

EFFI-CYCLE 2017

>>> *DRIVE THE FUTURE* <<<

DRIVE EXCELLENCE SEASON

RULE BOOK



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SAE NIS EFFI-CYCLE 2017

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SECTION A- GENERAL GUIDELINES

1 Overview

1.1 Introduction

Efficycle is an intercollegiate design competition for undergraduate and graduate engineering students where teams have to design and fabricate an energy efficient Hybrid-human powered - three wheeled - electric vehicle. The vehicle must be aerodynamic, highly engineered, safe and ergonomically designed. The design should be commercially viable as a product and should be attractive to the consumers because of its visual appearance, performance, reliability and ease of operation.

1.2 Purpose

The purpose of the event is to provide an opportunity for engineering students by setting up a trend of using eco-friendly vehicles in India and come up with some innovative designs. Students have to tackle real world engineering problems, work in multi-disciplinary teams, practice design for manufacturability and manage a full product development cycle of life.

1.3 Competition Summary

The Competition includes designing, fabricating and validating a three wheeled vehicle driven by two drivers. The vehicle would be capable to be driven simultaneously as well as alternatively by two drivers and also simultaneously and alternatively on electric and human power. The vehicle would be evaluated for its design, performance, safety, durability and the teams compete against each other. The cumulative scores of all the events would decide the overall ranking of the teams in the event.

1.4 Vehicle Design, Analysis, and Construction

The research, analysis, and design of the vehicle entered by a college must be performed solely by a team of current SAE INDIA student members of that college/university. Only fabrication assistance for things requiring outside assistance is allowed. Teams are expected to have full participation from all concerned people. Use of sound engineering practices is expected in design and manufacturing of the vehicle.

2 SAE NIS Effi-Cycle Rules and Organizing Authority

2.1 Authority of the Rules

The SAE NIS Efficycle Rules are the responsibility of the Efficycle Technical Committee and are issued under the authority of SAE NIS.

Official announcements from the Efficycle Technical Committee shall be considered part of rules and shall have the same validity as these rules even if these not initially included in the rulebook and communicated later on.

Ambiguities or questions concerning the meaning or intent of these rules will be resolved by the Efficycle Technical Committee only.

2.2 Rules Validity

The SAE NIS Efficycle Rules posted on the event website and dated for the calendar year 2017 of the competition are the rules in effect for the competition.

2.3 New Rules for Efficycle-2017 Competition!!

This is third consecutive season of theme based Efficycle Competition. Efficycle 2015 was organized as “Light Weight Season” and Efficycle 2016 as “Build Quality Season” focusing on the importance of the light weight and better built-up quality in the performance of Efficycles.

Taking forward efficycle on the path of technical improvements, season of 2017 is being organized as ***DRIVE EXCELLENCE SEASON*** of SAE NIS Efficycle. There are several major & minor changes in the rules and some more new rules are also introduced. Teams must consider the rules given in this document only as effective rules for ***DRIVE EXCELLENCE SEASON***. Teams must try to design and fabricate a vehicle which performs better in laden conditions on smooth horizontal roads as wells as on grades.

Drive performance will be observed through various static checks and dynamic events in this season. However focus on light weight and build quality parameters will continue. Vehicles may be checked rigorously to evaluate the build quality of the vehicles before presenting them to dynamic events. Build quality shall be considered as an overall combination of multiple parameters including but not limited to structural quality/strength, vehicle overall configuration, ergonomic design and aesthetic presentation etc.

DO NOT ATTEMPT to design your vehicle as per the rules of any previous season.

2.4 Rules Compliance

By entering SAE NIS Efficycle competition, the team, members of the teams as individuals, faculty advisors and other associated personnel agree to comply with and be bound by these rules, all the rule interpretations or procedures issued or announced by SAE NIS, Efficycle Organizing Committee and Efficycle Technical Committee. All team members, faculty advisors and other associated representatives are required to cooperate with and follow all instructions from competition organizers, officials and judges.

2.5 Understanding the Rules

Teams are themselves responsible for reading, interpretation and understanding the rules of the competition. To seek the clarifications regarding the rules, teams should contact Efficycle Technical Committee at efficycle.technical@saenis.org. Teams must keep the records of all such email communications ready for reference of judges/inspectors during the event.

2.6 Participating in the Competition

Teams, team members as individuals, faculty advisors and other representatives of a registered college who are present on-site at a competition are considered to be “Participating in the Competition” from the time they arrive at the event site until they depart from the site at the conclusion of the competition or earlier by withdrawing. Hence all such individuals will be bound by the event rules effective for the current season.

2.7 Violations on Intent & Misinterpretation

The violation on intent of a rule will be considered a violation of the rule itself. Questions about the intent or meaning of a rule may be addressed to the Efficycle Technical Committee.

If the team wants to use some particular parts/methods/procedures which are not included in the rulebook directly or indirectly, teams must get a clarification from Efficycle Technical Committee. Special permissions may be given in some cases upon the discretion of the committee. Without the permission of committee (through emails only), teams are not permitted to use such parts/methods/procedures etc. and the usage shall be considered as violation of rules.

2.8 Official Communication

All teams must pay attention to the official announcement made by Efficycle Organizers. All official announcements will be posted on website <http://effi.saenis.org> and/or at official Facebook Group www.facebook.com/groups/EfficycleSAENIS. Event organizers or Efficycle

Technical Committee may directly communicate to teams/captains/facilitator/faculty advisors to provide any additional information.

Following are the official email IDs for the communication with competition organizers:

1. efficycle.technical@saenis.org: for technical queries, rules clarifications, event procedures etc.
2. efficycle.teams@saenis.org: for general queries regarding team registrations, fees submission etc.

Communication with any individual event organizers through email, phone calls or social media will not be considered as official communication and will not hold any validity for competition purpose.

2.9 Right to Impound

Efficycle Technical Committee reserves the right to impound any on-site registered vehicle at any time during the competition for inspection and examination by the organizers, officials and technical inspectors.

2.10 General Authority

SAENIS and the competition organizers reserve the right to revise the schedule of the competition and/or interpret or modify the competition rules at any time and in any manner that is in their sole judgment, required for the efficient and smooth operation of the event.

3 Eligibility

3.1 Eligibility Limits for Teams

Eligibility is limited to undergraduate and graduate engineering students to ensure that this is an engineering competition rather than a race.

3.1.1 Student Status

Team members must be enrolled as degree seeking undergraduate or graduate students in same campus of a college, institute or university situated in India. Team members who have graduated during the seven (7) month period prior to the last date of competition remain eligible to participate.

3.1.2 Team Size

A group Minimum 5 to maximum 12 student members can register as a team for Efficycle 2017 season. The team may contain students from any engineering discipline.

3.1.3 SAE Membership

Team members, faculty advisor and other representative must be member of SAE INDIA at the time of event, the proof of which (such as Membership card) is required at the competition. In addition, the participating college must have an active SAE Collegiate Club. If not, then the students are advised to form an SAE Collegiate Club in their colleges. Participating students are also advised to apply for +1 membership of SAE India to avail maximum benefits from SAE India. The students shall bring their proof of active membership at the event, failing which they will not be registered for the event.

Note: More information regarding the SAE Membership and establishment of Collegiate Clubs can be found at www.saeindia.org

3.1.4 Age

Team members must be at least eighteen (18) years of age at the time of participation in event.

3.1.5 Driver's License

Team members (at least 2) who will drive the vehicle at any time during the competition must hold a valid, government issued 2W/4W driver's license.

3.1.6 Liability Waiver

All on-site participants, including students, faculty advisors and all other representatives of team are required to sign a liability waiver upon registering on-site.

3.1.7 Medical Insurance

Individual medical/health insurance coverage is required for at least 2 drivers and is the sole responsibility of the participants. Teams will be asked to submit these documents at the time of event during on-site registration. No medical insurance will be provided by Efficycle Organizers or by SAE NIS. No claim by participants will be entertained in this regard at any stage of the event.

3.2 Faculty Advisor

3.2.1 Status

Each team is supposed to have a Faculty Advisor appointed by the college/university. The Faculty Advisor is required to accompany the team to the competition and will be considered by competition officials as the official college/university representative. Faculty Advisor must have a valid SAE India membership.

3.2.2 Responsibilities

Faculty Advisors may advise their teams on general engineering and engineering project management theory and act as guide of team. The Faculty advisors are allowed to attend static & dynamic events along with their team at event site but will not be allowed to provide answers or justifications for any question on behalf of team.

3.2.3 Limitations

Faculty Advisors should not design any part of the vehicle nor directly participate in the development of any documentation or presentation. Additionally, Faculty Advisors may not fabricate nor assemble any components, nor assist directly in the preparation, maintenance, testing or operation of the vehicle. In Brief – Faculty Advisors may not design, build or repair any part of the vehicle. But they can support their team for proper upkeep of vehicle in case of any breakdown. He/she can also not perform in the dynamic event on behalf of the team members. Also it is recommended that all documentation of team should be verified by the Faculty Advisor.

3.3 Team Facilitator-Introduced since 2016

3.3.1 Status

Teams can appoint one **Team Facilitator** (not mandatory) to guide the team throughout the event. Facilitator should be an engineering student of the same institute passing in year 2017 or 2018. Facilitator will have the similar status as of a team member. He/she must have a valid SAE India membership.

3.3.2 Eligibility

- a) Must be an undergraduate engineering student of an institute passing a 4 year degree course in year 2017 or 2018.
- b) For the institutes which have participated in Efficycle earlier, facilitator appointed must be a participant of any previous Efficycle seasons.

- c) However, for institutes which are participating first time in Efficycle, the participant of any other reputed SAE event (recognized as CDS event by SAE) may be appointed as facilitator provided that the event is already finished by March' 2017.
- d) **Institute which have not participated in any CDS event of SAE earlier, are not eligible for appointing a facilitator for participating team.**

3.3.3 Responsibilities

Team facilitators are expected to guide the teams based upon their experience gained out of participation in previous Efficycle seasons or other SAE CDS events. This basically includes guidance on project management, planning of fabrication and design validation etc. Team facilitator may discuss design and manufacturing related problems with teams.

Team facilitators may communicate with the Efficycle Technical Committee regarding any issues related to event. He/she should accompany the team during the event and can help them in making strategies during competition. Summarily the team facilitator is a guide to the team who should continuously workout on the improvement of performance of team and overall vehicle quality.

3.3.4 Limitations

Facilitator cannot help the teams directly by doing design, manufacturing or documentation related things hands on. Direct participation by a facilitator in any static or dynamic event is prohibited. Also he/she cannot present on behalf of the team. Facilitators shall be provided access to the team pits but their entry to evaluation area, technical inspection area, test tracks etc. is restricted.

