion Engine, with the following fuel types:

   i. Gasoline: Shell Regular Unleaded / Shell Gasoline / Shell FuelSave Gasoline

   ii. Diesel: Shell Diesel Extra / Shell Diesel / Shell FuelSave Diesel

   iii. Ethanol: Ethanol E100 (Denatured)

   The gasoline and diesel provided by the Organisers during the competition are the Shell fuels prevalent in the local market where the event takes place. For testing and tuning purposes in the Team's home countries where Shell fuels may not be available it is recommended to use the locally available Unleaded 95 (87 US) or Diesel instead.

b) Battery Electric

c) Hydrogen Fuel Cell

Article 54: Results Calculations

a) All live results available during the competition are provisional until verified and published by the Organisers after the completion of the event, usually within three days after the event.

   The winner of the competition will be the Team with the highest energy efficiency result in their vehicle category and energy class, within the valid attempts as defined for each competition.

b) For all vehicles, the results will be calculated based on the propulsion energy consumed PLUS the electrical energy consumed by the vehicle as measured by a joulemeter.

   In cases where the net electrical energy consumed by the vehicle, as measured by the joulemeter, is negative, no energy (or fuel) credit will be added to the results. This case may occur in Internal Combustion Engine vehicles that include engine powered charging of the battery.

c) Results for the Internal Combustion Engine class will be expressed in kilometres per litre (km/l) or miles per gallon (mpg) of gasoline equivalent, corrected to a temperature of 15 °C on a tank-to-wheel basis.

   The calculation of gasoline equivalent will consider the net calorific value (NCV) and density values of the actual competition fuel consumed, plus the energy consumed from the battery as measured by the joulemeter, corrected for the efficiency of the electricity production process.

Fuel type example values	NCV by mass (kJ/kg)
Gasoline	42,900
Diesel	42,600
Ethanol	26,900
Hydrogen	119,930

Table 1 - NCV example values for different fuels

Example: 10 km is covered with 50 millilitres of diesel and the total electrical energy measured by the joulemeter is 30,000 J. Using the equations:

- *Millilitres of gasoline (from diesel) = (ml diesel) x ((NCV diesel x density diesel) / (NCV gasoline x density gasoline))*
- *Millilitres of gasoline (from joules) = (joules / engine % / alternator %) / (NCV gasoline x density gasoline)*

The corresponding total gasoline equivalent volumes consumed are:

Diesel: 50 x ((42600 x 0.83716) / (42,900 x 0.7646)) = 54.362 millilitres gasoline

Electricity: 30,000 / 0.25 / 0.75 / (42,900 x 0.7646) = 4.878 millilitres gasoline

Net = 54.362 + 4.878 = 59.24 millilitres gasoline

Where:

0.25 = efficiency of the engine conversion process

0.75 = the efficiency of engine driven alternator generated electricity

0.83716 = example density of Diesel (kg/l) @ 15°C

0.7646 = example density of Gasoline (kg/l) @ 15°C

The final fuel consumption result is thus:

Fuel consumption (km/l) = (km / (ml / 1,000)) or

10 / (59.24/ 1,000) = 168.81 km/litre gasoline equivalent

d) Results for the Battery Electric class will be expressed in kilometres per kilowatt hour (km/kWh), or miles/kWh, and will be determined using a joulemeter supplied by the Organisers.

e) The Hydrogen Fuel Cell class will use a flow meter to measure the hydrogen consumed, and the energy consumed from the starter or accessory battery will be measured by the joulemeter. The results will be calculated using the NCV of hydrogen listed above and expressed in km/m3 hydrogen, or miles/m3.

Example: 10 km is covered using 50 litres of hydrogen and the total electrical energy measured by the joulemeter is 10,000 J. Using the equation: litres of hydrogen = (joules / fuel cell %) / (hydrogen NCV x hydrogen density), the corresponding total calculated consumed litres of hydrogen are:

Hydrogen: 50 litres hydrogen

Electricity: 10,000 / 0.5 / (119,930 x 0.08988) = 1.855 litres hydrogen

Net = 50 + 1.855 = 51.855 litres hydrogen

Where:

0.5 = efficiency of the fuel cell

0.08988 = the density of hydrogen (g/l) at STP

The final fuel consumption result is thus:

Fuel consumption (km/m3) = (km / (l / 1,000)) or

10 / (51.855 / 1,000) = 192.85 km/m3 hydrogen

Article 55: Fuel Supply and Handling

a) During a competition, Teams must only use the fuels as provided by the Organisers.

b) Teams may not add any additives to the fuel. Only the energy derived from the combustion of the fuel in the presence of air alone within the engine system may be used for forward propulsion. No other material that could serve as engine fuel may be used at any time during the event.

c) Participants handling fuel must wear safety goggles and chemically resistant gloves.

d) Catalysts, water injection, or fuel treatment devices are not allowed.

