

HEALTH & SAFETY PLAN - Regional Finals

Revision A

Introduction

Our aim is to have an incident free event, but if something does happen, the staff, marshals, and volunteers running the event will be asked to assist and will be briefed on the day to follow the steps outlined in this document.

Type of Event

Students will participate in events that test the design and construction of electric vehicles they have built over the course of the year. On-track events will include; a Drag Race over 60m, a Gymkhana (agility) challenge, and a combined Endurance and Efficiency event. There will also be off-track events that judge engineering, innovation, and sustainability. Spectators will be allowed near vehicles in the pit area but will NOT be allowed on track areas during competitions.

Event Headquarters

The control headquarters (HQ) will be located close to the track entry, and the accident register, site map, fire extinguisher, and first aid kit will be located here. An EVelocity staff member will be stationed at HQ for the duration of the day.

Communications Network

Communications will primarily be conducted using walkie-talkie radios between EVelocity staff, including the Safety Officer, HQ person, and key volunteers. Mobile phones will be used for other volunteers - a Contact Sheet will be located at HQ with contact details of all officials and volunteers.

Vehicle Access & Egress

Vehicles will enter via the designated entrances and park in the allocated areas as directed by the Parking Supervisor, and as indicated on the site map (sent to all attendees beforehand). Site egress will follow the reverse route.

Competing vehicles are to be parked in the pits when not racing and are not to be powered on during this time. Vehicles should be pushed to and from the track, and once on the track, drivers will be given permission to power on their vehicles by the Head Marshal.

Venue Staffing

The event will have the following delegated roles: Event Manager, Head Marshal, Marshals, Race Starter, Judges, Safety Officer, Trained First Aid Person, Scorers, Scrutineers, and Parking Supervisor. Only members of the marshalling team are to be on the track.

These people will all be briefed on their role and safety requirements prior to entering the track.

Accident Investigation & Reporting

An incident register will be located at HQ and must be completed by witnesses and officials as soon as possible following any incidents. Any vehicles involved must be inspected for damage and re-scrutineered before re-entering the competition. The First Aid Person is to be informed via radio or through the HQ desk. The First Aid Person will take charge of the first aid requirements at the scene and supervise any appropriate actions. Officials will contact external agencies should they be needed.

First Aid

There will always be a third-party Emergency Medical Technician (EMT) on-site during the event, as well as trained First Aid Persons. There are to be no track events conducted in the absence of an EMT. The EMT will be stationed at a track entrance for the duration of the day and will be notified of any incidents by phone or in-person. The EMT's contact details will be located on the Contact Sheet - located at HQ and on all clipboards held by officials.

Safety: Vehicles

All competing vehicles are to be scrutineered prior to racing at their Regional Final event, and a WoF sticker will be issued to verify compliance. Only compliant vehicles are allowed to participate. People with engineering knowledge will act as scrutineers under supervision of the Chief Scrutineer.

Safety: Officials & Competitors

All attendees will be greeted upon commencement of the event with a welcome announcement. This will cover general housekeeping, such as bathroom and drinking water locations, as well as the emergency assembly point(s) and procedures.

Officials and volunteers will be briefed in further detail prior to the start of the first EVelocity event, followed by a briefing for drivers.

All drivers must have completed their Driver Responsibility Form before being allowed to race.

Official & Volunteer briefing points:

- All officials and volunteers must act as safety officers - if something is seen to be happening that could lead to an accident, swift action should be taken to prevent it.

- Specific event briefings (i.e. Drag Race rules and procedures) will take place at the event zone prior to the start of each event.
- Keep an eye out for anything that looks unsafe and take action to remedy the situation.
- Vehicles are not to be powered or driven in the pits.
- High-vis vests and walkie talkie radios will be handed out.

Driver briefing points:

