

EVelocity regulations - Competition Class

Background:

For some time participants in end-of-year EVelocity events have expressed a desire to drive longer, and compete more directly with fellow participants in a more traditional racing format.

To some extent this has clashed with the goals of the EVelocity programme insofar as the intent is predominantly educative and skill based, rather than any more pure form of motor racing.

In other words we consider the journey is probably more important than the destination. Designing, developing, constructing, fault-finding, improving, fostering team work and the like are all promoted through the scheme as it is presently run.

The end of year competition is chance for participants to demonstrate their work throughout the year, to show how well their design copes with a variety of standard requirements, and to meet up with like-minded individuals from other schools.

Participants have the opportunity to compete in an arena where driving skill, vehicle manoeuvrability, safety, longevity, design suitability, economy, sustainability, and technical capacity are valued above outright speed.

The competition design also takes into account the age, experience and nature of participants, the costs involved, and the typically used components of the vehicles constructed.

Often the drivers are in their first years at high school, the vehicles utilise inexpensive components - not untypically from bicycles - and a wide variety of design and creativity is evident and permitted.

Necessarily this means that many vehicles have high centres of gravity, use components not designed for high lateral loading and would otherwise be unstable at high speed.

To this end EVelocity has been at pains to promote competition classes that limit potential equipment failure, higher technical requirements and which ensure the maximum freedom in design yet also maintains a minimum standard of construction.

This latter standard is designed to first of all ensure a certain level of safety, but also be educative as many times in later life most participants will experience the need to design to, and/or adhere to, some set of tested criteria. We hope to promote general comprehension of such requirements.

All of these things have been a constant challenge, and at the end of each year, and the beginning of the next, the EVelocity programme advisory group meet in order to try and maintain the overall direction of EVelocity, look at and adopt new forms of competition, new technologies, and to generally ensure a safe but enjoyable programme outcome.

This year is no different and, having taken into account participants expressed desires, along with the aims of EVelocity, we have developed the new class of competition described below.

New class development:

As EVelocity has progressed we have been pleased to see the continual refinement of vehicles, the emergence of newer forms of technology and its integration into various designs, and also to watch how younger participants have developed their vehicles and themselves over their time at school.

It is often these participants who have been through several iterations of their design and several competitions, who have expressed a desire to ‘drive more’, or to compete more directly with fellow participants. This is also true of some older participants.

For the reasons given in the background section EVelocity has been cautious about permitting or encouraging direct racing per se.

From an overall programme perspective we do not wish to lose the freedom participants have to develop their vehicles within as broad a scope as possible, which means that, amongst other things, we do not want the programme to become too formulaic.

Coupled with this we have tried to ensure that students, particularly at the early stages of their high school career, are able to compete at minimal cost, and with simple designs. Education, of course, is at the core of EVelocity’s ethos.

From a participant perspective in any form of more direct competition there are many different things to consider, not in the least human and machine elements that come into play which are not present at lower speeds, or when competition is limited to the clock or is more skill based.

However, we have also come to the view that constant refinement of vehicles and participants driving skills is to some degree naturally competitive. It is inevitably through such competition that further skills and design development occurs, and it is something that EVelocity lacks at present, to some extent, meaning there is an effective ceiling to the design and skill aspects of the programme.

Taking this into account, and with the increased use of better facilities, such as Kartsport tracks, EVelocity has decided to introduce a further class of vehicle and an additional competition category for end of year regional and national events.

This class will be known as the ‘competition class’ because participants will be able to compete directly against their compatriots in a relatively standard racing format, and machines will be judged to high level of technical, design and presentation merit.

In developing this class we have had several things in mind. The first is safety, particularly given the age and experience of participants. We also wished to ensure that this did not diminish design creativity amongst participants, that it did not lead to participants abandoning the other classes, that it would be as affordable as possible, and that no one school could capture the whole of the class.

In reading the following please take this into account and note that for the purposes of this class this document is more regulative than guiding, and that for clarity it is split into Part 1 (Machine), Part 2 (Competitor), Part 3 (Competition).

An astute reader will also see that, while there is a lot to read, and while the criteria may appear to favour a ‘standard’ kart chassis, the regulations have been designed to allow as much design leeway as possible at the same time promoting a sound and safe vehicle.

Vehicle requirements:

As this is a direct competition class, and as participants will have had previous EVelocity experience a high standard of construction is expected and will be required.