Article 56: Joulemeters

a) Joulemeters will be provided by the Organisers and must be installed on all vehicles.

b) Joulemeters must be installed inside the engine compartment and must be visible and accessible.

Visible means that the joulemeter display or status LEDs must be easy to read by someone standing outside the vehicle. Accessible means the pushbuttons on the joulemeter can be reached. Body panels are allowed to be removed to view and access the joulemeter.

c) Joulemeter placement in vehicle electrical circuit:

i. The joulemeter must be installed between the battery and the vehicle electrical system.

For ICE vehicles, the starter motor cable must be connected after the joulemeter but before the main vehicle fuse. This placement is to ensure the joulemeter measures the starter energy. The starter motor is not required to be fused.

For Battery Electric vehicles, if a relay is used as the emergency stop isolation device, the relay coil is not required to be part of the vehicle electrical system, and its energy is not required to be measured by the joulemeter.

ii. For vehicles with a supercapacitor, an additional joulemeter must be installed between the supercapacitor and the vehicle electrical system to measure the supercapacitor voltage and energy (for hybrid vehicles, see Article 63).

iii. The horn circuit may be powered by a separate circuit connected directly to the battery (see Article 31d).

This means the horn circuit is not required to pass through the joulemeter and the horn energy will not be measured by the joulemeter

iv. The location and placement of the joulemeter(s) will be verified during technical inspection.

d) All electrical energy used by the vehicle, except for specific systems explicitly exempted (i.e., the horn circuit, systems covered in Article 57i), must be measured by the joulemeter. This includes all propulsion and non-propulsion electrical components. The measured energy will be factored into the vehicle's final energy efficiency result.

Article 57: Vehicle Electrical Systems

a) For safety reasons, the maximum voltage on board of any vehicle at any point must not exceed 60 Volts max by design. This includes on-board batteries, external batteries, supercapacitors, fuel cell stack, etc.

b) For all energy classes, only one vehicle battery is allowed.

i. For Internal Combustion Engine and Hydrogen Fuel Cell vehicles this is called the accessory battery (see Article 57h).

ii. For Battery Electric vehicles this is called the propulsion battery, which means that an accessory battery is not allowed.

Battery definition: A 'battery' is defined as a source of electrical energy, which has exactly two connectors and can be described as a unit. This unit may contain more than one sub-unit or battery module. If more than one sub-unit or battery module is used, they should be packaged together in a single physical package. The package may be made of any material provided it contains the entire battery.

c) The battery must be fixed outside of the Driver's compartment behind the bulkhead (see Article 27). Batteries mounted directly under the driver's seat are not allowed.

d) If Lithium-based batteries are used:

i. Battery Management Systems (BMS) must be tailored to the lithium chemistry to control and protect the battery against risk of fire.

1. The BMS must provide cell balancing and overvoltage protection during off-track charging.
2. For battery electric vehicles, the additional requirement of cell level over-discharge and cell level overcurrent must be provided as part of the on-vehicle system. The BMS must AUTOMATICALLY isolate the battery, without operator intervention, if a limit or out of range condition is reached on any of the above parameters.
3. For Battery Electric vehicles, the on-vehicle BMS must be located in the physical battery package and be powered directly by the battery (see Article 57b:ii)

ii. For all self-built batteries, the following applies (note: a battery with a separately purchased BMS is also considered a self-built battery).

1. If there are one or more cells or modules, the overcurrent protection value for cells in parallel must be selected such that under normal operating or expected failure conditions, no single cell will be exposed to current beyond its rating.
2. All cells or modules must be identical in configuration. (i.e. a battery constructed from cells of different capacities is not allowed).

If the BMS is purchased separate from the battery, ensure it is compatible with battery chemistry. Example: Li-Polymer (LiPo) batteries require a BMS designed for LiPo batteries.

iii. Charging of batteries must be done with the battery charger purchased together with the battery or a purpose-built charger specifically suited to the given battery chemistry. For self-built batteries, Teams must demonstrate that the charger is suitable and is integrated with the BMS system.

iv. The maximum capacity of any Lithium-based battery used is 1,000 Wh. For batteries not rated in Wh, the Wh rating is calculated by multiplying the amp-hour rating of the battery by its nominal voltage.

v. Protection for Lithium-based battery charging, whether in or out of the vehicle must be provided, see Article 24h).

vi. Any 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 securely mounted and 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 or in the engine compartment in the event of a vehicle rollover. Velcro or similar materials that will melt are not permitted to be used in battery mounting. Lightweight aluminium, other semi-metallic materials, or non-solid trays are not acceptable as metal containment.

vii. Power tool or hand-held equipment batteries are not permitted as a Battery Electric vehicle propulsion battery.

viii. Printed manufacturer's documentation for lithium-based batteries and the associated battery management system must be available for review during technical inspection (see Article 67c).