- Key personnel will be introduced.
- Vehicles are only to be driven during racing events and when marshals are present. There are to be no vehicles driven in the pits and should only be powered on at the request of an official.
- Drive safely and sensibly at all times and act under the direction of marshals (identified by their high-vis vests).
- There will be a detailed briefing for each event at the event zone immediately before the event takes place. This will include an event description and procedure.
- A track-walk and an overview of the flag system, detailed in full below, will be conducted before the Efficiency Event.
- If a vehicle is behaving abnormally the first reaction should be to power off and inform a marshal.
- In the Efficiency Event, drivers are asked to keep left, and if passing, give the other vehicle at least a metre of clearance.
- In the case of an accident, drivers should slow down to walking pace and follow the signals of marshals.
- There is to be no passing on corners.
- If a vehicle is involved in an accident, drivers of vehicles involved should activate the kill switch to disconnect their batteries and remain in their vehicles, if safe to do so, until advised by a marshal.
- In case of battery fire: stop the vehicle, exit the vehicle and activate the kill switch, shift the vehicle away from flammables if safe to do so, and establish a safety zone (10m radius). Avoid fumes.
- All drivers must be wearing the required overalls, leather gloves, long pants, full face helmet and suitable shoes at all times while driving.
- In the pits, tools and maintenance gear should be kept tidy and out of the way of foot traffic.

- Failure to comply with the direction of officials may result in disqualification and/or removal from the event.

Flag System

Flag Colours

A coloured flag system will be used during track events to communicate with drivers:

- A **blue** flag tells a driver that there is a faster vehicle behind that should be allowed to pass. The driver should pull to the side and slow until the vehicle has passed.
- A **black** flag indicates a disqualification, and the driver must exit the track immediately by pulling to the side and waiting in their vehicle until the session concludes (this could be due to misbehaviour, mechanical issue etc).
- A **yellow** flag signifies there is a hazard on or near the track (e.g. when a vehicle has stopped) and to drive with caution. Vehicles will be expected to slow to a walking pace.
- A **red** flag signifies that the session has been stopped (e.g. in the case of a serious incident, or when the time limit is reached), and all drivers must slow to a walking pace and leave the track via the designated track exit.
- A chequered flag indicates the driver has completed their race and should exit the track on their next pass.

Incident Procedure

1. Ensure that the appropriate flag is raised for the severity of the incident. A yellow flag should be raised any time there is debris, or a stopped vehicle on or near the track.
2. Inform other marshals via radio of the incident.

3. Ensure that it is safe to enter or cross the track before assisting drivers. Do not attempt to assist if drivers are not complying with flag rules. Escalate flag status if necessary.
4. Reassess the severity of the incident once on scene. Escalate flag status if necessary. Assessing the situation:
 - a. Is the driver currently injured?
 - b. Is the driver in danger of future injury?
 - c. Are other drivers in danger of future injury?
 - d. Is there debris on the track that cannot be easily cleared?

If the answer to any of the above questions is “yes”, then the **red** flag should be raised.

5. If it is safe to do so, move the vehicle or debris off the track. Drivers must remain in their vehicle during this process.
6. If the session can continue, ensure that the driver rejoins the track safely, and continue to monitor conditions for at least one lap before resuming racing. If the vehicle is badly damaged, it should return to the pits.
7. In any scenario that a driver must exit their vehicle, the driver is to pull to the side if able, and power off their vehicle via the kill switch. Driver's should only exit their vehicles if there is imminent danger and they have to get out, not simply because their vehicle has broken down.
8. Drivers involved in an incident should power down their vehicle via the kill switch immediately.
9. Drivers may head to the pits off-track if they are no longer racing but are not to cross the track while there are still vehicles racing. Their vehicles should be pushed, not driven.

The **red flag** procedure is as follows:

- All drivers slow down to a walking pace and return to pits where possible.
- Designated first-aiders and fire extinguishers to report to incident site immediately.
- In the case of a severe injury, first aiders take control of the situation with respect to the driver's safety. No movement or removal of the driver without first-aiders direction.

- In the case of a battery fire, drivers are to power off the vehicle via the kill switch and exit the vehicle. The fire can then be suppressed with an extinguisher. Down-wind areas should be cleared, as well as the safety radius of 10m.

Battery Care & Safety

Batteries Used in EVelocity

Many different types of batteries are used in the EVelocity competition. The Standard Class (350W) kits come with two 12V lead-acid batteries. Open Class vehicles are allowed to bring their own batteries and are allowed to use lithium ion (Li-Ion), lithium polymer (LiPo), or lithium iron phosphate (LiFePO4) batteries. These batteries have significant performance advantages over the traditional lead-acid batteries, but they often require extra care and attention to be used safely. This section will outline the safe use of different battery chemistries and the risks and procedures surrounding each.

Battery Chemistry Overview

Lead acid

Generally considered low-risk and included in all Standard Class vehicles. They should be charged according to instructions, never short circuited between terminals, and kept cool. We recommend that all batteries are kept in fireproof containers. If a lead-acid battery fire is to occur, the same safety measures should be taken as if they were lithium batteries.

