

Hybrid & Electric Cars

Guidance for organisers of Speed events

Electric vehicles rely on stored electrical energy to power an electric motor to provide propulsion. Hybrids are primarily powered by an internal combustion engine with ancillary power from an electric motor. Kinetic Energy Recovery Systems (KERS) are effectively a development of the hybrid and recover energy in a number of ways additional to those of the typical hybrid, e.g. exhaust flow and heat, brake heat etc.

The attraction of electric motors is they produce maximum torque at zero revolutions, thus acceleration performance is generally impressive. All major manufacturers now produce hybrid and / or electric cars which are eligible to compete in production car classes.

In order to run hybrid and electric cars in MSA permitted events as either competitive or demonstration / parade vehicles, organisers will be required to demonstrate that they have adequate measures in place to control the risks.

The FIA series; Formula E, WEC & F1, run at UK venues and are subject to their own regulations.

Hazard Awareness

The key hazards relating to vehicles equipped with lithium-ion batteries and power systems carrying a significant electrical current:

- Electricity at high voltages - a risk managed by insulation and control systems that result in the links between the individual cells being broken so there is only the cell voltage in the system. The control systems also automatically shut down the system if it senses current going to earth and there are features such as impact sensitive cut offs etc. Discharge and charge rates are closely controlled and monitored to minimise the risk of cells overheating.
- Overheating and fire - there is an exothermic reaction so while it flames, it is in itself not burning. It will ignite nearby combustible materials. No fire extinguisher will touch an exothermic reaction, the only way to deal with such a problem is to extremely rapidly get the temperature down. If a cell is punctured or squashed it will short circuit with the same result.

Acceptance of entries

Written permission is required from the MSA to run electric or hybrid vehicles at an event.

Prior to considering the acceptance of entries for hybrid or electric vehicles the event organisers must carry out a Risk Assessment to include the emergency arrangements for the safe handling and recovery of these vehicles.

For a hybrid or electric car to be accepted onto an event entry list they must either comply with National Type Vehicle Approval (running within road-going series production cars S11.1.1 or standard cars 11.9.1) or FIA Appendix J Article 253 (J5.1).

These cars are only eligible to compete on road surfaces for which they have been designed e.g. asphalt. Consideration must also be given to the physical restraints of the venue and any resource required for dealing with incidents and recovery (see below).

Electric or hybrid cars not currently licenced for use on the public highway must have been approved by the MSA and been issued with an MSA Vehicle Passport (S9.1.7).

Arrangements for Scrutineering

Where electric or hybrid vehicles are included in the competition, the organisers must ensure that they appoint a Scrutineer who is competent in scrutineering hybrid or electric vehicles. The Chief Scrutineer will identify the member of the scrutineering team who has experience of electrical engineering and/or electrical power systems.

It is essential to obtain the Technical Manual for the vehicle from the potential entrant well in advance of the event to be able to conduct a suitable risk assessment, establish safe systems and isolation procedures and identify the necessary resources for dealing with an incident. The MSA will require a copy of this manual before a MSA Vehicle Passport is issued.

Scrutineers should have the opportunity to review the potential entry and the relevant documentation that a garage would need before working on the vehicle.

The owner or suitable representative of the vehicle must be present during scrutineering to be available to answer any technical questions specific to that vehicle.

A Risk Analysis of the service history of the vehicle may be required. To ensure that the batteries and other items have been maintained in accordance with manufacturers requirements.

Venue requirements

Venues wishing to host hybrid or electric vehicles at their events must have the following provisions in place:

- Scrutineering personnel with competency in scrutineering hybrid & electric vehicles
- First on scene personnel – marshals, rescue & recovery – who have received manufacturers (or if available MSA) training in responding to incidents involving hybrid or electric vehicles & have knowledge on the hybrid & electric vehicles specific to an event
- Equipment to confirm safe status of electrical systems e.g. absence of voltage
- Personal protective equipment (PPE) for first on scene and scrutineers – electrical insulation gloves (Class 0 rated to 1000V), face shield and other items as specified in the manufacturer's Technical Manual
- Procedures to ensure that all first on scene personnel remove or cover metal items on clothing, jewellery and spectacles
- Training for first on scene personnel in correct use of PPE
- Firefighting measures for dealing with a high intensity lithium ion battery fire - adequate water provisions (typically 40,000 litres or more) to the manufacturer's recommendation for the vehicles entered to allow cooling of the batteries over prolonged periods
- Appropriate recovery vehicles to comply with manufacturer's recovery guidelines – note that towing of hybrid or electric vehicles involved in an impact is not permitted
- Provision of an exclusion zone for vehicles involved in an incident which may have destabilised the electrical systems and a procedure for dealing with the vehicle
- Appropriate signage to identify vehicles which may be in an unsafe state and suitable equipment to cordon off the area
- If multiple hybrid or electric vehicles will be on track at the same time the provision needs to cover multiple incidents

Emergency Management

Electric and hybrid vehicles typically have electrical systems running at voltages of 300 volts DC and higher with motors converting the power to AC. Any electrical system of 50v or more is considered as requiring specific precautions.