3.4 Registration Procedure:

3.4.1 Online Registration

Teams are required to register online at the Efficycle website <http://effi.saenis.org>. All updates would be put up on the website and official Facebook group and it is the responsibility of the teams to check these updates time to time. For online registration, teams will produce the details as mentioned on the registration form. After registration through website, teams must submit the scanned copy of registration form with photographs and signatures to Efficycle Organizing Committee.

3.4.2 Event Site Registration

The teams shall mark their presence at final event by registering at event site on the 1st day of competition. All participants must provide the following documents –

- A valid driving license issued by the Government as a photographic proof for the Drivers. For other team members, college ID or any other substitute alternate document for a photographic identification.
- SAE Membership cards of all team members, facilitator and faculty advisor.
- Emergency contact data [point of contact (e.g. parent, guardian or spouse), relationship, and phone number].
- PAN Card copy of at least one team member/captain/faculty advisor.

3.4.3 Change in Team

Any changes in the team are not allowed after the final confirmation mail is sent to team from efficycle.teams@saenis.org. However any critical issues related to team structure, captain, facilitator or faculty advisor at any stage of the event must be informed to Efficycle Organizing Committee at efficycle.teams@saenis.org.

3.4.3.1 If there is a requirement of changes in team, first a written permission must be taken from Head of Department/Dean/Director of the institute on college letter head and should be sent to Organizing Committee.

3.4.3.2 These issues will be reviewed by Organizing Committee for further decisions. *Please note that this letter is required to only put up the issue in consideration of organizing committee and Efficycle Organizing Committee reserves its rights to disregard such requests.*

3.5 Vehicle Shipping

The teams must ensure that their shipping agency or freight forwarder or commercial carrier complies with all the rules laid down by the government for inter-state transportation. The vehicle shipping may be a complex and lengthy process. It is the responsibility of teams to ship the vehicle on proper time so that it reaches the event-site before start of event. The participating team itself must be listed as receiving party of consignment. Neither event organizers/SAE NIS nor the host institute can be listed as receiving party.

Teams must keep proper care during transport to avoid any damage to the vehicle. A proper care must be taken while selecting the mode of shipping (train/truck etc).

Event Organizers or SAE NIS do not send any event invitation or road permit etc for such transport. Teams are themselves responsible for any such arrangements. Any such requests made by teams will be disregarded.

3.6 Maximum Entries per college

Multiple teams from any college/university may register for the event. Multiple teams cannot have any team member, facilitator or faculty advisors in common.

3.7 Eligibility for Participation in Main Event- **Introduced since 2016**

There is no Virtual Qualifier Round for main event in the Efficycle 2017 event. But the performance of all teams registered for the event will be evaluated by Efficycle Technical Committee throughout the season. If any team is found not meeting the expectation, it may be barred from the participation in main event at any stage. This evaluation will be done by several means such as reports submission, direct discussion with the team members or faculty advisors, college level visits and inspections. However, if any team's performance is found very poor during the whole season, then it may be restricted from participation in final event as per rule 7.5.

3.8 Registration Fees*

Total registration fees for Efficycle 2017 event will be INR 27000/-. The registration fee will be submitted in 2 phases as below:

- | | | |
|-------------|---|--------------|
| 1. Phase-I | : | INR 15,000/- |
| 2. Phase-II | : | INR 12,000/- |

***Registration fee is non-refundable.**

3.9 Fee Waiver for Girls Participants- **Introduced since 2016**

Phase-I: All teams including "All Girls Teams" will be given concessions of Rs. 1000/- per girl participant in the team maximum up to Rs. 4000/- per team.

Phase-II: The registration fees of Phase-II for "All Girls Teams" will be completely waived-off. Whereas, there will be no fee concession for other teams.

4 Vehicle Eligibility

4.1 Student Developed Vehicle

Vehicles entered into competitions must be conceived, designed, fabricated and maintained by the student team members without direct involvement of professionals, automotive engineers, racers, professional fabricators, technicians, machinists or related professionals.

4.2 Second Year Vehicles-~~New~~

Vehicles, which have participated in SAENIS Efficycle 2016 competition, are eligible to participate in the event. This rule permits the teams to utilize vehicle frames and other components from 2016 competitions. However, the vehicle including frame will be subjected to following compliances:

- a) Modifications required as per Efficycle 2017 rules.
- b) Improvements required for improving the build quality as preventive actions or due to breakdown in previous competition (e.g. reinforcements, trusses etc).

Teams may also reuse their other components such as motor, batteries, seats, seat belts, wheels etc provided these qualify the requirement of the current rules. It is expected from the teams, opting for second year vehicle, to carry out significant improvements in the vehicle. These teams may be subjected to strict inspection and static & dynamic evaluations.

Teams, willing to use the second year frames, must write to Efficycle Technical Committee for seeking the prior permission latest by 25th July 2017.

4.3 Information Sources

The student team may use any literature or references related to vehicle design and information from professionals or from academics as long as the information is given as a part of discussion of available alternatives with their pros and cons.

4.4 Professional Assistance-~~Prohibited~~

Professionals should not make design decisions, drawings or fabricate the vehicle. Those vehicles found to be professionally made will be disqualified from the competition and that college/university will suffer a ban of next 1 more year from participating in the event.

4.5 Kit Vehicles-~~Prohibited~~

Vehicles fabricated from a kit or published designs are ineligible to compete.

4.6 Student Fabrication

Efficycle is intent of the SAE Collegiate Design Series competitions to provide direct hands-on experience to the students. Therefore, students should themselves perform all fabrication tasks whenever possible.

4.7 Proof of In-house Vehicle Fabrication

Proof of fabrication of the vehicle in college facility will be required in form of photos, videos taken during the each stage of fabrication of vehicle (e.g. prototyping, fabrication of components, frame, seats and assembly etc). It is solely the team's responsibility to produce all such document when asked by the event organizers.

Permission of College to use workshop facility for fabrication purpose is also required. This permission letter should be submitted to Efficycle Technical Committee before starting of vehicle fabrication at college facility.

4.8 Limitation on Fabrication at External Facilities

Only those components, which require special tools/machinery for the fabrication, can be allowed for fabrication from external facility. Bills, Invoices, Machinery Rent Receipt along with College/Faculty Advisors Permission will be required as a proof of such works.

4.9 Previously Participated Teams

Efficycle is intended for putting genuine design efforts in conceptualizing the efficycle. Hence the teams which have been participating in the previous seasons of event must incorporate significant improvements in their design with proper justification. This doesn't include the changes enforced by change in rules. However, it is subjected to the decision of judges during evaluation.

SECTION B - VEHICLE REQUIREMENTS

5.1 Vehicle Configuration

The vehicle must have three wheels that should not be in a straight line (i.e. tandem configuration is **prohibited**). The vehicle must be capable of carrying two riders, of at least of 1905 mm (6'3") height and weighing 115 kg each and a payload of 20kg. Teams can build the vehicle with only tadpole (2F1R) configuration. **Delta (1F2R) configuration is not allowed in Efficycle-2017 event.**

5.2 Maximum Vehicle Dimension

Vehicles participating in the competition can have a maximum width of 60 inches (1524mm) covering all its rigid or movable projected parts. Length of the vehicle is not restricted but it is recommended to be within 100 inches (2540mm). All dimensions will be checked without the drivers (unladen condition).

5.3 Maximum Vehicle Weight

Efficycle is intended for building vehicles with least weight. Teams are encouraged to follow light weight practice during design stage and to use light weight components and systems in the vehicle.

Maximum recommended Efficycle kerb weight is 150kg. The teams coming with vehicle weight within 150kg will be considered for Light Weight Score. The actual weight will also be compared with the estimated weight declared in the design report.

5.4 Vehicle Frame

5.4.1 Frame Design

The efficycle frame is the basic structure on which other subsystems are mounted. Frame should be rigid, protective and ergonomically designed.

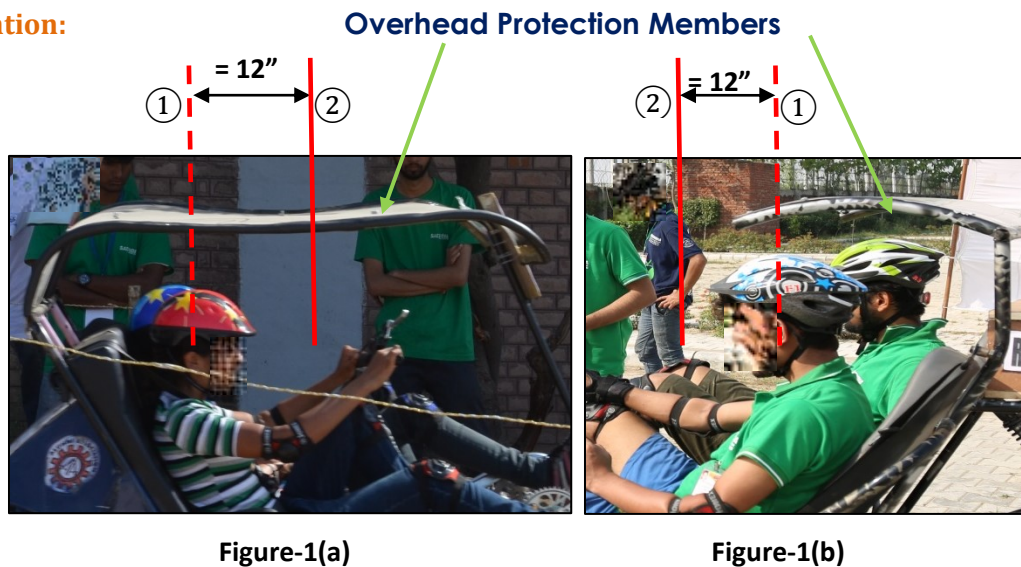
5.4.2 Protection Offered by Frame

The frame must protect the drivers in case of collisions and breakdowns and must prevent the entry of debris/foreign particles during running conditions. **Protection for the impact from front, sides, rear and rollover are mandatory.** Severe track conditions must be taken into account while designing the frame.

5.4.2.1 Overhead protection

The overhead protection members must be extended *horizontally* at least 12 inches (304.8mm) forward from the center of each driver's heads or extended *horizontally* till Point 'B' (as explained in Rule 5.6.6) whichever is more forward while measured in a normal driving position (refer figures-1(a), 1(b) & figure-4). The overhead protection members must be placed with enough supports such that these don't break or deform excessively causing risk to the drivers in case of vehicle rollover. As shown in below figures, both kind of configurations (i.e. close hoop and open hoop) are permitted.