Lithium

Lithium-based batteries are more volatile than lead-acid batteries and are considered a fire risk. While the failure rate is low, if precautions are not taken, these failures can have serious consequences. Lithium batteries are prone to 'thermal runaway'; a self-reinforcing process where the heat of a burning battery continuously accelerates the release of energy, and these fires can be extremely difficult to put out. Fire can start if the battery suffers:

- Puncture or impact.
- Charging when previously overcharged or over-discharged.
- Sun or heat exposure
- Drawing more current than the battery is rated for
- Overcharging or over-discharging

In the case of a battery fire, take the following steps:

- As soon as smoke is seen or the battery is hot, isolate the battery using the kill switch.
- Immediately remove the driver and establish a safe zone with a 10m radius.
- Do not inhale smoke or fumes, nor allow them to come into contact with skin or eyes.
- If safe to do so, move the vehicle or battery away from flammable materials.
- Shower the battery with lots of water to cool it and extinguish the fire with a Class ABE fire extinguisher. If fumes or heat prevent this it should be left to burn out in a safe area.
- The fire service should be called if there is risk the fire could spread.

Note: Modern lithium-ion batteries do not contain solid lithium metal, and so will not chemically react with water as is expected of solid lithium metal.

Use of Lithium Batteries in EVelocity

Choice of battery

We encourage teams to independently research their battery choice. They should select a battery for its capacity, discharge rate, voltage, weight, size, and safety features. They should also define their own battery care procedures for the proposed battery. Once the team has decided on a

battery, we encourage them to check this and their care procedures document with EVelocity technical staff, as we will be able to provide guidance on the battery's suitability and safety.

Scrutineering

As a part of the scrutineering process, the following need to be checked to permit vehicles to race:

1. Battery health: Check for swelling, distortion, strange smell or evidence that they have run hot. These are the first signs of poor battery health and that battery should not be used.
2. Battery management system (BMS): Ensure that the team is using one in their system, or at the very least has used a balance charger.
3. Battery protection: Check for an appropriately sized protective fuse and ensure the battery is mounted out of direct sunlight, protected from puncture or rubbing on the ground, and a firewall is present between the battery and the driver. Being housed in a fireproof container (at all times) is recommended.

Examples of fireproof containers: steel ammo box or COTS fireproof bag.

Charging & Discharging

Before Charge

- Read the instruction booklet of the charger before use to ensure it is the correct one for the battery.
- When charging lithium batteries with multiple cells (all lithium batteries used in EVelocity), ensure that a balance charger is used.
- Where a battery management system (BMS) is used, ensure that the BMS is compatible with the charger before charging.
- Each individual cell must be checked to ensure that they are above the minimum voltage as they should NOT be recharged if they are below the manufacturers recommended minimum voltage level.
- Check the packaging and connectors of batteries are not damaged.

- Cells within a battery should be of the same type. Where multiple batteries are used, each should be charged separately, or tested for balance before being connected to the charger.
- Check that the polarity of the power and balance leads are correct before connection.
- Keep batteries in a fireproof container when in storage, being charged, or in use.
- Batteries that have visible ‘ballooning’ (swelling or bulging) should not be used and should be disposed of.

Charging

- Only use a charger designed for the type of lithium battery being used. If the charger can support different battery types, select the correct mode to match the battery.
- Charge batteries in a fireproof container or bag in an open area away from flammable materials.
- Never charge batteries below freezing (0°C), nor when they are warm or hot to the touch.
- Set the charger to the proper cell count and/or voltage listed on the battery labels.
- If adjustable, set the charger to the Ampere charge rate shown on the battery label. If no charge rate is provided, take the battery capacity in Amp-hours (Ah), and set that as the charge rate in Amps (e.g. 2Ah battery should be charged at 2A).
- Never overcharge a battery beyond the capacity stated on its label or rated maximal voltage.
- Closely monitor charging batteries as this is when they are most vulnerable to catching fire.

Discharging

- Use a battery management system (BMS). Ensure that cells do not fall out of balance.
- Never discharge batteries at Amperage levels higher than specified on the battery label.
- Keep the battery temperature below 60°C while in use.
- Batteries should never be run down below the manufacturers minimum voltage rating as they may be damaged, lose performance, or catch fire when being recharged.

- In an emergency, stop using the battery immediately, disconnect it, and if possible, place it in a fireproof container or a safe area outside, away from flammable materials.