Welds will be closely inspected and must be adequately laid down, chassis rails and any bracing must be appropriately placed and must ensure that the vehicle is capable of withstanding the forces typically applied to it. An understanding of load, fatigue, security and adequacy in design and construction must be demonstrated – and participants will be queried on this.

All fixings will need to be locked (spring washers, nylocs, castle nuts and pins etc), wiring must be tidy and the vehicles should present well.

More specific requirements follow, but if you are at all uncertain about anything you are encouraged to ASK before it is too late to change your design.

Electrical & mechanical

Motor

- Motors must be electric
- Total motor power is not to exceed 3kW. Students should ensure they design within this requirement. A suitable power limiter will be fitted by EVelocity for each event.
- Power source and motor specifications must be supplied to EVelocity at least one month before the competition.
- One or more motors are permitted but the total power must not exceed 3kW.
- In the event of a significant crash and/or inversion of the vehicle the motor(s) and battery should remain attached to the vehicle in the same position.

Battery

- Battery voltage is not to exceed 48V (nominal) and the battery must be of a recognised chemistry (for example Pb, LifePO4).
- Battery must be securely constrained to the chassis such that in the event of a significant crash and/or inversion of the vehicle the battery will remain attached to the vehicle in the same position.

Wiring & associated components

- All wiring within the vehicle must tidy and secured to a professional standard. Wires must not be in a position to chafe, become loose, foul the driver or any other part of the operating mechanism.
- Wires must be rated for the current requirements. Explanatory note: assuming a reasonable safety margin a 3kW motor at 48V would require upwards of 63A continuously, and possibly more at peak. The battery – controller – motor wiring used must be rated as capable of this. See the Appendix for a wire size table.
- Battery connectors; a mating pair of Anderson Power Products SB50 connector shall be fitted directly in the wiring from the battery, following the kill switch. One of the connector pair shall be suitably secured to the chassis or bodywork in order to allow single handed removal.
- Wires and associated components must be adequately insulated, and be in good condition.
- Wires passing through conductive material such as steel must be well protected against chafing, most likely via double-insulating.
- There must be an adequately rated DC ‘kill switch’ directly after the fuse or circuit breaker and before anything else in the circuit. A driver accessible lanyard attached to the free SB50 connector, and capable of separating the connection with a single pull, *may* suffice as a kill switch.
- The ‘kill switch’ may take the form of a DC-rated contactor, with appropriate remote switch, or possibly be the requisite circuit breaker if it is triggerable, and accessible as required.
- The kill switch must be clearly visible and appropriately marked such that a reasonable person is able to easily identify it. It must work.
- There must be an adequately rated DC fuse or circuit breaker directly in the circuit after the battery.
- Controller must be adequately rated for the task and fixed to the chassis such that in the event of a significant crash and/or inversion of the vehicle the controller will remain attached to the vehicle in the same position.
- To avoid doubt; the kill switch, circuit breaker, wiring, and any other associated components must be securely fixed to the chassis such that they would not ordinarily become adrift in normal use, nor in the indirect event of a crash. The use of tape and other temporary fixing will not be acceptable except in special circumstances, and is likely to result in a scrutineering fail.
- Low current circuits should also be appropriately and separately fused. Please see the Appendix for a table showing requirements.

Chassis & body

General

- Must not exceed 1800mm long x 1300mm wide (bumper to bumper and the outside of wheeltrack).
- Wheelbase must be between 900 to 1300 mm.
- Wheeltrack must be between 900 to 1300 mm
- Must have four wheels.
- No part of the chassis, bumpers, wheels or any other component should have sharp edges or burrs.
- Moving drivetrain components (chains etc) must be guarded, and the driver must not be able to normally come into contact with them

Steering

- Steering must be mechanical, be well constructed and secured to the chassis proper, and use the standard Ackermann principle.
- Steering wheel must be adequately secured, there should be no substantial play in any of the steering components and the components themselves must be adequate for the task.
- Steering wheel and fixings to the chassis should be capable of withstanding reasonable lateral and longitudinal force (this is what drivers 'hang on' to, it shouldn't give way in normal use).
- Steering wheel must be of solid construction and should not have any protrusions, nor permit any shaft intrusion during (possible) impact.
- Steering wheel centre should be securely padded and preferably recessed from the rim.

Axles

- In a conventional rear axle arrangement a min 24mm solid or hollow axle must be fitted and it must be adequately supported by suitable axle bearings, themselves securely affixed to the chassis. **A hollow axle must have at least 3mm wall thickness.**
- Stub axles must be minimum 15mm diameter at inside bearing, minimum 12mm diameter at outside bearing.
- Full axles must have a minimum 25mm diameter.