e) All batteries and Supercapacitors must be short circuit protected. Protection may be in the form of a fuse, fusible link, or a current interrupting device (circuit breaker). Automatic reclosing current interrupting devices are not allowed. Short circuit protection devices must be located on the positive conductor and as close as possible, or a maximum 300 mm from the positive terminal of the battery or Supercapacitor. The rating of the short circuit protection device must enable the battery or Supercapacitor to always supply enough short circuit current to open the device. For vehicles with a starter motor, the starter motor cable is NOT required to be protected.

f) For safety reasons, both the positive and negative circuits of the propulsion battery (for Battery Electric vehicles) and Supercapacitors must be electrically isolated from the vehicle body, frame, and metal components.

g) All vehicle electrical circuits must be protected against electrical overload. Overload protection may be in the form of fixed current limits within electric controllers or by the insertion of individual circuit fuses.

h) The accessory battery provides all allowed vehicle electrical needs such as safety devices (windscreen wipers, lights, hydrogen sensors, hydrogen relays and hydrogen shutdown valve), ignition, fuel injection control, and starter motor.

The accessory battery may also power electrically driven engine components such as engine oil and cooling pumps, electric turbo compounding, electromechanical variable valve timing, compressors/ blowers, etc.

i) Only Driver communications (see Article 16), driver display, or ventilation devices are allowed to be powered using built-in batteries. These devices must be unmodified and self-contained.

j) All electrical/electronic enclosures purchased or built by the Teams must be made of transparent material or at least have a transparent cover to allow the technical inspectors to view the contents.

k) Electrical wiring must be in good condition, neat, secured and not close to moving parts. Exposed high voltage terminals must be protected from accidental short-circuit. All wiring connections and terminations must be visible and easily accessible. Splices are not allowed.

l) If solar panels are used, they must follow the natural contour of the vehicle body and must not form a separate structure or be part of any protruding element. The solar panel output must be connected to the vehicle electrical system between the battery and the vehicle joulemeter.

Article 58: Not used

4B – Internal Combustion Engine

Article 59: Propulsion

The type and design of the internal combustion engines are not restricted; however, they must run only on the fuel provided by the Organisers and must not consume any engine oil (2 stroke engines are not allowed).

Article 60: Other On-Board Energy Sources

a) For all fuel types, stored pneumatic energy not replaced during the competition by the engine may only be used for the fuel injection system.

b) For Prototype vehicles, fuel pumps are permitted for all fuels provided they are mechanically driven by the engine only. Electric fuel pumps are prohibited.

c) For Urban Concept vehicles, fuel pumps are permitted for all fuels. The use of an electric fuel pump is permissible under the following conditions:

   i. The fuel pump must be an inline type.

   ii. The fuel system must maintain operating pressure while the fuel pump is off.

   iii. A pressure gauge must be installed to verify the fuel system pressure in the pressurized portion of the fuel system. The pressure gauge must be marked with normal operating pressure.

   iv. Fuel system pressure must not exceed 5 bar.

   v. Fuel pump must be installed between the tank and the liquid flow meter.

   vi. No additional fuel storage volumes are allowed other than the fuel tank. Submersible pumps are not permitted.

d) For Urban Concept vehicles it is required, for Prototype vehicles it is permitted to pressurise the liquid fuel tanks, to feed the engine, only under the following conditions:

   i. Pressurisation is done by means of a translucent compressed air bottle fitted with a safety valve set to 5 bars maximum – or the lower operation pressure of the vehicle system. This safety valve must be located between the pressurised air bottle and the pressure regulator.

   ii. The pressurisation is done in the starting area by means of an air pump.

   iii. The Driver must not modify the pressure during the competition.

   iv. This rule does not apply to Urban Concept vehicles with an electric fuel pump.

e) Auxiliary energy sources (chemical, latent energy from phase changes, etc.) are not permitted.

f) For all vehicles, if the engine temperature is regulated, this must be accomplished using pressurized pure water in a cooling system powered by a mechanical or electrical pump. The components must be rated for system operating pressure and there must be over-pressure protection.

g) The external regulation temperature of the engine by external heating devices is limited to 100 °C.

h) The use of vacuum from air intake cannot be used for auxiliary equipment such as clutches.

Article 61: Fuel Tanks

a) The vehicle must be equipped with only one of the following approved fuel tanks available by purchase from the Organisers. Tank capacities:

- Prototype: 30, 100 or 250 cc
- Urban Concept: 30, 100, 250 or 350 cc

b) The fuel tank must be mounted in an accessible and zero-degree vertical position which allows in-situ filling with a burette of approximately 1 metre height.

c) The fuel tank must be mounted in a way that its top is at least 50 mm below the roll bar and far from any moving parts, batteries, heat and ignition sources.

d) The fuel tank cap, whether it is leak-proof or not (drilled), must be in place during the competition. For diesel engines, a small (<3 mm) hole must be drilled in the centre of the cap to allow air to enter the tank, hence allow fuel out.

e) Fuel return lines must be fed into the fuel feed line below the fuel tank. For diesel engines, the return line can be fitted to the fuel cap only if the engine was originally equipped with a manual priming pump and this return line and the pump have not been modified.

f) Teams must equip their vehicle with clear fuel lines which are not prone to expansion when pressurised and must be able to connect to the Organiser-provided liquid flow meter (see Article 62i).

g) For all pressurised fuel systems, the hoses connecting the pressure bottle to the fuel tank cap must be flexible (do not need to be Rilsan/Nylon type) to allow easy connection and to prevent side loading to the tank necks.