[Illustration:



In above figures 1 (a) and 1 (b), 2 red lines are shown. Dotted Line ① shows the center of driver's head in a normal driving condition. Solid Line ② represents the minimum length which will be required for horizontal extension of overhead protection member from the driver's head center. Examples of previously participated vehicles are shown to illustrate the correct and incorrect usage of overhead protection.

Figure 1 (a): The vehicle shown in this figure uses the *close hoop configuration* of overhead protection members. In this vehicle, the protection members are extended beyond 12 inch limit (Line ②) to make a close hoop structure. However, as per the rule, the joint/bend at this member may be provided at Line ② or the member can be extended further to it. Hence the criteria of the rule are satisfied.

Figure 1 (b): The vehicle shown in this figure uses the *open hoop configuration*. The overhead protection members are provided above the drivers' head. But these members are shorter than the required length and eliminated before 12 inch limit (Line ②). Hence members must be extended horizontally till Line ② at least to satisfy the rule's criteria.

If Line ② falls in between Line ① and Point 'B', then the protection members must be extended horizontally till Point 'B' at least. [This situation may arise in case of larger seatback angles.]

Note: Figure 1(a) and 1(b) are showing only 12 inch limit illustration. For illustration of Point 'B', figure-4 at page 23 must be referred.]

5.4.2.2 Side Protection

Side protection members must be placed such that the drivers' bodies must be completely inside the periphery made by vehicle frame. The handhold must be provided inside the frame periphery such that co-driver needs not to hold any external members for support while driving.

No part of the drivers' bodies including torso and head must project outside (towards left or right side) vehicle frame periphery during static as well as running conditions. Periphery is referred to a geometric plane or a surface passing through external edges of any 2 nearest frame members and has a complete enclosure therefore. Side protection members and handholds must be placed such that these do not hinder the ingress and egress of drivers noticeably.



Figure-2(a)



Figure-2(b)

5.4.2.3 Front Fairing

A fairing is compulsory in the front part. The fairing must be constructed with the transparent sheet of sufficient strength which is mounted to the frame with the help of strong mounting members. This mounting may be made removable for the repairing and shipment purpose. But the fairing must be always mounted on the vehicle and cannot be removed during competition after technical inspection is cleared.

Vertical limits of the fairing should be extended at least till the top of head of drivers (forward to only the front driver in case of longitudinal arrangement of seating positions) and up to the seat cushion surface plane when viewed from front. It can also be extended on the lower side to cover other vehicle components, if required. Horizontal edges should cover the whole width of driver seating area.

Fairing should be aerodynamically designed and can be curved in shape. It is allowed to provide sufficient access through fairing sheet (in form of profiles of different shapes cut in sheet) for drive train component placement and legs movement.

If the fairing is placed between the drivers and the drivetrain components projecting forward and not at the front most position then it is necessary to provide a drive train protection sheet as explained in rule 5.11.

5.5 Frame Material & Cross-Section Requirements

Teams may build the frame from materials or combination of materials mentioned under this rule. Use of multiple cross-sections and more than one type of material within the frame is allowed.

Teams would be asked to justify the selection of material of particular strength and cross-section. The use of material is recommended on the basis of their strength, weight & recyclability etc. ***Teams should work out upon the material availability, weld-ability, weight reduction, structural strength etc.***

5.5.1 Steel or Steel Alloys

If steel or steel alloys are used to build the frame then the following criteria must be fulfilled for all cross sections used in frame.

“The bending strength & bending stiffness of the cross section used in frame must not be less than bending strength & bending stiffness when a circular cross section of 1 inch (or 25.4mm) outer diameter and 0.078 inch (2 mm) wall thickness with carbon percentage 0.18% is used.”

But a wall thickness of less than 1.5mm cannot be used in frame regardless of the cross section even if the above criterion is satisfied.

Frame members must be joined using good welding practices. All the members of frame must be joined to each other using welding over complete run of joint. Joining of any two or more steel/steel alloy members together in frame with bolted application is not allowed.

Note:

The bending stiffness and bending strength must be calculated about a neutral axis that gives the minimum values.

- Bending stiffness is considered to be proportional to the product EI where:

E = Modulus of elasticity (205 GPa for steels)

I = Second moment of area for the structural cross section

- Bending strength is given by:

$$M = (S_y \cdot I) / C$$

Where:

S_y = Yield strength (365 MPa for 1018 steel)

C = Distance from neutral axis to extreme fibre

[Illustration:

A combination “X” of reference material & cross-section is defined in the above rule which is having a circular cross section, Outer Diameter = 1 inch (25.4mm) and wall thickness = 0.078 inch (2mm) with carbon percentage = 0.18%.

The teams should calculate the following

1. Bending Strength of X = $(S_y \cdot I) / C$ [for example, AISI 1018 with C% = 0.18% may be taken which is having the yield strength $S_y = 365 \text{ MPa}$]
2. Bending Stiffness of X $\propto E \cdot I$

Now if the team is using a combination “Y” of any different material or different cross-section, then the Bending Strength & Bending Stiffness of Y must be calculated with similar procedure and compared such that

$$\begin{array}{lcl} \text{Bending Strength of Y} & \geq & \text{Bending Strength of X} \\ \text{Bending Stiffness of Y} & \geq & \text{Bending Stiffness of X} \end{array}$$

5.5.2 Using Other Metals or Composites Material

The complete frame of the partial frame may also be constructed with

1. Metals other than steel family or its alloys.
2. Composite materials
3. Combination of both (including partial usage of above with steel frame)

Teams are encouraged to work upon alternate materials for making the vehicle light weight. For such materials teams may also use bolting applications. A bolted joint is allowed with 2 or more non-steel/alloy members or non-steel/alloy to steel/alloy members.

However, in all such cases the criterion of bending strength & bending stiffness stands valid mentioned in rule 5.5.1 above.

For all materials, the strength of welded joints can be taken same as parent material for ease of analysis and calculation.

5.5.3 Material Testing Report

A material testing report will be required at the time of event, in which material compositions and strengths etc should be clearly mentioned. (Minimum requirements are Carbon percentage and Yield Strength in MPa).

Teams may use external laboratory for material testing. Material strength testing may also be done in the institute's facility and an in-house validated report should be presented. The proof of in-house testing should be kept in form of photos, videos captured during strength testing.

The certificate provided by material dealers will not be accepted.

5.6 Driver Seats

5.6.1 Seat Requirements

Use of a separate driver seat is mandatory for individual drivers. Cushioning or padding attached directly to the frame will not be accepted as a seat.

The seat shall be fastened to the frame using mounting tabs and bolting applications. Seats directly bolted to frame members are **prohibited**. Minimum 4 mountings at the bottom part of the seat are compulsory.

[Teams are encouraged to use in-house fabricated seats for overall vehicle weight reduction.]

5.6.2 Thigh & Torso Supports

The seat **MUST** support the thigh and the entire torso (full width) of both the drivers. Torso support must end at maximum 2 inch (50.8mm) below the driver shoulders and it must be able to provide the support to driver torso in all static and dynamic conditions.

Refer below examples for allowed and prohibited types of seats.

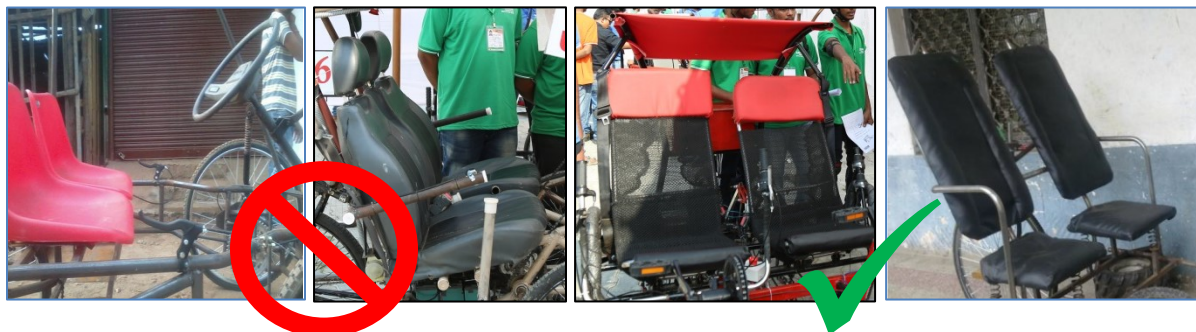


Figure-3

5.6.3 Seating Configurations

Seats can be placed in any of the following configurations-

- 1) **Adjacent:** Both seats are placed side by side
- 2) **Longitudinal:** Seats are placed one after another in longitudinal direction of vehicle such that one seat may be called as Front Seat and the other one as Rear Seat.

5.6.4 Adjustments in Seat and Seatback

Longitudinal adjustment in the seats is allowed for providing suitable adjustment for different drivers. The adjustment system should have a proper locking mechanism such that it remains intact in the position of use.

Seatback may also be provided with the reclining adjustment such that it can be adjusted at different angles.

Length of Overhead protection members will be checked at foremost positions of seat and seatback such that criterion of rule 5.4.2.1 is fulfilled.

5.6.5 Seat Height (d) -

Maximum height (d) of the top surface of seat cushion (measured at Point 'A' on seat cushion located 4 inches (101.6mm) forward to the point of intersection of seat cushion and seatback) cannot be more than 24 inches (609.6mm) from ground for any driver seat. The measurement will be taken without drivers & payload while the seat cushion is not compressed.

5.6.6 Sitting Space Height for Drivers (h_s) -

Sitting space for drivers is vertical space available between seat cushion top surface and the bottom edge of overhead protection members. This will be measured in vertical direction from Point 'A' to the point 'B' (where Point 'B' is the projection of Point 'A' on the bottom edge of the overhead protection member when viewed from side). Following sitting height (h_s) must be provided according to the seatback angles (α):

Range	Seatback Angle from Vertical (α)	Sitting Height (h_s)	Tolerance
1.	$\alpha \leq 25^\circ$	= 40 inch (1016mm)	± 1 inch (± 25.4 mm)
2.	$25^\circ < \alpha \leq 45^\circ$	= 37 inch (939.8mm)	
3.	$45^\circ < \alpha$	= 32 inch (812.8mm)	

If the seatbacks or suspensions are adjustable such that seatback angle includes more than one range, as given in above table, then the sitting height should be taken according to least possible seatback angle.