- Axle support must be reasonable placed to ensure minimum bending moment on the axle.
- All axle wheel nuts must split pin locked, or use nylocs that are in good condition.
- Axles must not protrude past the outside of tyres or rims.
- Wheels must be securely attached to the axles.

Note: It is recognised that some people may wish to use wheels fitted with hub motors, otherwise designed for the purpose, and that these may not absolutely conform to the above axle requirements. This may be permissible and participants must discuss this with a scrutineer BEFORE beginning construction

Front and rear bumpers

- Front and rear bumpers are required and must be adequately constructed from a minimum 19 x 1.2 mm steel tube.
- Bumpers must form an extended loop and be no less than 100mm and no more than 200mm between top and bottom rail centres with the bottom loop centre between 60mm to 100mm from the ground.
- Bumper horizontal rails must be wider than the outer chassis, corners must be rounded and should be flush to the outside of the wheels, but no more than 50mm inside of that line.
- Bumpers must be supported in a minimum of two places from the chassis and be of such a construction to withstand substantial impact. In side view the bumper will be in the vertical plane.
- Overall width of the bumper must not exceed the outside wheeltrack at any time
- Side protection bumper bars (or pods) are also required and must be supported in a minimum of two places from the chassis and be of such a construction to withstand substantial impact.

Side bumpers

- Side bars must form an extended loop, be no less than 100mm and no more than 200mm between top and bottom rail centres, and be adequately constructed from a minimum 19 x 1.2 mm steel tube.
- The lower (side) bar must be between 60mm to 100mm from the ground, the front of the bars must be no more than 200mm from the front wheel (with the wheels straight ahead), and no more than 100mm from the back wheel, and must not protrude outside wheels, or be more than 50mm inside wheels.
- Strong plastic front and rear bumpers, and/or side pods may be used but must meet all above dimensions and requirements.

Roll bar

- An anti-roll bar shall be fitted immediately behind the seat.
- The bar shall form a hoop that extends at least 50mm beyond the top of the drivers helmet and be fabricated from min 25 x 1.6mm steel tubing. P
- The bar should be braced to the rear such that it is not significantly displaced in a roll-over situation when the vehicle is travelling at full speed.

Floorpan

- The vehicle must have a floorpan adequately secured to the chassis.
- Floorpan must be of suitable material, and confined within the main frame, and be parallel to the main frame.
- The pan must extend from front of seat to forward of the drivers feet.

Seating

- The seat shall be of a type that will adequately restrain the driver from falling out either side during normal manoeuvring
- Seat must have adequate rear support, there must be a rear head brace
- Seat must be securely attached to the chassis.
- A seatbelt is required. This should be a minimum of a lap belt, it may be a full harness.
- The belt(s) must be secured back to the chassis in a manner such that it would not separate from the vehicle in the event of a crash. The anchorage should take into account the likely force involved, it should adequately distribute load as needed.

Wheels and tyres

- Outer diameter of tyre must not exceed 300mm diameter.
- Wheels must be of a design capable of handling the torque, lateral loads, and other demands placed upon them during the course of the event. It is not anticipated that spoked or lightweight pressed steel wheels would be adequate (if in doubt you must ask a scrutineer BEFORE commencing construction).
- Tyres must be of a type capable of handling the torque, lateral loads, and other demands placed upon them during the course of the event.

- Pneumatic tyres must be correctly inflated, and not have any canvas showing or other damage that might render them less capable than designed for.
- All wheels and tyres must be not be damaged in a way that reduces their capacity.
- Wheel bearings must be in good condition with minimal play and no notable roughness.
- Wheels must be securely fixed to hubs and from there to the chassis

Brakes

- Brakes must work on both rear wheels only.
- Brake pedal or hand lever must be adequate with minimal play before the brake is engaged and be accessible to driver at all times.
- Brakes must be even between wheels. To avoid doubt this means that they must be capable of pulling up the vehicle evenly with little or no lateral diversion on a homogeneous dry surface.
- Brakes must be capable of locking the rear wheels with the driver in the vehicle.
- All components of the braking circuit (levers, pedals, rods, cables, hydraulics, pads, discs, drums, shoes etc) must be capable of sustaining any amount of strong usage and must remain intact and operational throughout. This will be tested.