Article 62: Fuel System

a) Participants must provide a description and a precise technical drawing of the fuel supply system from tank to engine.

b) This system must be designed that it can be completely drained and refilled before the competition.

c) The fuel line between the tank and the engine must not include any additional components, for example filters. A second valve directly at the bottom of the fuel tank is tolerated.

d) For diesel engines, a cut-off solenoid valve is required (see Article 37d).

e) Engines with carburettors are prohibited (fuel injection is mandatory).

f) The air intake manifolds must not contain any fuel (or be able to accumulate any fuel) or blow-by gas when the vehicle is on the starting line prior to departure. Air filters are not allowed in the intake system. Blow-by gas must not be recycled during the competition but must be collected in a specific canister for environmental protection.

Blow-by gas: gas inside the engine (oil vapours, unburnt fuel, or gas in the combustion chamber that has not been evacuated in the exhaust). This gas is usually recovered at the intake manifold. This is known as blow-by gas re-circulation.

g) The fuel system must be easily accessible for inspection and measurements.

h) It must be possible to set the fuel supply system to atmospheric pressure for measurement of the fuel level. The pressurisation system must be equipped with a pressure gauge and normal running pressure must be clearly marked on the gauge

i) The fuel consumption will be measured using a liquid flow meter unless otherwise stated in Chapter II. The liquid flow meter, provided by the Organiser, must be installed by the Teams, below the fuel injector. The liquid flow meter will be stand alone with an internal battery.

j) Fuel is a volatile product. Therefore, it is not allowed to artificially increase the fuel system temperature, which would lead to the formation of vapour locks. Conversely, cooling or refrigeration of the fuel below ambient temperature is also prohibited.

Article 63: Vehicles using Hybrid Technology

For Shell Eco-marathon, hybrid technology refers to an ICE vehicle using mechanical power from the engine and electrical power from an electric motor, and results will be communicated in km/l or mpg gasoline equivalent.

a) A Supercapacitor is the only allowed energy storage device for hybrid vehicles. Mechanical or hydraulic energy storage is not permitted. The use of any battery in the hybrid propulsion system is forbidden.

b) This capacitor must be the only source of stored energy for the electric motor driving the vehicle.

c) Two measurement points (voltage + and –) must be installed outside the vehicle to allow the voltage measurement. These must be labelled with "Supercapacitor Voltage", and the relevant polarity.

d) The state of charge of the Supercapacitor will be checked before and after each run by measuring its voltage. A joulemeter must be installed between the supercapacitor and the vehicle electrical system to measure the Supercapacitor voltage and energy (see Article 56c:ii). The voltage registered after the run must be at least equal to the voltage registered before the run. In the event of the contrary, the Supercapacitor must be re-charged by running the engine until its voltage is equal to the voltage registered before the run. The time required to recharge is added to the recorded time of the relevant run.

e) The electric circuitry must be correctly fused to prevent overloading any of its parts. The fuse needs to be clearly labelled in the technical drawings and easily accessible for Technical Inspection (see Article 57g).

Article 64: Starter

a) An electric starter must be used during the competition. Manual hand starting is prohibited.

b) It must be clearly established that the starter is never capable of providing any forward propulsion to the vehicle.

4C – Electric Propulsion

Article 65: Hydrogen Fuel Cell vehicles

a) Fuel system

   i. Participants must provide a description and a process flow diagram of the fuel supply system.

   ii. The fuel system must be easily accessible for inspection and measurements.

   iii. The energy needed for temperature regulation, fan, compressor, electronic management system for the fuel cell and the propulsion motor must be supplied by the fuel cell and not by the accessory battery.

   iv. The hydrogen distribution system must include the following components:

      1. Pressure regulator directly attached to the outlet of the hydrogen cylinder. The maximum allowed outlet pressure is 6 bar. Inlet pressure to be compliant with the pressure used in the region.

2. Two mechanical or digital pressure gauges physically displayed in vehicle – outlet of cylinder, outlet of regulator.
3. Emergency shutdown valve directly attached to the outlet of the pressure regulator.
4. Pressure relief valve before the flow meter, which must protect the hydrogen piping and associated equipment from overpressure below their maximum pressure rating.