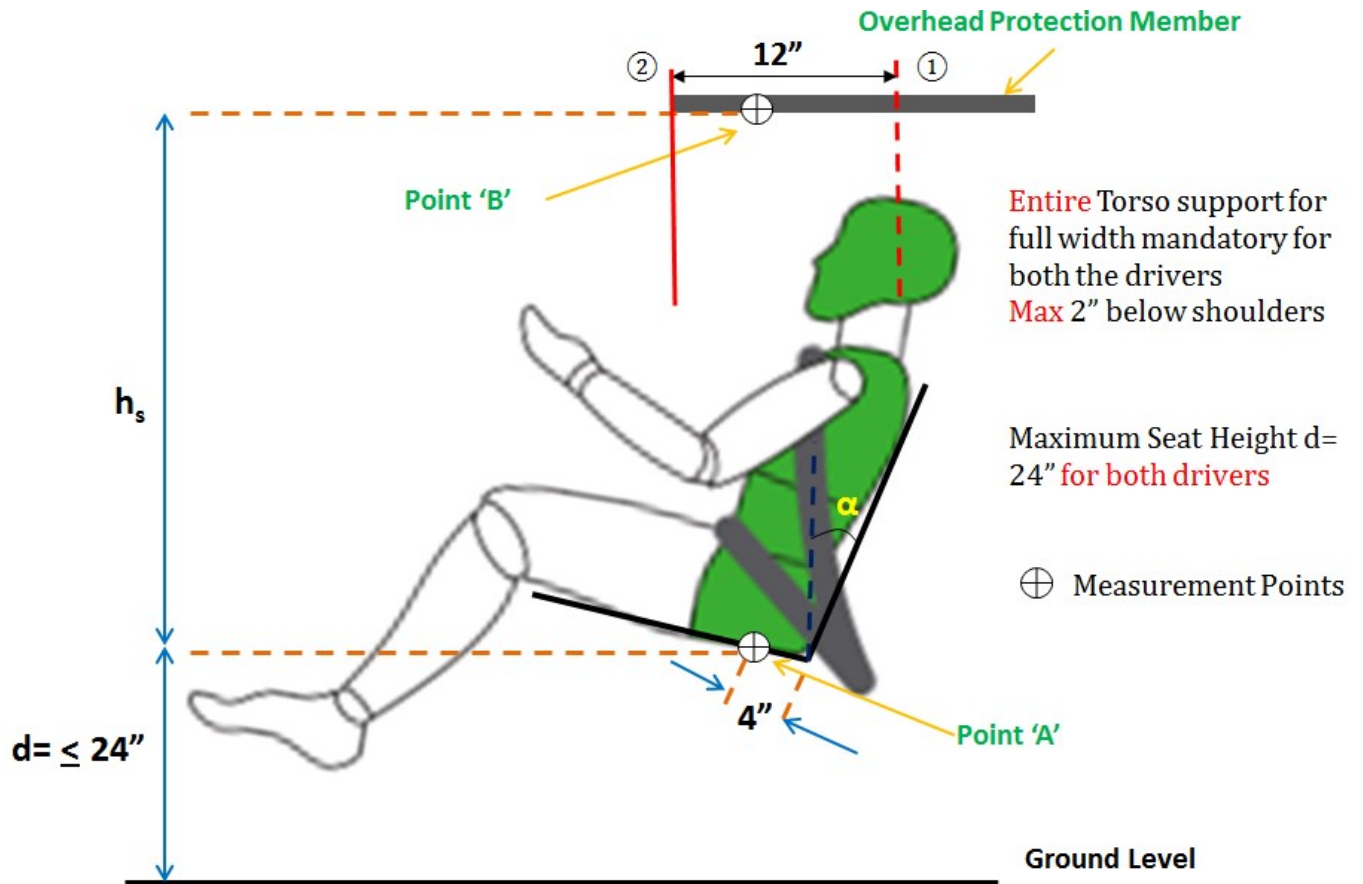


Figure-4

5.6.7 Seatback Support Member

The purpose of providing a seatback support member is to provide a rigid support to seatback and to restrict its movement in case of failure of seatback adjustment or locking system. It should be placed close to the seatback such that minimal gap exists in between.

If recliner seats are used, the seatback support member will be placed at the maximum possible rearward inclination of the seatback. A cross-section of sufficient strength can be used for this member and it should be welded to frame in form of linear member in transverse of vertical directions, curved member or loop etc.

5.7 Seat Belts

5.7.1 Seat Belt Requirements

Use of 3-point seat belts with retractor is mandatory for both the drivers. Use of OEM seat belts with standard buckle and mountings is recommended. Normal shoulder straps, side release buckle straps, belts with metal cam lock buckles etc cannot be considered as seat belts. (Refer below figures).

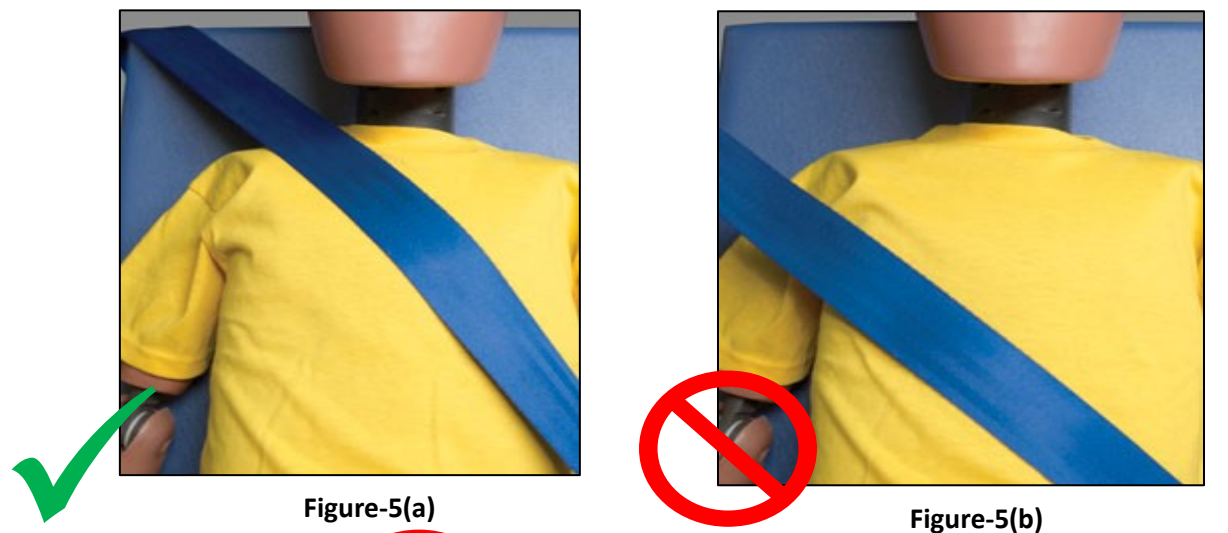


Figure-6

5.7.2 Seat Belt Mounting

Shoulder belt must be mounted behind the shoulder and minimum 4 inches (101.6mm) above the shoulder level of the drivers. The lateral distance of seat belt mounting from the longitudinal center plane of seat must be minimum 8 inches (203.2mm) at the height of 4 inches (101.6mm) above the shoulder level.

Shoulder belts must come across the outboard shoulder of drivers and should be buckled to the lap inboard.

Standard mountings provided with the seatbelts should be used. Teams should not try to make holes etc directly on the webbing for mounting purpose. Belts with tampered webbing or tampered stitching shall not be accepted.

All seat belts should be mounted with bolting on tabs fixed on frame (mandatory). Shoulder belt mounting can be placed on seatback supporting member (recommended).

5.7.3 Head Restraint

Head Restraints may be provided (not mandatory) as a separate attachment to vehicle body/frame/seat or as an integral part of seat itself (i.e. by extending the height of seatback support member).

If the head restraint is provided, the maximum clearance between the head restraint and drivers' helmet must be 1 inch (25mm). The minimum area of the head restraint should be 6 in x 6 in (152.4mm x 152.4mm).

5.8 Clearances

5.8.1 Body Clearances

There should be a clearance (gap) of minimum 3 inches (76.2mm) between the both the drivers, driver and any component of the vehicle, in static and dynamic conditions. Hands, torso, thighs etc & body parts that make contact with the vehicle in normal seating position are excluded from the rule.

5.8.2 Ground Clearance

All rigid parts of the vehicle must have minimum 6 inches (152.4mm) clearance from the ground when measured with both the drivers in normal riding conditions. The measurement of ground clearance will be done at the lowest rigid parts¹ of vehicle which cannot change their position at the time of impact either without resulting in permanent failure in the subsystems or without increasing the risk of injuries to drivers and bystanders. Wheel assemblies are exempted from this rule. Wheel assembly includes all the parts directly mounted to wheel or wheel hub like brake disc, derailleur² etc.

The moving parts such as pedals etc must have minimum 3 inches (76.2mm) from the ground at their lowest position.

¹ It may be considered that rotary parts such as pedals & cranks etc can change their positions in case of direct impact to them by ground obstacles of not more than 6 inches. Whereas chain, sprocket, derailleur etc cannot change their position, even if these are rotary/movable during operation.

² Only those derailleur are exempted which are directly mounted on wheel hub.

However, any decision related to compliance of vehicle regarding ground clearance will be taken by Technical Committee during the technical inspection. Teams may be asked to make necessary changes in case the vehicle seems unsafe for dynamic events.

5.9 Power

Vehicle must have the provision to drive it on Human power and Electrical Power both simultaneously or alternatively.

5.9.1 Human Power

The vehicle **MUST** have the capability to be driven by human power. Both the passengers **MUST** be provided with individual power-trains to drive the vehicle in both single passenger mode and dual passenger mode. This means that there must be at least one operating human power drives provided to both the drivers such that it can be simultaneously or alternatively driven by any or both of the two drivers.

It is recommended that the teams work upon designing a **Power Accumulation System** for human power drives such that the power obtained from individual human power drives can be accumulated and delivered to axle. This arrangement should avoid the relative slip between two pedal drives due to difference of pedaling speed of both drivers.

5.9.2 Electrical Power

Vehicle must have the option to run on electrical power. Team must use one PMDC/BLDC motor of maximum power output 400 Watts for this purpose. The motor installed on the vehicle must contain the OEM's plate with output power and all other specifications mentioned on it. Teams are free to use any kind of controlling devices (drive train, gear box, CVT or any electronic devices) to control the speed of the motor. BLDC motors used in hub mounted automotive applications are allowed. But direct mounting of the motor to the wheel hub and its direct coupling to axle is **PROHIBITED**. Some transmission system is mandatory to transfer the power from motor to wheel. Internal Combustion engines and solar cells are excluded from the competition.

5.10 Drive Train

For power transmission, use of shafts, chain-sprockets, belt-pulleys, gear trains & friction wheels etc is permitted. All moving parts such as belts, chain, and sprocket, must be shielded, to prevent injury to the driver or bystanders, from the metal / chips that may fly apart due to centrifugal force. These guards/shields must extend around the periphery of the belt or chain. These must be mounted with sound engineering practice, in order to resist vibration.