Other

- These regulations are subject to amendment at any time.
- Notwithstanding anything in these regulations, a scrutineer may require a vehicle to be altered, or may limit participation for reasons of safety.

Competition:

Entry requirements

- Drivers must have driven in at least one year of regional/national events in other classes.
- Drivers must be at least 14 years old and be capable of competently operating the vehicle.
- Drivers must wear an approved full-face motorcycle helmet at all times when in the vehicle.
- The helmet must fit correctly, it must not be significantly damaged, chipped or cracked.
- Suitable protective footwear, eye protection, gloves and overalls (full length and long sleeved) or racing suits must be worn at all times when in the vehicle.
- A minimum of bare skin should be showing and all hair must be contained within the helmet or overalls/race suit.
- No clothing is to be worn on top of overalls.
- No more than three separate entries per school.

Competition rules

- Competition will be six laps in total
- Competition is standing start at a conventional start/finish line
- Grid placements will be staggered in order to allow safe launch room
- Competition winner is the driver who passes the finish line first at the end of their six laps
- Class winners are
 - vehicle judged to be best presented.
 - vehicle judged to be best constructed.
 - vehicle judged to have the highest level of technical capacity (eg telemetry).
 - Ability of participants to explain, when questioned, various technical aspects of their vehicle

Driving Rules

- Drivers must attend the drivers/track briefing prior to entering the circuit.
- If you spin out or break down on the track remain in the vehicle with both hands raised until instructed what to do by a track marshall.
- If you need assistance raise your hand.
- If you run off the track you must re-enter at the point of exit when the track is clear or safe to do so.

- No unauthorised people on the track at any time.
- Drivers must use hand signals must be used at all times when stopping or leaving the track, must do so safely, and with consideration to others.
- No driving of vehicles is permitted before the drivers briefing is held, and all drivers must attend the briefing.
- No driving of vehicles during before or after the competition unless approved by Chief Marshall.
- Deliberate barging, shunting, weaving or other dangerous behaviour will disqualify that driver from the competition and they will be required to exit the track immediately.
- Any and all overtaking should be completed without deliberate contact and must be done without either driver being forced off their line.
- Any abuse of any other person will result in disqualification.
- Any penalties will be in the form of points deduction. The amount of that deduction is at the discretion of the Chief Marshall.
- All vehicles to be stationary on the grid prior to starting.
- Any vehicle that jumps the start shall restart with a 20m penalty, a second jump by the same vehicle will result in that vehicle having an additional 20m penalty, a third jump will result in the driver being excluded from the competition.
- Any incidents will be dealt with as appropriate by the Head Marshal who has absolute discretion to stop, restart, shorten, lengthen, cancel or otherwise alter the competition as that person deems is required to ensure a safe competition.
- Flags will be used by flag marshalls to signal requirements to drivers:
 - Green means go
 - Yellow means caution and no overtaking
 - Red means race is stopped, return to start (slowly)
 - Other signals will be explained in the drivers briefing
- Drivers must obey marshalls directions at all times, appeal only to Head Marshall.

Insurance, indemnity, scrutineering:

- EVelocity will have sufficient Public Liability Insurance cover and is able to produce proof of such cover
- ALL DRIVERS, Head Marshall, Flag Marshalls and other Volunteers must sign the indemnity form provided to protect EVelocity, Ground Owner, Sponsors, Volunteers or Officials from any form of claim.
- Minors under 18 years of age must have a parent or guardian's signature acknowledging the conditions of entry and indemnity.
- Vehicles must be presented in a clean state for scrutineering and any damage occurring to a vehicle will require it to be re-scrutinized before racing again.
- Scrutineering will be conducted according to the regulations presented in this document.
- The intent of scrutineering is to ensure a vehicle, and driver, is of a sufficient standard and is as safe and capable as possible of competing within the event.
- A scrutineers decision is final, appeal only to chief scrutineer.

Appendix:

Minimum power wiring sizes with respect to voltage

Nominal battery voltage	Max. continuous current (A)	Minimum wire gauge (AWG)	Minimum wire area (mm ²)
24 (not to exceed 29.4V)	125	6	16
36 (not to exceed 46.2V)	83	8	10
48 (not to exceed 54.6V)	62.5	10	6

Battery fuse rating

Nominal battery voltage	Maximum fuse rating (A)
25V	250
36V	166
48V	125

Note; If it can be shown that the battery manager has the necessary over-current rating compliant with the above table, this will suffice in place of a fuse.