Pressure relief valves must be vented outside through the top, side, or back section of the vehicle. The exhaust tubing must be well secured to the vehicle.

v. The flow meter must be fixed at the inlet of the fuel cell and must be the last component before the fuel cell.

b) Hydrogen cylinders

i. Fuel cell-powered vehicle must use a compressed hydrogen cylinder, referred to hereafter as a cylinder, as provided by the Organisers during the entire event. Only one cylinder may be fitted to a vehicle.

ii. Teams must not bring their own hydrogen cylinders or cartridges. Cartridges and other means of hydrogen storage are not permitted. Cylinders will be provided by the Organisers.

iii. Only one hydrogen cylinder will be supplied at a time. A new cylinder will be provided in exchange for an empty one. All cylinders will be labelled with a specific number to ensure traceability. Cylinders must be returned to the Organisers before paddock closure. No cylinder shall remain in the pit area after paddock closure.

It is recommended that a single team member, who has hydrogen experience, be identified as the person to be responsible for handling the hydrogen cylinders.

iv. The cylinder must be installed securely in the vehicle to minimise movement and stress on pipework when the vehicle is moving.

c) Ventilation

i. The vehicle body must allow for ventilation at the highest point of the fuel cell compartment, providing an orifice with a minimum opening of 500 mm^2. Another 500 mm^2 opening must be provided at the highest point of the driver compartment.

d) Hydrogen detector

i. A hydrogen sensor must be installed in the fuel cell compartment, near the main ventilation orifice mentioned above. This hydrogen sensor must initiate an emergency shutdown. The trip level of the hydrogen sensor must be tuned to 25% of the LEL (Lower Explosive Limit) of hydrogen, i.e. 1% of hydrogen in air. The hydrogen sensor must activate within 10 seconds of being exposed to hydrogen.

For commercial Fuel Cells with integrated hydrogen detector, it is still required to fit a hydrogen sensor as described above.

ii. The reset of the hydrogen detector, i.e., the hydrogen sensor and its electronics, must be done manually via a switch located in the fuel cell compartment. This switch must not be accessible by the Driver from the cockpit.

e) Pipes and connections of the hydrogen circuit

i. In all cases, piping and connectors of the hydrogen circuit must be suitable for hydrogen use and be leak free. "Leak free" is defined by a hydrogen leak sensor measurement of < 500 ppm

at the vent hole and < 40 ppm at each individual connection. A Team member must be able to present proof that the piping and connectors are suitable for hydrogen use.

ii. If the pressure in the hydrogen circuit is higher than 1 bar above atmospheric pressure, piping must be made of steel, and connectors must be screw/compression type.

iii. If the pressure in the hydrogen circuit is lower than 1 bar above atmospheric pressure, flexible piping and push-in connectors are accepted.

iv. No use of Teflon tape on the connections of the flow meter. Teflon tape is only permitted upstream of the flow meter if the connection to the regulator requires it for hydrogen sealing. In any case, Participants are responsible for damage to the flow meter due to wrong connections.

f) Purge pipe

i. If a purge pipe is needed, its end must be located outside the vehicle.

g) Measurements and Equivalencies

i. The consumption of hydrogen is measured by a flow meter. The flow meter will be checked/calibrated by the Organisers before Technical Inspection.

ii. The Vögtlin Red-y compact series GCM-BIKA-BN00 flow meter will be provided by the Organisers at the event.

iii. The display of the flow meter must be visible from outside the vehicle. It must be inaccessible by the Driver in normal driving position.

Visible means that the flow meter display must be easy to read by someone standing outside the vehicle. It is acceptable if this requires the removal of body panels without the use of tools.

iv. The serial number on the hydrogen flow meter must not be covered or removed.

h) Oxygen and air reserves

i. Oxygen for the fuel cell's operation must be from the surrounding air, not from oxygen tanks or compressed air reserves.

i) Supercapacitors

i. If an embedded electric storage device is part of the powertrain, it must be of capacitor type, referred to hereafter as 'Supercapacitor'. Other types of embedded electric storage device (for example, batteries) are forbidden.

ii. Two measurement points (voltage + and –) must be installed outside the vehicle to allow the voltage measurement. These must be labelled with "Supercapacitor Voltage", and the relevant polarity.

iii. The state of charge of the Supercapacitor will be checked before and after each run by measuring its voltage. A joulemeter must be installed between the supercapacitor and the vehicle electrical system to measure the Supercapacitor voltage and energy (see Article 56c:ii). The voltage registered after the run must be at least equal to the voltage registered before the run. In the event of the contrary, the Supercapacitor must be re-charged by running the fuel cell until its voltage is equal to the voltage registered before the run. The time required to recharge is added to the recorded time of the relevant run.

j) Hydrogen humidifier

i. If a hydrogen humidifier is used, it must be integrated as part of the fuel cell stack and installed after the gas flow meter in the hydrogen supply circuit.