Storage

Lithium batteries should be stored out of direct sunlight, away from moisture, and in a cool (-10°C to 40°C) environment with the batteries separated in such a way that they cannot short between each other. They should be disconnected when not in use and stored upright in a fireproof container. Batteries must be stored at their specified “storage voltage” and must be checked on regularly to ensure that they have not fallen below this point. All cells must be balanced before storage.

First Aid

Eyes - wash eyes with clean running water for 15 min while keeping eyelids open.

Skin - remove any contaminated clothing and flush affected skin for 15 min.

Respiratory tract - remove victim to fresh air.

In all cases, follow through with immediate medical attention.

Drivers and marshals will be briefed with the above safety measures on the day of the event.

Risk Assessment & Mitigation

The purpose of risk assessment is to identify possible hazards and state how they will be eliminated or managed. EVoloccity will compile an incident register at the Information desk. (HQ). Witnesses are asked to record their comments on any incident they see.

Participating teams will need to complete and file a level 3 RAMs report with their school.

Risk	Action
Electrical Equipment	All mains electrical equipment will have been checked and certified by a qualified electrician on an annual basis as required. Teams will not have access to 240V outlets at the venue. If vendors require 240V outlets, any extension cords are to be taped down or covered and away from walkways. A Residual Current Device (RCD) will be used in all such scenarios. Any vendor generators must comply with all relevant safety regulations and must be run in a well-ventilated area away from foot traffic and activity areas.

Battery Fire
(non-lithium based)

If smoke is seen coming from a battery, the vehicle's kill switch should be activated immediately. If safe to do so, the vehicle should be removed to a site away from flammable materials. A safe zone (10m radius) should be established around the fire, and smoke inhalation and contact with skin and eyes is to be avoided at all costs.

Fire is to be treated with water and the class ABE fire extinguisher available from the HQ desk.

If it is not safe to treat the fire and there is no chance of the fire spreading, the fire should be left to burn out.

Should there be any risk of the fire spreading the Event Manager or Safety Officer should call the Fire Service. See the Contact Sheet for personnel information.

Prior to the event, guidelines for the use of lithium batteries will be circulated amongst teams that have elected to use them.

Battery Fire
(lithium-based)

Vehicles are required to have additional safety measures in place when employing lithium-based batteries (LiPo, Li-Ion) in order to receive a WoF pass. This includes:

- Battery Management System (BMS) - all lithium-powered vehicles should have a BMS present which must be able to be checked by a scrutineer. If no BMS is present, then a balance charger must be used and each cell should be within 0.1V from highest charged cell to lowest charged cell, provable at the time of scrutineering.
- Temperature monitoring - all lithium batteries are to be actively monitored for overheating, with a warning system in place that indicates to the driver if the temperature has exceeded 60°C.
- Low voltage indicator - a system should be in place to indicate to the driver that the voltage of a cell has dropped to the safe limits for their battery type. If it is not automatic, the driver is required to power down their vehicle if the low voltage indicator is active.
- Firewall - an adequate firewall must be present between the driver and battery pack.

Modern Lithium-ion batteries are safe if protected from sunlight, heat, puncture or impact, and a BMS controls charge and discharge. They should be protected from direct sunlight and heat and should be mounted inside a fireproof

container. Scrutineering will check the installation of the battery, kill switch, and fuse, along with measures to prevent them coming loose, being knocked, and potential exposure to heat or sunlight.

In the event of a fire:

- Smoke will normally be seen for a few minutes. - Stop the vehicle immediately and remove the driver -Stop any ongoing races.
- Move the vehicle away from any flammable materials if safe to do so.
- Create a 10m safety zone around the battery.
- Cool with water and extinguish using the Class ABE fire extinguisher located at HQ. Water will cool the cells, stopping 'thermal runaway' and the fire growing.

If the fire cannot safely be extinguished and it is away from flammables with no chance of spreading, the fire can be left to burn out.

Care should be taken to prevent breathing in the smoke or fumes and also contact with eyes or skin. If this does happen, remove contaminated clothing, flush the open eye or skin with lots of water and seek medical assistance. The fumes are very toxic.

General Fire & Earthquake

In the event of an emergency, the Event Manager or Safety Officer should contact emergency services. See the Contact Sheet for personnel information.

The emergency assembly point(s) will be advised during the welcome announcement.

In an earthquake, people should move away from structures, DROP, COVER and HOLD, then move to the assembly point(s).