5.11 Drive Train Protection

All drive train parts (like chain/sprockets etc) which are projecting towards front must be covered using a metal/non-metals sheet of sufficient strength. That sheet must cover minimum area of 24 inches (609.6mm) width x 18 inches (457.2 mm) height in front of vehicle such that in case of any collision, the rotating parts do not cause injuries to other riders, bystanders etc. All rotary parts must be provided with the shields to prevent the injuries to the drivers while driving the vehicle.

5.12 Battery

Teams can use 12V-48V & maximum 35A-hr rating batteries. Use of more than one battery for electric drive circuit is allowed provided that the combination (series or parallel) of batteries doesn't have the output more than the above specified range. Each battery should have the specification written on it by manufacturer only.

Use of a separate battery/ battery bank for other electronic components such as lights etc is allowed. The specification of this battery must be selected as per the consumption requirement and it should be light weight.

The batteries must be sealed and leak proof. Vehicle found with any type of leakage in batteries at any stage of event will not be allowed to run any more. To avoid any short circuit the terminals of batteries must be shielded but should be kept accessible for the approach of any measuring instrument.

Batteries should be mounted using sound engineering practices. Hung mountings are not allowed. The mounting should be able to protect batteries from falling at the time of bumps and leaning etc. All components of batteries and motor along with the mountings must be inside the vehicle frame. Batteries cannot be removed from vehicle for charging purpose once the technical inspection is cleared. The proper arrangements must be provided to charge the batteries while they are mounted in the vehicle. Teams may carry portable chargers for charging batteries in pit area,

It is recommended that the teams provide an **On-Board Battery Charging Mechanism** in the the vehicle for minimizing the consumption of electricity for battery charging. For any such arrangements the teams may be asked for explanation at the time of technical inspection and design evaluation. However battery charging is allowed before each dynamic event.

In order to reduce weight of the vehicle, team may explore the options of using different type of batteries other than the conventional batteries used in automobiles. But in all such cases safety of riders and vehicle must be ensured. Short-circuit/fire/explosion prevention techniques should be applied.

5.13 Brakes

All Efficycle are required to have brakes on all wheels to ensure the maximum braking performance and safe driving conditions during the event. Teams can use both hydraulic and non-hydraulic brakes. Brakes **MUST** be mounted on all three wheels; mounting of brakes only on drive axles is **STRICTLY PROHIBITED**. Control of all 3 brakes must be given to at least one driver.

Brakes may be tested during technical inspection by pushing the vehicle in forward direction, with both the riders in normal riding positions. Drivers will be asked to apply the brakes. All wheels are required to be locked during this test. Also there will be a separate brake test according to the procedure specified in rule 8.1.4.

5.14 Steering Control

Teams are free to use any type of the steering mechanism. All the rotating parts must be in the proper covering & fastened with lock nuts. Steering control should be given to the driver having seats on the right side of the vehicle (in case of side by side seating) or to the front driver (in case of front & rear seating). System can be controlled by using mechanical linkages, gears, wires or by electronic devices. In case of handlebars used in steering system, the handles at lock-to-lock positions must comply with rule 5.8.1.

Steering system must be designed such that the turning radius of vehicle is not more than 4 meter. Turning radius will be checked in 'Figure of 8' test having outer circle of 8 meter (315 inches) diameter.

5.15 Utility Requirement

Vehicles participating in the event should be capable of carrying a load of 20 kg. Vehicles must be equipped with one utility box of internal dimension at least 16 inches (406.4mm) x 12 inches (304.8mm) (base dimensions) x 8 inches (203.2mm) (vertical height). Utility box must be provided with an openable cover at top. Utility box should be strong enough to hold the luggage firmly and must be mounted rigidly on vehicle frame. Hung mountings are not allowed.

The utility requirements will be checked by putting a payload of 20kg in the utility box during 'Drive Excellence Test' only as per rule 8.10.

5.16 Vehicle Integrity

No vehicle may discard any part after the vehicle is in motion. Any vehicle found with unsafe loose parts during technical inspection will not be allowed in the event. The vehicle must have integrated structure to ensure the maximum drivers' & bystanders' safety.

If Technical Inspectors find any type of risk to safety, they may ask to make modifications/ changes in the vehicle at event site.

5.17 Wires and Harnesses

Selection of wire diameter/cross-section must be done according to the current in the circuit. All wires and harnesses must be fastened securely to the vehicle structure that prevents coming off in static and dynamic conditions. Use of metal wires, synthetic threads and tapes as a fastening device is **prohibited**. The wires and cables must be routed along the frame in a flexible casing and should be tied to it such that these do not entangle with the riders' body and other moving parts of the vehicle. All electrical connections should be properly insulated from the frame.

5.18 Kill Switch

Push-to-off kill switch must be provided on the vehicle. Whole electrical circuit of drivetrain must get dead by pushing off the kill switch. **AT LEAST ONE** kill switch must be easily accessible to each driver. Rotary-to-off kill switches, electric switches, self-retracting switches and MCBs are not acceptable for this purpose.

5.19 Fasteners

All fasteners used in the systems must be captive; defined as requiring NYLON locknuts, cotter nuts or safety wired bolts (in blind applications). Lock washers or thread sealant do not meet this requirement. Any vehicle failing to comply with this rule shall not be qualified in Technical Inspection.

5.19.1 Fastener Grade Requirements

All bolts used in the system must meet SAE grade 5 or metric grade M8.8.

5.19.2 Thread Exposure

All threaded fasteners used in the vehicle must have at least 2 threads showing past the nut.

5.19.3 Socket Head Cap Screws

Socket head cap screws, also known as "internal wrenching bolts" or "Allen head bolts" used, must have the bolt head, clearly marked with the letters "NAS", "12.9", or "10.9" or high-strength metric fastener.

5.20 Drivers' Equipment

Both drivers must wear the well fitted cyclist helmets with an integrated (one composite shell) belt to tighten the helmet. Also wear the knee and elbow pads during all dynamic events of the competition.



Figure-7(a)



Figure-7(b)

5.21 Vehicle Identification

All vehicles are required to have proper display of identity of vehicle. Vehicle identification includes **Vehicle Number, Team Name and College Name**. Along with this, the vehicle must display SAE INDIA logo, event sponsor logo that will be provided by the organizers at the event site. If vehicle identification is lost or obscured, the vehicle will be removed from the competition until this is repaired.

5.21.1 Vehicle Number

The vehicle number must be of at least 6 inches (152.4mm) height and 1 inch (25.4mm) line thickness (font thickness). This number will be allotted by the event organizers to all the teams participating in the final event. The number must be clearly displayed on all four sides of the vehicle. It should be vertically placed to ensure its maximum visibility for the purpose of identification & scoring.

Numbers can be placed in form of protrusions, cutouts, reflective stickers of proper color (excluding white) etc. Painted numbers are not allowed. If a vehicle number is obscured during the endurance race any laps run without a number will not be counted. Vehicle, with numbers not clearly visible, may get disadvantage of loss in scoring.

5.21.2 College Name

College name must be displayed in full or initials at least one place on vehicle which is easily visible from the front and it must be of minimum 2 inches (50.8mm) height.

5.21.3 Logos

Logos of SAE NIS and event sponsors will be provided at the event site. This must be displayed at both sides of the vehicle. Teams can also display their team sponsors logo but it should not affect the visibility of vehicle number and event logos.

A space of 12 inches x 12 inches (304.8mm x 304.8mm) must be provided to paste the event logos when viewed from the front.

5.21.4 Identification Flag

An identification flag of the dimension 12 inches (304.8mm) length x 8 inches (203.2mm) height is required on the vehicle above the topmost member of the frame. Recommended location of flag mounting is behind the driver seating area. Shape of the flag can be rectangular or triangular. Flag must display the Vehicle Number on both the sides and it may also contain the Team Logo etc.

5.22 Prohibited Items/ Practices

5.22.1 Vehicle Items/ Accessories

Vehicle should not have any sharp edges which can hurt the drivers and others. The use of horns and bells is **prohibited**. Vehicle body should not have any reflective surfaces or reflective paint. Use of side view mirrors is allowed but they should be accommodated within the maximum vehicle dimensions. Any type of hazardous or explosive materials must not be used in the vehicle.

5.22.2 At Event Site

The teams cannot carry any type of energy drink, liquors, alcohols or energy boosting drugs at the event site. If any team found violating this rule will be disqualified with immediate effect and that college/university will suffer a ban of next 1 more year from participating in the event.

Any kind of misbehave with event officials, volunteers and other team members etc must be avoided. Any participant must not indulge in the tampering of event properties, tracks etc.

SECTION C - DRIVER RULES

6.1 Rider Clothing & Safety

Any rider/team found unsafe in the opinion of Technical Inspectors, would not be allowed to take part in dynamic events until approved by respective Technical Inspectors.

- Clothing intended for cycling use or to decrease wind resistance is allowed (skin suits).
- Riders are advised NOT to wear loose clothing during the dynamic events.
- All drivers MUST wear cycling helmet, cycling jersey, full length trousers, shin, elbow and knee guards and running shoes. Shorts/nickers are not allowed.
- The riders to be secured to their vehicles by seat belts, subject to requirement and decision of inspecting authority (as per rule 5.7)
- The vehicle can be equipped with a cyclist' water bottle for drivers.
- Riders should have their eyes protected while driving either by safety glasses.
- Riders are required to wear shoes and gloves while driving. Use of knee and elbow guards and shin guards is compulsory.
- All moving parts such as chains, idlers, gears etc should be provided with guards to protect the driver from injury

6.2 Rider Rules

- A rider cannot push any other person or vehicles during the event.
- Riders can exchange their positions in specified zones only.
- An Efficycle may not receive pacing of any form from external source.
- A rider may not ride a vehicle with a flat tire or other mechanical problems that the Event Officials seem unsafe. The rider must stop or proceed on foot thereon with the vehicle until it is repaired.
- A rider may proceed on foot along the track as long as the vehicle is present on track (carried, dragged, or pushed). A rider separated from his vehicle may not proceed along the race route, but may travel backward by any means along the route.
- Riders must not block or impede the progress of other vehicles.
- During all the tests same drivers shall drive the vehicle. Only in case of some injury extra drivers can replace the injured drivers with prior acceptance from Event Officials, but in no case both primary drivers will be changed simultaneously.
- Drivers MUST comply with the instructions of the track volunteers & announcements.
- **Drivers can perform any trial runs at the designated practice area only. If any vehicle found performing trials or over speeding etc. at the other places then it may be penalized.**

SECTION D - REPORTS & INSPECTIONS

7.1 Reports Submission

There is no virtual qualifier round for Efficycle 2017 competition. However, teams' progress will be evaluated continuously throughout the season. Teams will be asked to submit the reports and other documents time to time before the pre-decided deadlines. Following documents shall be required for submission:

- | | |
|---------------------|---------------------------------|
| 1. Project Plan | 5. Design Validation Plan (DVP) |
| 2. CAD/CAE Report | 6. As-Built Vehicle Report |
| 3. Fabrication Plan | 7. Cost Report |
| 4. Design Report | 8. Marketing Presentation |

The format of above documents shall be released by technical committee.