ii. Humidifiers must be supplied with pure water only. If the water is heated, the heater must be equipped with overtemperature protection.

iii. Any water reservoir used with the humidifier must include a pressure relief mechanism designed to vent any backflow of hydrogen or excess pressure outside of the vehicle.

k) Fuel cell starter battery

i. The accessory battery must be used to start the fuel cell, which must be isolated by design from the fuel cell output, meaning the energy cannot contribute to vehicle propulsion.

ii. Any battery must not be mounted directly adjacent to the hydrogen cylinder.

l) Electrical circuit/Electronics

i. A fuse must be installed on the positive terminal of the fuel cell stack. Its melting current (expressed in Amps) must be less than the active area (expressed in square centimetres) of one cell of the stack. For instance, if the active surface of one cell of a 20-cell stack is 60 cm^2, the melting current of the fuse must not exceed 60 A.

ii. If a Supercapacitor is used in the circuit, a fuse must be installed on the positive terminal of the Supercapacitor pack. The fuse rating must be less than or equal to the maximum usable power divided by the rated voltage.

Article 66: Battery Electric Vehicles

a) The drive train in the Battery Electric energy class is restricted to a maximum of one electric storage device, and up to two electric motors, with associated control units. The electric motors may be purchased, purchased-and-modified, or purpose-built. The motor controller MUST be purpose-built for Shell Eco-marathon. Modifications to purchased motor controllers or the use of purchased motor controller evaluation kits are not acceptable. Motor controllers built from sub-components such as single-board computers, power stages, etc. are encouraged. If a motor controller is built incorporating one or more printed circuit boards (PCBs), the text "SEM" must be included in the mask of the PCB etching. If the motor controller includes controlling software, the software must be developed or integrated for Shell Eco-marathon.

b) Only Lithium-based batteries are permitted as electric storage devices.

c) The vehicle must be equipped with an onboard Battery Management System (BMS) to control and protect the battery against risk of fire as defined in Article 57d.

Any BMS for propulsion batteries must provide an AUTOMATIC isolation of this battery in the event of any measured parameters getting out of their designed range.

d) The Lithium-based battery and any accessory circuits are subject to the maximum voltage defined in Article 57a.

e) The vehicle battery must be placed outside the Driver's compartment behind the bulkhead and securely mounted. Bungee cords or other elastic materials are not permitted for securing the battery. See Article 25h.

f) All electrical circuits must be protected as defined in Article 57g

5. Documentation

Article 67: Technical Documentation

a) Competitors need to provide technical documentation in English in two stages:

i. Prior to the event as part of the registration process (see Article 67b)

This documentation serves only to verify that the Team understands the Rules. Online approval in no way constitutes a pre-approval for the Technical Inspection phase.

ii. At the event (see Article 67c)

This should consist of a precise technical description of the vehicle. During technical inspection, the documentation will be compared against the vehicle. Deviations between the technical documentation and the vehicle must be reconciled prior to passing technical inspection.

b) Technical Documentation – prior to event.

i. Competitors must provide, through the registration website, documentation on the vehicle energy supply and propulsion system. It is not necessary to submit detailed component specifications or electrical schematics as part of the online submittal process.

ii. The online submitted energy supply and propulsion system block diagram and associated text description must contain information describing the energy flow and component function for the vehicle energy and propulsion systems. Specific items to be included in the block diagram for each energy class are listed below:

- Internal Combustion Engine: engine, fuel tank, fuel line, injector, pressure relief valves, pressure regulators, pressure gauge, compressed air bottle, vehicle cut-off mechanism, engine, transmission, clutch, wheel, motor, supercapacitor, motor controller if used
- Hydrogen Fuel Cell: Fuel cell, cylinder, solenoid valve, pressure regulator, hydrogen sensor, flow meter, motor controller, motor, supercapacitor, vehicle cut-off mechanism
- Battery Electric: Motor, battery/BMS, fuse, e-stop switches, motor controller

c) Technical Documentation – at event (to be reviewed during Technical Inspection)

i. Competitors must have available for inspection with the vehicle printed documentation describing selective technical aspects of the vehicle. The printed documentation must be bound and divided into the following sections. The general and additional required sections for each energy class are defined below.

1. General (all energy classes)
   - Electrical schematic
   - Battery/BMS, if a Lithium-based accessory battery is included in the vehicle
   - Brake system
   - Electrical steering system, if applicable
   - Self-fabricated wheels, if applicable
2. Internal Combustion Engine
   - Energy supply and propulsion system block diagram
   - Hybrid system, if applicable

3. Battery Electric
    - Motor/motor controller
4. Hydrogen Fuel Cell
    - Energy supply and propulsion system diagram
    - Gas regulator
    - Fuel cell system
    - Supercapacitor, if applicable
    - Pressure relief valve
    - Solenoid valve
    - Pipes and fittings

ii. The minimal contents of each of the above required sections are defined below.