Drugs & Alcohol

This is an alcohol-free event. Staff will be monitoring all event attendees to check that drugs and alcohol are not evident and have not been consumed.

Unstructured Event	All volunteers will be briefed by the event organisers prior to the start of events. Volunteers will be asked to be vigilant about the safety of people arriving and leaving competition areas. Spectators will watch the competition from behind the safety barriers or a safe distance from the competing vehicles. Events cannot start unless the track is clear. Competing vehicles will be parked in the Pit Area. Access to this area will be controlled by a marshal when vehicle movement is required. During events drivers are to keep left on the track to allow others to pass safely.
Vehicles & Drivers	All vehicles will be scrutineered and given a WoF pass sticker before being allowed to compete. The vehicles cannot be altered after scrutineering. Volunteers will look out for potential damage to any vehicles. After an incident a scrutineer must examine all affected vehicles to ensure they are still safe. A fuse and kill switch will be fitted to all vehicles and clearly marked. All drivers are required to wear cotton overalls, sturdy shoes, gloves, a full face crash helmet, and safety glasses if their helmet does not have a visor. Drivers will be instructed to pull over and power down their vehicle as their first instinct should it start running

	abnormally or unstably.
Spectators	Marshals will ensure vehicles move safely from the pits to the start line. Spectators are required to stay behind the fences or cones while events are running. There are to be no spectators on the track or on unprotected track sidelines. Any poor behaviour will be referred to HQ and event staff.
Personal Harm & First Aid	In the case of someone being badly hurt, contact the marshals and event HQ immediately to engage external agencies. An EMT and First Aid Person will be in attendance. Accidents or near misses must be recorded on the incident register. If exposed to smoke from a lithium-ion battery fire, remove any contaminated clothing, then wash the affected area with clean water for 15 minutes. Medical attention should follow. Drivers will identify themselves to event officials upon arrival at the event if they have any medical or health conditions. These are also disclosed in the Driver Responsibility Agreement.
Track	Solid objects that cannot be removed from alongside the track will be covered by cushioning materials. The track and immediate area will be checked before and after each event for debris or movable objects that could cause harm and moved to safe distances. Spectators will watch from the safety zones.

Traffic	Parking areas for cars and trailers will be indicated in the site map and by signage on the day. Cars and trailers are not allowed in the pit area.
Children	Lost children should be kept in the immediate area for 15 minutes before taking them to the HQ. Parents & caregivers are solely responsible for their children's individual medical needs, ensuring their medical requirements are on hand.
Vehicle Construction	The WoF form completed by scrutineers will attest to compliance against design requirements and construction quality and safety. Attention will be paid to weld strengths, robustness of design, roll cages, brakes, and driver safety requirements. An energy monitor will be fitted prior to racing to ensure vehicles do not exceed the 2kW specified power limit.
Track Safety	KartSport tracks are analysed before events for safety in terms of track surfaces, corner design, safety fencing and barriers, lack of dangerous fixed obstacles, cushioning around obstacles that cannot be moved etc.
Driver Inexperience	Drivers will be briefed before racing and are expected to have driven and tested their vehicles in preparation for the day. They should be familiar with how their vehicle behaves. Briefing is to be led by EVelocity personnel to include knowledge of the Flag System, safe braking, passing etiquette, limiting speed to driver abilities, how to hold a line into and out of corners, and responsibilities and expectations.

Driver Protection

All drivers will have abrasion resistant overalls, leather gloves, a full-face helmet with visor or goggles, and sturdy shoes. Note: helmets are not to be used if modified or damaged in any way.

Drivetrains should be sufficiently covered to prevent driver or clothes from being snagged, and long hair is to be tied up.

Monitoring Driving

Marshals will be briefed on their responsibilities on race day. They will be vigilant and proactive about safety and flag use in their assigned area of the course.

The event organiser will have the authority to immediately ban any driver risking the safety of others.

Overtaking

This action poses the greatest potential risk factor and will be mitigated by:

- The grid positions being arranged with the fastest karts in the front row moving back to the slowest in the rear.
- Driver briefings going over holding driving lines on the track, recognising where opportunities to pass arise, and how to allow this to happen safely for both parties.
- The flag system

Accidents

Trained first aid personnel will be vigilant trackside and ready to respond.

Key marshals will have radio contact with first aid personnel, and the closest marshal will isolate any accident from other vehicles, activate the vehicle's kill switch, and protect the driver until first aid personnel arrive. The flag system will be used to stop the race if required.