7.2 Project Deadlines

Sr. No.	Project Activity	Deadline
1.	Project Plan Submission	23-June-2017
2.	CAD/CAE Report Submission	28-July-2017
3.	Fabrication Plan Submission	30-July-2017
4.	Design Report Submission	25-Aug-2017
5.	DVP Submission	8-Sept-2017
6.	Vehicle Readiness	22-Sept-2017
7.	As-Built Vehicle Report Submission	29-sept-2017
8.	Cost Report Submission	6-Oct-2017
9.	Marketing Presentation	13-Oct-2017
10.	College Level Technical Assessment	23-Sept-2017 to 12-Oct-17

7.2.1 Design Readiness

At the time of design report submission, all design related work must be complete. However, teams can start the prototype work, parts procurement and the actual vehicle fabrication. No major changes in the design such as change in frame design, specification of material, motor, battery etc are expected after design report submission.

7.2.2 Vehicle Readiness

The vehicle must be 100% complete by 22-Sept-2017. Teams are expected to finish all type of design & fabrication work by this deadline and the vehicle must be in ready-to-participate condition.

After this, teams must undertake extensive design validation & testing of vehicle in-house. During this period, college level technical assessment will also be performed as mentioned in rule 7.4 below.

7.3 Penalty for Late Submission of Reports

Every team must adhere to all the deadlines mentioned above. If any team doesn't submit the required reports within the deadlines, a penalty of 10 marks per day shall be levied for late submission up to maximum 50 marks. This penalty will be deducted from the overall team score in the event. After non-submission of documents till 5 days from submission deadline, team will be barred to participate in the related static event. Hence teams are advised to submit the documents in advance to avoid any issues during last minute submission.

7.4 College Level Technical Assessment (100 Marks)

7.4.1 Procedure

Technical Assessment is intended for evaluation of team's readiness for the participation in event. A college level technical assessment of each team shall be conducted before main event. A technical assessment team (having one or more technical inspectors), appointed by Efficycle Technical Committee, will visit the institute and perform necessary inspections. The overall objective of the assessment is to ensure the quality of vehicles and team's preparation for participation in the competition.

7.4.2 Requirements

During technical assessment vehicle must be completely ready as per the rulebook requirements. All the documentation, driver equipment and other particulars required for event shall be checked by an inspector.

Technical Inspectors shall thoroughly inspect the vehicle in the same way as it will be performed during the event. Some dynamic tests may also be performed which necessarily includes at least brake test and figure-of-8 test.

7.4.3 Feedback of Technical Assessment Team

Teams must take this assessment positively because the feedback given by the inspectors will help them out in making required improvements in the vehicle. Teams may discuss problems faced in vehicle performance, event strategies etc with the inspectors assigned to them. Inspectors may also suggest some modification in the vehicle.

A report of overall technical assessment will be sent by the assessment team to Efficycle Technical Committee. Based upon their report, marks will be awarded to team.

7.5 Disqualification from Participation

Performance of teams will be monitored in terms of reports submission, quality of reports etc. If there is any excessive delay or no submission of documents mentioned in rule 7.1 above, teams will be intimated about their poor response. If any team's performance is find very poor even after intimation, then it may be disqualified from participation in final event. Teams shall be solely responsible for these issues.

Teams may also be disqualified if it is felt during the college level assessment that the vehicle shall not be ready for the participation by the time of start of competition.

Sr. No.	Possible Cases	Actions
1.	Late Submission of Reports	<ul style="list-style-type: none"> • Intimation to team and penalty of 10marks per day up to maximum 50 marks penalty. • Delay of more than 5 days or non-submission of report will lead to disqualification from participation in corresponding static/dynamic test in main event.
2.	Consistent Late Submission of Reports	<ul style="list-style-type: none"> • Intimation of disqualification; • Team may be disqualified when total penalty reaches 200 marks.
3.	Vehicle not ready at the time of inspection and completion not expected till start of event	<ul style="list-style-type: none"> • Team may be disqualified from event.

SECTION E - EVENTS & PROCEDURES

8 Main Event

There will be following categories of events:

1) Technical Inspection

- a. Rulebook/Safety Compliance Check (refer rule 8.1.1)
- b. 'Figure of 8' Test (refer rule 8.1.2)
- c. Electric Drive Inspection (refer rule 8.1.3)
- d. Brake Test (refer rule 8.1.4)
- e. Build Quality Check (refer rule 8.1.5)
- f. Weight Measurement (refer rule 8.1.6)

2) Static Evaluations

- a. Design Evaluation (refer rule 8.2)
- b. Cost Evaluation (refer rule 8.3)
- c. Marketing Presentation (refer rule 8.4)
- d. Build Quality Evaluation (refer rule 8.5)
- e. CAE Award Evaluation (refer rule 8.6)
- f. Innovation Award Evaluation (refer rule 8.7)

3) Dynamic Tests

- a. Acceleration Test (refer rule 8.8)
- b. Gradient Simulator Test (refer rule 8.9)
- c. Drive Excellence Test (refer rule 8.10)
- d. Endurance Run (refer rule 8.11)

8.1 Technical Inspection

To ensure the safety and rulebook compliances of all the vehicles participating in the event, a technical inspection will be done which includes Safety Check, 'Figure of 8' test, Electric Drive Inspection, Brake Test and Weight Measurement. Vehicle must clear all these tests in order to proceed for all the dynamic events. Any team who fails to clear technical inspection round will not be allowed to participate in the dynamic events further. **However, teams can participate in static events in such cases whereas teams shall not be entitled for any award even if the scores in static event are highest.**

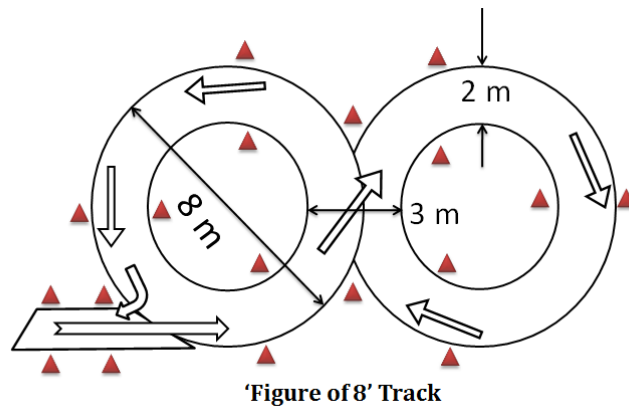
8.1.1 Rulebook/Safety Compliance Check

1. Safety Check will be done to ensure the safety of the vehicle, drivers and bystanders. Vehicle will be tested according to the rulebook and general safety compliances. Teams must ensure that any part of the vehicle do not violate the rulebook.

2. There will be maximum 2 attempts to appear for each stages of technical inspection. During this check, Technical Inspectors may ask to make any changes/modification in the vehicle that is not according to the rulebook or seems challenging the drivers' & bystanders' safety.
3. Final decision in this regards lies with the Efficycle Technical Committee.
4. Teams may be allotted a sequence and a time limit for inspection. Any team failing to appear for inspection at the prescribed time may suffer severe penalties. Hence teams must keep their vehicle in proper running condition at the time of start of event.
5. **SAFETY CHECK OK** Sticker will be issued to vehicle after successfully completing rulebook and safety compliance test.

8.1.2 'Figure of 8' Test

'Figure of 8' test will be done to ensure the driving capabilities of driver on a maneuvered path and also the dynamic stability of vehicle.



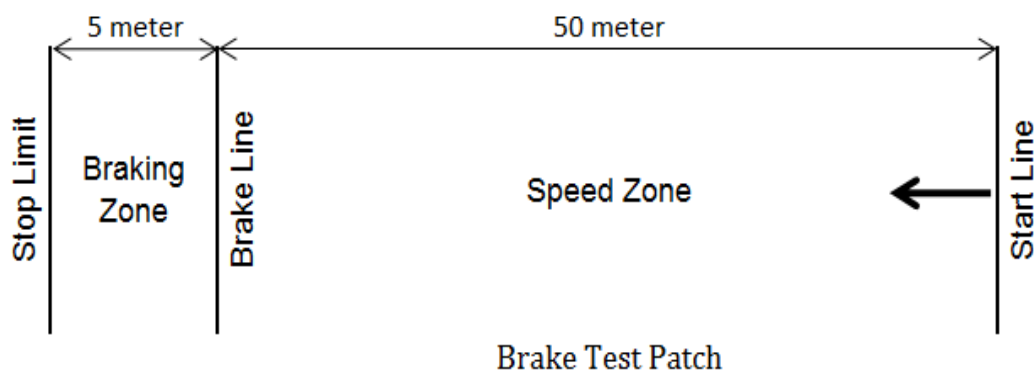
8.1.3 Electric Drive Inspection

1. Electric Drive Inspection will be done to check the compliance of battery & motor specification with the criteria set in the rulebook.
2. It will be ensured that there are no safety hazards due to electric short circuit, battery leakage or poor component mountings etc.
3. Without passing electric drive inspection, teams will not be allowed to participate in the event.
4. **ELECTRIC-DRIVE OK** sticker will be issued to vehicle passing the electric drive inspection test.

After successful completion of all rounds of technical inspection, **'TECHNICAL INSPECTION OK'** sticker will be issued by the Efficycle Technical Committee. Then only it will be allowed to participate in any static or dynamic event.

8.1.4 Brake Test

1. Vehicle may appear for Brake Test after successfully passing the tests mentioned in Rule 8.1.1, 8.1.2 and 8.1.3 above.
2. Brake Test will be performed to ensure the maximum braking performance of vehicle in case of any emergency during the dynamic events.
3. Vehicle carrying the Safety Check-OK sticker will only be allowed to attempt.
4. Team will be allowed to cover a distance of 50 meter in 15 seconds time and then to apply brakes. Vehicle must stop within the distance of 5 meter after applying brakes.
5. After successful completion of brake test, '**BRAKE TEST OK**' sticker will be issued by Brake Test judges.



8.1.5 Build Quality Check

1. After completion of Tests till rule 8.1.4, vehicle will be presented for Build Quality Inspection.
2. Build Quality inspection may involve the rigorous tests to ensure the good build quality of vehicle frame, tires and looseness etc in subsystems. It is recommended to follow good engineering practices to qualify the build quality check.
3. Upon successfully passing the build quality check, vehicle will be declared **FIT TO RUN**.
4. If vehicles are found unsafe/not suitable for dynamic event, it may be barred from further participation in dynamic events.