- Energy supply and propulsion system block diagram: include updated diagrams and associated descriptive text as defined in Article 67b above.
- Brake system: provide brake circuit diagram, and manufacturer's technical data with installation instructions on brake master cylinder, brake rotors, and brake callipers.
- Electrical schematic: provide a vehicle level schematic showing all vehicle wiring and associated components and connections. The schematic should include component values such as voltage levels and fuse ratings. Schematics of components such as the engine management system or fuel cell controller are not required in this section.
- Hybrid system: include manufacturers' component specifications at the lowest level of purchased components. Include diagrams describing the power flow into and out of the hybrid system. Include supercapacitor documentation (see the supercapacitor section below).
- Battery/BMS: (For Lithium-based batteries only) Provide battery/BMS manufacturer component specifications at the lowest level of purchased components. At minimum, the battery documentation should include cell chemistry, cell electrical characteristics, cell series or parallel configurations, battery voltage, and current ratings. The BMS data MUST include:

    1. Cell over-voltage and under-voltage protection limits
    2. Battery over-current limit (not required for accessory battery)
    3. Operation of cell balancing

    If a configurable or Smart BMS is used, the above BMS values must be shown on the BMS interface page.
- Motor/motor controller: Provide motor/motor controller manufacturers component specifications at the lowest level of purchased components. For Battery Electric Vehicles, include design documentation on the purpose-built motor controller. The documentation may contain control flow diagrams, motor controller and sub-component schematics and PC board layouts if PC boards were used.

- Fuel cell system: Provide fuel cell manufacturers component specifications at the lowest level of purchased components. This should also include the surface area of the fuel cells, rated power and voltage.
- Supercapacitors: Provide supercapacitor manufacturers component specifications at the lowest level of purchased components. At a minimum, include supercapacitor system rated voltage and maximum current.
- Electrical steering system: Provide overview of lowest level purchased components.
- Gas regulator: Provide certification/manufacturer's documentation, as a minimum listing maximum rated inlet pressure, outlet pressure range (min-max), relief valve set pressure if applicable.
- Pressure relief valve: Provide pressure settings, flow rate, and technical data.
- Solenoid valve: Provide maximum/minimum inlet pressure, control voltage.
- Pipes and fittings: Provide maximum rated pressure and technical data.
- Self-fabricated wheels: Provide a detailed overview of the test methodology, including the tools and equipment used. List all test conditions, such as pressure levels, test duration, and environmental conditions.

6. Awards and Prizes

Details of the Awards and Prizes will be published in the Chapter II Rules for each event.

7. Miscellaneous

Article 100: Personal Data

For all Shell Eco-marathon Events, any information constituting personal data is governed and covered by the Shell Eco-marathon Privacy Notice.

Article 101: Not Used

Article 102: Intellectual Property

Any work performed as part of the Competition may result in the creation of valuable intellectual property. Teams are encouraged to consider all intellectual property created for the Shell Eco- marathon Competition as valuable assets, and to seek professional advice for the protection of their intellectual property. Material uploaded will share your inventions and methods with the world, so you might be advised to make it clear that this is your intellectual property.

Article 103: Third Party's Intellectual Property

By entering, each Team warrants and represents that its vehicle and/or its design is original and does not infringe, defame or otherwise violate the rights and/or property of any third party; does not violate any laws or regulations; and does not utilise, use or infringe the property of any third party including the property and rights of another Team without express written permission to do so. Each Team further warrants that the possession, exploitation, use or distribution by that Team of any intellectual property including without limitation patents, copyrights, designs, trade or service marks, whether registered or not, shall not infringe or misappropriate the intellectual property right of any third party. Each Team shall indemnify the Organisers and its parent, affiliate and subsidiary companies against any costs, loss or damage suffered or incurred by the Organisers and its parent, affiliate and subsidiary companies as a result of any claim that the use by a Team thereof infringes the intellectual property right of any third party.

Appendix 1: Identification of Vehicles

Identification	Position	Dimensions	Quantity
Shell Pecten 	■ Right side ■ Left side ■ Front of vehicle	215 mm x 260mm	3
Race Number 	■ Right side ■ Left side ■ Front of vehicle	200 mm x 260 mm	3
Partner Strip 	■ Right side ■ Left side	770 mm x 80 mm	2
Emergency Stop 	On exterior position of the shutdown actuator	120 mm x 105 mm	1
Lift Here 	On positions where the vehicle should be lifted	80 mm x 40 mm	4
Opening Mechanism 	On exterior position(s) where the vehicle should be opened	120 mm x 60 mm / 60 mm x 60 mm	2

Table 2 - Vehicle sticker descriptions and placement location

Appendix 2: Driver Apparel

To assist teams in choosing the right equipment, please find below an overview of accepted and recommended standards which meet these requirements, as well as a list of standards which will not be accepted.