All electric and hybrid vehicles have technical manuals that detail the means of approach and recovery of the vehicle which must be supplied with the entry and followed studiously as each vehicle is different with different risks. A risk assessment should be complete for every potential vehicle rescue and recovery activity.

See above for the venue requirements.

General guidelines for dealing with an incident

The following information is guidance which should be expanded upon, utilising specific information from the vehicle manufacturer, and developed into a safe system of work:

- If a hybrid or electric vehicle is involved in an incident, protect yourself with the appropriate PPE that has been provided to you including electrical insulation gloves and face shield. Leave any metal objects e.g. cutting equipment, clear of the vehicle.
- Approach the vehicle with care not touching any part of the vehicle, ideally remaining stood back from the vehicle. Take particular care if there is wet weather or ground conditions.
- If the driver is not impaired ask the driver to isolate the vehicle and to self-extricate.
- Should the driver not be responsive and clearly in need of assistance, locate and turn the identified isolator OFF, using gloved hand. Hybrid & electric vehicles have different systems for isolating the HV supply. Both HV and 12V supply must be isolated.
- Check the dash display and vehicle generally for light displays. Some vehicles have a 'system status light display' to indicate whether the system is active or isolated. If there is no such display then if there are no visible lights illuminated it is likely that the system is isolated. Check this against the instructions from the vehicle Technical Manual.
- Watch for signs of electrical current flow or battery damage, such as arcing, sparks, sizzling etc., particularly in wet conditions.
- HV cables are coloured ORANGE, do not sever or touch such cables or the components to which they are connected whilst the electrical system may still be live
- Only first responders who have received appropriate training and have the correct PPE should be working in the vicinity of the vehicle until it is confirmed as safe.
- Do not make contact with the car with any other part of the body until its status is confirmed as safe.
- When satisfied that the electrical systems are isolated, proceed with appropriate care.
- At all times monitor the vehicle for leaking fluids, vapour, smoke, sparks, unusual odours, popping or hissing noises.
- Noise emitting from a battery may indicate that there is ignition within the battery; such carries a risk of explosion or external ignition.
- Be aware that if a vehicle is in contact with such as a metal barrier that too may be 'live'.
- Once the vehicle occupant(s) have self-extricated or been extricated ensure all personnel remain back from the vehicle and arrange for the competitor or his/her technical team to supervise the vehicle's removal.
- Inform the scrutineering team that the Scrutineer with suitable experience of hybrid and electric vehicles is required to oversee the recovery operation and the return of the vehicle to the designated exclusion zone. (Many vehicles require the

setup of an exclusion zone where the vehicle must remain for several hours or days. Check the vehicle specific recovery instructions – see Venue Requirements)

- Damaged vehicles should not be stored within buildings but in the open away from flammable structures and materials and cordoned off in such as to prevent unauthorised access and to create a safety zone around the vehicle. Allocate enough staff to police the exclusion zone until any risk has passed.
- Continually monitor the vehicle, particularly if there is visible damage to the battery unit, as there is a risk of ignition for a significant period after an incident.
- If a lithium-ion battery ignites, it is an exothermic reaction rather than a combustible fire. To deal with such ignition requires sustained large volumes of water to be applied for a prolonged period of many hours. It is unlikely that application of fire extinguishers will deal with such an incident. In this case ensure all personnel are suitably isolated from the vehicle by creation of an exclusion zone so that they are not affected by heat, gaseous emissions or any potential explosion.

Re-charging of vehicles and/or batteries

Where vehicles / batteries are being re-charged, only equipment specified by the vehicle / battery manufacturer is to be used. The vehicle / battery should be charged within a suitable isolated safety zone and the charging operation and safety zone monitored by a suitably experienced person.

Remember

- Exposure to high voltage electrical currents can kill or result in life changing injuries
- Modern battery systems are sophisticated and incorporate many control and fail safe systems to monitor battery condition, control charge and discharge, provide automatic shutdown if operating parameters are breached etc.
- Gasoline and similar fuels offer the potential for fire and explosion, the risk is managed by methods of storage and use, the same applies to electrical energy. Whatever the energy storage or energy application system risks are to be identified, managed and respected.