8.1.6 Weight Measurement & Light Weight Score (100 Marks)

Weight of the vehicle qualifying technical inspection will be measured. The vehicle mass will be compared with the maximum recommended mass as mentioned in the rule 5.3. Vehicle having weight within 150kg will be entitled for light weight score.

Vehicle with minimum weight will be awarded full 100 marks and vehicles with more than 150kg weight will be given zero marks. All other vehicles will get a score on comparative basis from 20 to 100.

8.1.7 Inspection Stickers

1. Vehicle must carry these all stickers issued during the various stages of Technical Inspection such as '**SAFETY CHECK OK**', '**ELECTRIC DRIVE OK**' and '**BRAKE TEST OK**' during the whole event. It will be allowed to participate in any dynamic event only if all the stickers are present on the vehicle.
2. If stickers on the vehicle are lost or tampered, sole responsibility lies with the participating team and stickers will not be issued again in any case.
3. However, Efficycle Technical Committee reserves the right to withdraw any stickers at any stage of competition if vehicle is found unsafe, tampered or in other similar situations.

8.1.8 Changes in Vehicle after Technical Inspection

1. Any types of changes are not allowed in after the vehicle obtains **FIT TO RUN** status. Vehicle must participate in the event in **As-OK condition**. No part of vehicle can be changed, modified, removed or replaced thereafter.
2. Any type of repairing/maintenance works may be performed only after the permission of Efficycle Technical Committee.
3. Efficycle Technical Committee reserves the rights to remove the stickers at any stage of event in case of vehicle tempering or vehicle may be barred from event for certain duration or vehicle may be disqualified depending upon the severity of case.

8.1.9 Workshop Access

1. Any vehicle may enter in the workshop area only after appearing for the 1st attempt of Rulebook/Safety Compliance Check and with the permission of Technical Inspectors.

8.2 Design Evaluation (150 Marks)

8.2.1 Aim

The aim of the Design Event is to provide an opportunity for the engineering students to develop an innovative hybrid human powered vehicle design, document it and present it to a panel of judges who will evaluate the design.

Design assessment will be done through Design Report, As-Built Vehicle Report and On-site Design Evaluation

8.2.2 As-Built Vehicle Report

This report is to ensure that the vehicle participating in the competition is built as presented in the design report. However, there may be some situations that require deviation from the original design during fabrication. But all changes must comply within the rules as specified in the Effi-Cycle 2017 Rulebook. For this purpose, teams will be asked to submit the report of their as-built vehicle.

This report will be considered for the design evaluation during final event. Report formats, submission dates and other details will be published on official website accordingly.

8.2.3 Design Evaluation at Event Site (150 Marks)

Design Evaluation round provides the participants an opportunity to discuss their design process and to highlight the innovations implemented & special features of their vehicle. At the time of design evaluation, vehicle and team must be present before the judging panel.

Teams will be asked to explain their design methodology, design of the subsystems, material and part selection, safety, calculations and analysis carried out and innovations implemented in the vehicle etc. Marks will be given according to the justification of team over such questions asked by the judging panel.

8.3 Cost Evaluation (150 Marks)

8.3.1 Aim

The aim of the Cost Event is to provide an opportunity for the engineering students to carry out the cost assessment of their vehicle, document it and present it to a panel of judges who will evaluate the cost.

8.3.2 Cost Report

Cost Report is a document which provides the method of calculating the vehicle cost. The format and guidelines of cost report will be published on the official website. Teams have to follow the specified formats only.

The basic concept behind the cost report is to make students understand that cost is an important parameter in the design and manufacturing considerations. On the basis of this document teams may practice to optimize their design, manufacturing and part selection processes.

8.3.3 Cost Evaluation at Event Site

Cost assessment is divided into two parts: **Cost Evaluation (160 marks) & Teams justification over panel questions (40 marks)**

Cost evaluation will be done at event site. At the time of cost evaluation, vehicle and team must be present before the judges along with their cost report. Evaluation will be done by the judges towards the cost projected in the cost report. If details of parts are found missing in the report, severe penalties will be applied in terms of adding the cost of missing part into projected cost by multiple times.

$$\text{[Final Cost (C) = Cost Projected in Cost Report (A) + 3 x Penalties Applied (B)]}$$

Along with this teams will be asked to justify the selection of various parts or fabrication techniques to manufacture their vehicle. Teams must have the proper knowledge of BOM and cost estimation.

Note:

1. *Teams must understand that score of Cost Evaluation will not be given on the basis of only minimum cost projected in the cost report; but is the overall score depending upon the cost projected, penalties applied and the justifications given by teams against the questions of judging panel.*
2. *Cost evaluation do not have any concern with the performance of team/vehicle in other static and dynamic events in the competition*

8.4 Marketing Presentation (150 Marks)

8.4.1 Aim

The aim of the Marketing Presentation is to provide an opportunity for the engineering students to prepare a strategic business model of establishing a firm which can produce their own design at a certain rate (say 2,000 vehicles per year) and market it. Judges can be considered as hypothetical capital investors who can invest into team's business model to support in establishment of that firm.

8.4.2 Presentation Format

Teams are advised to prepare the model by working out on the following points in the presentation:

1. Unique Selling Proposition (USP)
2. Market/Customer Survey (to analyze the product demand)
3. Different concepts & variants
4. Plant layout for mass production
5. Cost of product in mass production

6. Break-Even Analysis (in terms of time & quantity)
7. Return on Investment (in terms of time & money)
8. Marketing strategies (sales & after sales)

Presentation must be in MS PowerPoint format with the file size not exceeding 10MB. Use of promotional videos, charts, graphs, brochures is encouraged, provided that the total time doesn't exceed the specified duration. Other details will be specified on the website.

8.5 Build Quality Evaluation (100 Marks)

The build quality of vehicle shall be checked during the event. The vehicle should be presented before the panel clean and in completely ready condition. Evaluation of the build quality may be performed on the basis of following parameters:

- | | |
|-------------------------------|----------------------------------|
| 1. Frame | |
| 2. Design, Material Selection | 6. Ergonomics |
| 3. CAD/CAE Analysis | 7. Quality of the weld joints |
| 4. Overall Vehicle Layout | 8. Quality of the machined parts |
| 5. Aesthetics | |

8.6 CAE Evaluation- ~~New~~

The aim of CAE Evaluation is to evaluate teams' knowledge about CAE. This evaluation will be done only for those teams who apply for the CAE Award. **The score for the CAE award evaluation will not be included in the overall event score.** Nominations will be registered prior to main event. However, submission of CAD/CAE Report as per rule 7.2 is mandatory for all teams.

For reference of judges, teams must carry the following during evaluation:

- CAD/CAE Report
- All CAD Models related to frame and different subsystems
- CAE Models and analysis reports

During the evaluation, teams may be asked questions about CAE procedures, pre-processing, post-processing, optimizations, validation of CAE Results, calculations for loads, selection of material, optimization of design etc.

8.7 Innovation Evaluation-~~New~~

The aim of Innovation Evaluation is to evaluate the innovations implemented by the teams in their vehicles. This evaluation will be done only for those teams who apply for the Innovation Award. **The score for the Innovation award evaluation will not be included in the overall event score.**

For reference of judges, teams must present the following details during evaluation:

- Concept of the innovation implemented in vehicle
- Feasibility of the mass production for implementation on big scale
- Supporting data, calculations, drawings etc
- Scope of the innovation and their applications in the automotive industry

Innovations will be accepted in the fully working condition and must be demonstrated to judges. Technologies already functional in Indian Automotive Industry will not be accepted; however the new application of existing technologies will qualify this criterion.

8.8 Acceleration Test (100 Marks)

8.8.1 Aim

The goal of the Acceleration Test is to provide engineering students an opportunity to demonstrate the maximum acceleration & maximum speed capability of their vehicles in a non-race condition.

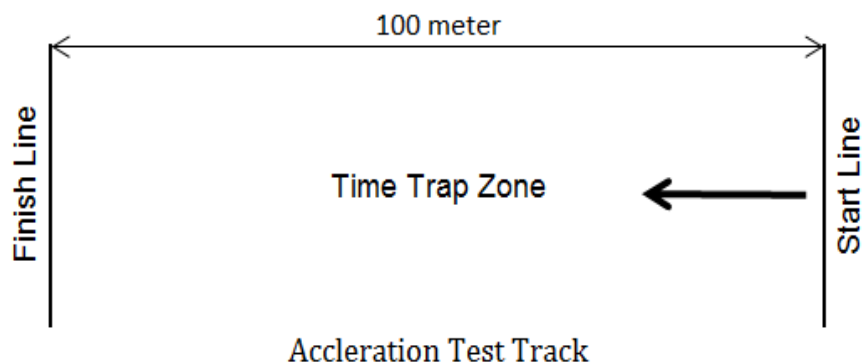
8.8.2 Track Description

The course will consist of straight, smooth and level paved surface of suitable width and clear of obstacles, pits, cracks or potholes. Track length will be of 100 meter in time trap zone. Vehicle will have to start from start line marked on track. There will be no separate run-up zone.

8.8.3 Method & Rules

1. Both the driver must ride the vehicle wearing all driver safety equipment.
2. Vehicle will be allowed to run on the track only when signaled by the track judges.
3. Team will be asked to start from standstill and to cover the distance of 100 meter in the minimum possible time. The time taken to cover the complete track will be noted down.
4. **Use of human & electric power both is ALLOWED.**
5. Maximum 2 attempts are permitted per team. The minimum time out of two attempts will be considered for evaluation.

6. In case of vehicle breakdown or rollover on track, departure from track before finish line; that attempt will be considered as void. No other chance will be given in lieu of.



8.9 Gradient Simulator Test (100 Marks) - **New**

8.9.1 Aim

The goal of the Gradient Simulator Test is to provide engineering students an opportunity to demonstrate capability of vehicles to climb on inclinations in non-race condition.

8.9.2 Track Description

The course will consist of straight, smooth and level paved surface of suitable width and clear of obstacles, pits, cracks or potholes. Total track length will be 50 meters. Vehicle will have to start from start line marked on track. There will be no separate run-up zone.

8.9.3 Method & Rules

1. In order to simulate the Grade-ability, the vehicle will be required to pull a payload at horizontal surface. This payload will be representative of the additional tractive force required to climb a gradient of maximum 5 degree when compared to the tractive force required in running on a horizontal surface.
2. Both the driver must ride the vehicle wearing all driver safety equipment.
3. Vehicle will be allowed to run on the track only when signaled by the track judges.
4. Team will be asked to start from start line marked on track from standstill condition and then to cover the complete track in minimum possible time. The time taken by vehicle to cover the distance from start line to finish line will be noted down.
5. **Use of human & electric power both is ALLOWED.**
6. Maximum 2 attempts are permitted per team. The minimum time out of two attempts will be considered for evaluation.
7. In case of vehicle breakdown or rollover on track, departure from track before finish line or not reaching the finish line; that attempt will be considered as void. No other chance will be given in lieu of.