If you have a helmet, a racing suit, or gloves, which are compliant to a standard not listed below, please send details to shellecomarathon@shell.com with your team name, vehicle category, energy class, and specifications of the equipment for review by the Technical Team. Photos are optional. Please send the information at least two weeks prior to the event.

Racing suit

Recommended	Accepted	Prohibited
SFI 3.2A/5	SFI 3.2A/3	SFI 3.2A/1
SFI 3.2A/10	FIA 8856-2000	CIK-FIA N2013-1 LEVEL 1
SFI 3.2A/15	CIK-FIA N2013-1 LEVEL 2	CIK-FIA N2001 LEVEL 1
SFI 3.2A/20	CIK-FIA N2001 LEVEL 2	
FIA 8856-2018	FIA 8877-2022	

Table 3 - Racing suit standard list

Gloves

Recommended	Accepted
FIA 8856-2000/2018	FIA 8877-2022
SFI 3.3/5	FIA 8867-2016
SFI 3.3/10	SFI 3.3/1
SFI 3.3/15	ISO 6940/6941
SFI 3.3/20	

Table 4 - Gloves standard list

Helmet

Recommended	Accepted
ECE 22.06	DOT FMVSS 218
SFI 31/41.2A	ECE 22.05
SNELL M2015	SFI 31.1/1A
SNELL M2020	SNELL M2010
SNELL SA2020	SNELL SA2000
SNELL K2015	SNELL SA2005
SNELL K2020	SNELL SA/SAH10
FIM FRHPhe-01/02	SNELL SA2015
FIA 8859-2015	SNELL K2010
FIA 8860-2010	FIA 8858-2010
FIA CMR2016	FIA 8860-2004
FIA CMS2016	FIA CMR2007
ACU GOLD	FIA CMS2007
JIS T8133:2015	BS 6658:1985
	INM/NBR 7471
	JIS T8133:2007
	CCC GB 811:2010
	CCC GB 811:2022
	KS G 7001
	SIRIM
	TIS
	IS 4151
	PSB
	CSA CAN3-D230-M85
	NZ 5430
	AS 1698:2006

Table 5 - Helmet standard list

Appendix 3: Shipping Guidelines

Step 1: Choose your freight-forwarder

- Make sure your freight agent is familiar with your destination country's import customs.
- Make sure any quotes you receive are 'door to door', including warehousing and duty fees.
- Make sure your freight agent can provide an advance draft Bill of Lading/Airway Bill.

Step 2: Choose mode of freight

Some considerations:

- Speed versus cost: road freight is usually the simplest way to ship your crate. If road freight is not an option, air freight is faster but significantly more costly. Sea freight is cost-effective but will take longer, it could be an option for outbound shipping.
- Regulations: Air freight is very strictly regulated with reference to dangerous goods. Please refer to the Dangerous Goods Shipping Guide for more information.

  Note especially the advice to separate lithium batteries from your main crate to prevent the whole crate from being labelled 'DG'

Step 3: Packing your vehicle safely

Your crate is an important item for your team to consider. Your crate should be sturdy enough to withstand shipping and multiple movements. Please read the below guidelines carefully, specifically the size and weight parameters, to ensure a successful delivery to site.

Vehicles packed in crates considered unsafe by the Organisers will not be unloaded.

- Items should be packed in reusable bolt and nut, plywood/timber cases
- Crates should be a maximum weight of 1500kg total (including the crate itself)
- Crates should have a maximum dimension of 1.5 m width, 3.75 m length, and 2 m height
- The door/opening to the crate should not be integral to the structure
- It is important that crates are packed to ensure a balanced distribution of weight, with markings to show the centre point of gravity and lifting points
- Crates should be raised off the floor so they can be lifted by forklift
- Ensure your crate can be tied down easily for transport

For easy identification, crates must be marked on two (2) opposite sides as per the example below. One of these sides should face the person who opens it.

SHELL ECO-MARATHON [EVENT NAME]
(Institution name, Team name, Race number)
C/O (insert name of your freight agent)
Number of Packages/Cases: _____ of _____
Gross Weight/Net Weight: _____ kg
Dimensions: _____ x _____ x _____ cm

In addition to the contact information, we suggest that you use internationally recognisable shipping icons on your crate for safe transit, for example:

This way up symbol	"Fragile" symbol	"Keep Dry" symbol
		

Table 6 - Internationally recognisable shipping icons

Once onsite and vehicle/items have been unpacked, all crates will be moved to a holding area for storage until departure. Your crate must be robust enough for multiple movements in transit and onsite.

An example schematic of a crate is available on the FAQ section of the Shell Eco-marathon website.

Dangerous Goods

All materials must be shipped in line with international shipping safety standards. Refer to the Shell Eco-marathon Dangerous Goods Shipping Guide and your chosen freight forwarder for applicable standards. Crates may be inspected by the Organisers on arrival and failure to follow the requirements for the shipping of Dangerous Goods may result in expulsion from the competition.