8.10 Drive Excellence Test (150 Marks) - New

8.10.1 Aim

The goal of the Excellence Test is to provide engineering students an opportunity to demonstrate the performance and durability of the electric drive of the vehicle in a non-race condition.

8.10.2 Track Description

The course will be a smooth path full of sharp turns, speed breakers and other obstacles etc. Total track length will be minimum 500 meters. Vehicles will have to start from start line marked on track. There will be no separate run-up zone.

At certain part of tracks, lifting or pushing of vehicle may also be required to cross the obstacle. In such cases, driver can get down from the vehicle to push-it against the obstacle or to lift it for crossing. Hence teams should keep their vehicle as lightest as possible to get the advantage.

8.10.3 Method & Rules

1. There will be 2 attempts for Drive Excellence Test, both to be performed on separate event days. The vehicles are allowed to charge the batteries before each attempt.
2. There will be maximum specified time limit for the completion of each attempt.
3. Maximum 2 attempts are permitted per team. The minimum time out of two attempts will be considered for evaluation. **However, each vehicle has to complete at least one attempt successfully to qualify for the endurance run.**
4. Both the driver must ride the vehicle wearing all driver safety equipment.
5. Vehicle will be loaded with the 20kg payload in utility box during the test.
6. Vehicle will be allowed to run on the track only when signaled by the track judges.
7. Team will be asked to start from standstill and to cover the complete track in the minimum possible time. Time taken to complete the test will be noted down.
8. **Use of ONLY ELECTRIC DRIVE is ALLOWED.**
9. In case of vehicle breakdown or rollover on track, departure from track before finish line or exceeding the specified time limit on track; that attempt will be considered as void. No other chance will be given in lieu of.

8.11 Endurance Run (400 Marks)

8.11.1 Aim

The goal of the Endurance Run is to provide engineering students an opportunity to demonstrate the durability of their vehicles in a race condition.

8.11.2 Track Description

Endurance track will be a closed circuit including lot of turns, bends, gradients and various kinds of obstacles. Total length of circuit will be around 2km. Team will have to line-up in funneling area before the start of event. Teams have to run on an endurance track for specified duration.

8.11.3 Method & Rules

1. Both the driver must ride the vehicle wearing all driver safety equipment.
2. Vehicle must line up according to their position as specified by the Technical Committee. Positions will be declared according to the performances in dynamic events.
3. Vehicle will be allowed to run on the track only when signaled by the track judges.
4. **Use of human & electric power both is ALLOWED.**
5. The total duration of endurance run will be maximum 2 hours and teams will be asked to cover maximum laps in this duration. The maximum duration of test may change later on and the decision lies with the technical committee.
6. If a vehicle meets breakdown during the run, it should be carried out of the track immediately. Vehicle may appear on the track after complete repair and only after the permission of Technical Inspectors. Decision of Technical Committee will be considered final in this regard.
7. Laps covered by the teams will be considered for the evaluation of endurance score. Partially completed laps will not be considered for scoring purpose.
8. Vehicles found in unsafe conditions on track will be removed from track with immediate effect.
9. After the completion of endurance run, vehicle will be impounded at parking area for final inspection. At that time no team member will be allowed in parking area.

8.11.4 Lap Counting and Timer

1. On the blow of siren, vehicles will be allowed to run on the endurance track.
2. At the time of blow of siren; timer will start for all the vehicles (timer at 00:00:00).
3. Lap counting of individual vehicle will be done each time it reaches to the start line.
4. After the completion of event, timer will be stopped (timer at 02:00:00).
5. Total laps covered by individual teams till 02:00:00 condition will be considered for evaluation. Partially covered laps will not be counted.

8.12 Marks and Scoring

Events	Maximum Marks
A. College Level Technical Assessment Score	100
Design Evaluation	150
Cost Evaluation	150
Marketing Presentation	150
Light Weight Score	100
Build Quality Score	100
B. Static Event Total Score	650
Acceleration Test	100
Gradient Simulator Test	100
Drive Excellence Test	150
Endurance Run	400
C. Dynamic Events Total Score	750
Overall Event Score (A+B+C)	1500

1. Each event of the competition has different goals and objectives. Performances in any two or more events cannot be compared.
2. Teams must participate in all the events. Teams not participating in any of the static or dynamic events or scoring zero in any event cannot be considered for top 3 positions, even in case of obtaining the highest overall score.

8.13 Competition Penalties

Sr. No.	Case	Penalty
1.	Violation or Breaching of rules	30-50 marks for each case, Depending upon severity
2.	Misconduct with volunteers or officials	100 marks
3.	Unauthorized entry in restricted area or tracks	50 marks
4.	Tampering with vehicle after Tech-OK	100 marks
5.	Intended tampering with tracks or event property	50 marks
6.	Unjustified or false protest	50 marks

1. These penalties will be imposed by the Competition Organizers with the immediate effect on occurrence of each case.
2. All penalties will be deducted from overall score not from any individual event scores.

9 General Rules for Competition

9.1 Drivers Training

All drivers who will participate in the dynamic tests must attend the Drivers Training sessions when called on event day. The trainings will clarify operating procedures and signals and it will identify tracks features, hazards, landmarks and penalties which can be applied on team in case of driving safely.

If drivers of any team are not present during the drivers training session, the concerned team would not be allowed to participate in dynamic events. In unavoidable absence of drivers, team may be represented by other team members.

9.2 Vehicle Identification

During the events- Vehicle must carry the Vehicle Numbers, Event Logos and Vehicle Identification Flag. Vehicle Identification items must be clearly visible from both sides of vehicle. In case of obscured, tampered, damaged or lost vehicle identification marks, team will be responsible of any loss in lap counting or scoring.

9.3 Protest

Participating teams are assumed to have full faith in the Rulebook and Event Procedures and hence any team may not protest against particular event procedures or the rulebook interpretation. In case of any objection/misunderstanding with the judgment taken during the event or any issue with the competitors, teams may discuss with the event organizers. But all such complaints will be taken in account for official consideration and further action only when submitted in written. Written complaints should be addressed to Efficycle Organizing Committee.

Protest must be filed within 2 hours of the completion of related event. Decision of event organizing committee will be considered as final. Team must ensure that if complaint is found to be false or unjustified; 50 marks will be deducted as penalty from total score of the complaining team.

9.4 Workshop Facilities at Event Site

1. Each team will be allotted a pit in the Pit Area to park their vehicle and to keep the tools and spare parts.
2. General workshop facilities like welding machines, cutting tools etc may be provided at event site, but teams are advised to bring their own necessary tools to avoid any difficulties.

3. MIG welding facility shall also be provided at the event site. Priority of usage shall be given to vehicles using alternate material in frame as per rule 5.5.2.
4. Power supply & adequate illumination will be provided in pit area.
5. **Workshop access will be given to the teams after appearing for the 1st attempt of Technical Inspection (Rulebook/ Safety Compliance Check) and with the permission of Technical Committee.**

9.5 Vehicle Presence at Event Site

Vehicle must enter to event site before the start of technical inspection or as specified by the event organizers. Vehicle must be parked in the assigned pit after the closing of events each day. Vehicle is not allowed to go outside the event site in any case before completion of the complete event except in case of voluntarily withdrawing participation from event. If vehicle found outside the event premises, it will be disqualified from participation with immediate effect. Teams must carry all necessary arrangements to event site with them.

SECTION F- DOCUMENTS REQUIRED DURING COMPETITION

10 Documents Required for Inspections & Evaluations

All teams must carry the following documents to the event site for vehicle inspection, static events and dynamic events

	Document	Soft Copy	Hard Copy
1	Project Plan	Y	--
2	Design Abstract	Y	Y
3	CAD/CAE Report_ latest revision	Y	Y
4	Fabrication Plan	Y	--
5	Design Report	Y	Y
6	Design Validation Plan	Y	Y
7	As-Built Vehicle Report	Y	Y
8	Cost Report	Y	Y
9	Original Invoices of Material & Services etc for Cost Report Evaluation/ estimate or quotations	--	Y
10	Marketing Presentation (In separate Pen Drive)	Y	--
11	Marketing Poster	--	Y
12	Technical Inspection Sheet (with Local TI Comments and signature)	Y	Y
13	Technical Inspection Sheet (1 Fresh Copy)	--	Y
14	In-House Fabrication Permission	Y	Y
15	Material Testing Report for all frame materials	Y	Y
16	Photos and videos of In-house fabrication	Y	--
17	Copy of any special permission related to vehicle / rule compliance or clarification as received from efficycle.technical@saenis.org	Y	--
18	Electrical Drive Circuit Explanation Diagram (Line diagram / Schematic of battery output with controller and motor)	Y	Y

11 Document Required for Team Registration at Event Site

- Original Hard Copy of Team Registration Form
- Original copy and Student ID cards of all the team members issued by respective college.
- Valid SAE membership cards of all the team members, facilitator & faculty advisor.
- Copy of special permissions for team changing as received from efficycle.teams@saenis.org
- Passport size colour photographs (four in number) of each person coming for the event.

12 Document Required for Driver Registration at Event Site

Following documents will be required for registration of at least 2 (TWO) Drivers, who will drive the vehicle at any time during the competition:

- Valid, government issued driving license of 2-wheeler or 4-wheeler.
- Copy of Medical insurance

SECTION G- CONTACT INFORMATION

13 Organizing Committee Structure

	Name	Organization	Responsibility
1.	Mr. U.D.Bhangale	ICAT	Convener
2.	Dr. Reji Mathai	IOCL	Co-convener
3.	Mr. Jitendra Malhotra	MSIL	Co-convener
4.	Mr. Jitendra Singh Gaur	ICAT	Technical Committee
5.	Mr. Harpreet Singh Juneja	ICAT	Technical Committee
6.	Mr. Nikhil Madaan	MSIL	Event Coordination
7.	Mr. Sumit Kumar	MSIL	Event Management
8.	Mr. Abhishek Dewan	MSIL	Event Management

14 Contacts

Details of contacts for official communication are as below:

	Particular	Contact
1.	Registration & General Communication	efficycle.teams@saenis.org
2.	Technical Queries & Rulebook Clarification	efficycle.technical@saenis.org
3.	Reports Submission	efficycle.reports@icat.in
4.	Official announcements & information (through online official channels)	effi.saenis.org , www.facebook.com/groups/EfficycleSAENIS/

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