

# Electrified Vehicles (EVs)

## Guidance for organisers



The term Electrified Vehicle (EV) is used in these guidance notes to refer to hybrid (HEV), plug-in hybrid (PHEV) or battery electric (BEV) vehicles.

Electrified vehicles use stored electrical energy (usually in batteries) to power an electric machine to provide vehicle propulsion.

Hybrid vehicles have 2 different energy storage systems and propulsion systems – a fuel tank and internal combustion engine and a traction battery and electrical machine(s).

A plug-in hybrid has a charge port to enable the battery to be charged by an external energy source. All major manufacturers now produce HEVs, PHEVs or BEVs which are eligible to compete in production car classes.

To enable EVs to participate in Motorsport UK permitted events as either competitive or demonstration / parade vehicles, organisers will be required to demonstrate that they have put adequate measures in place to manage the associated risks.

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

### Hazard Awareness

The key hazards relating to vehicles equipped with high-voltage (HV) propulsion systems and lithium-ion batteries:

- **Electricity at high voltage** - exposure to a voltage above 60v DC or 30v AC can be potentially fatal and as modern EVs typically operate at voltages greater than 350 volts, special precautions must be taken. The risk is managed by careful design, insulation and control & monitoring systems that ensure no HV potential is exposed during normal operation or under fault conditions. Should the integrity of the HV system be compromised then the system will act to isolate the HV battery from the remainder of the system. This should also occur during a crash event.
- **Overheating and fire** – Li-ion batteries contain large amounts of energy. All production HV batteries have an integrated Battery Management System (BMS) that is designed to protect the battery from over charge, over discharge or over temperature. Should a li-ion battery cell be physically damaged (crushed/punctured), short circuited or overheated a violent exothermic reaction may result. This can lead to thermal runaway from neighboring cells; an exothermic chain reaction once initiated is almost impossible to extinguish.

### Acceptance of entries

Written permission is required from Motorsport UK to run EVs at an event.

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

For EVs to be accepted onto an event entry list they must either comply with Section J – Competitors: Vehicles - Appendix 2 (Technical: Electrified Vehicles) 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).

All EV's must have a current and valid Motorsport UK Electric Vehicle Passport.

Stage Rally events are not included in this guidance document and further information is to be sort from the Motorsport UK Technical Team.

## Arrangements for Scrutineering

Where EVs are included in the competition, the organisers must ensure that they appoint a Scrutineer who is competent and experienced in scrutineering EVs. As a minimum this individual must hold a Motorsport UK Level 1 HV safety qualification (or equivalent) for pre-event safety scrutineering and a Motorsport UK HV level 2 qualification (or equivalent) for Eligibility Scrutineering. The Level 2 qualification is to be released in the future and further details are available upon request from the Motorsport UK Technical Team.

It is essential to obtain the vehicle specific Emergency Services Guide and associated technical information from the potential entrant well in advance of the event to enable a risk assessment to be conducted, establish safe systems & isolation procedures and identify the necessary resources for dealing with an incident. Note: Provision of the vehicle specific Emergency Services Guide to Motorsport UK is one of the conditions to enable an Electric Vehicle Passport to be issued.

For bespoke EV vehicles, a HV qualified team representative must be present during safety scrutineering to answer any technical questions specific to that vehicle. The driver must be able to demonstrate to the scrutineer the standard procedure(s) for energizing and de-energizing the HV system and the emergency de-energizing procedure.

Evidence of the vehicle service history may be requested to ensure that the battery and other equipment has been maintained in accordance with manufacturers requirements. For a prototype/bespoke vehicle, the detailed build log must be available during the safety scrutineering.

The HV qualified team representative must be present during eligibility scrutineering to enable the HV system to be safely isolated and then remove any part of the vehicle that the scrutineer requires for inspection.

## Venue requirements

Venues wishing to host EVs at their events must have the following provisions in place:

Scrutineering personnel with Motorsport UK (or equivalent) HV safety qualification and competency in scrutineering hybrid & electric vehicles

- First on scene personnel – rescue & recovery – who have received manufacturers (or if available Motorsport UK) training in responding to incidents involving EVs & have knowledge on the hybrid & electric vehicles specific to an event including a copy of the Emergency Services Guide as part of the rescue & recovery vehicle equipment.
- Personal protective equipment (PPE) for first on scene – as a minimum this must include HV insulated gloves (Class 0 rated to 1000V) and other items referred to in the vehicle specific Emergency Services Guide.
- 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 HV PPE and initial “one-handed” approach.
- Firefighting measures for dealing with a lithium ion battery fire – in accordance with the manufacturer’s recommendation for the vehicles entered.
- Appropriate recovery vehicles to comply with manufacturer’s recovery guidelines – note that towing of hybrid or electric vehicles involved in an impact that may have compromised the integrity of the HV system is not permitted.

- Provision of an “safe area/ exclusion zone” to store recovered vehicles involved in an incident which may have compromised the integrity of the HV system incl appropriate signage to identify vehicles which may be in an unsafe state and suitable equipment to cordon off the area.
- If multiple EVs will be on track simultaneously, the provision needs to cover multiple incidents.

## Emergency Management

The manufacturers of production EVs publish “Emergency Services Guides” that detail the basic architecture and component locations in the vehicle including any emergency shut off devices plus the means of approach and recovery of the vehicle. A copy of this guide must be supplied with the entry and followed carefully as each vehicle is different with different risks. A risk assessment should be complete for every potential vehicle rescue & recovery activity prior to the event.

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 an EV is involved in an incident, protect yourself with the appropriate PPE. 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 standing back from the vehicle. Take particular care in wet weather or wet 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 in need of assistance, locate and turn the identified isolator OFF, using gloved hand. Note: Different EVs have varying methods for isolating the HV supply.
- For standard vehicles, check the dash display and vehicle generally for warning lights. Prototype vehicles will have “HV Status” and “Ready-to-drive” status lights to indicate whether the HV system is safe and the system is active or isolated. Ensure the instructions for safe HV isolation contained in the vehicle specific Emergency Services Guide are followed.
- 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 attempt to sever or touch such cables or the components to which they are connected whilst the HV electrical system may still be live.
- Only first responders who have received appropriate HV 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 HV system 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 emanating from a HV battery may indicate that there is serious malfunction within the battery; which carries a risk of explosion or external ignition. If safe to do so, use an infra-red temperature measurement gun to determine the surface temperature of the HV battery case – any temperature above ~ 60 degC in conjunction with noise or leaking fluids etc. should be treated with caution.

- Be aware that any metallic item (safety barrier etc) in contact with the vehicle may also be “live” until the HV system is isolated.
- 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 their technical team to supervise the vehicle’s removal following the towing/recovery procedures contained in the vehicle specific Emergency Services Guide.
- Inform the scrutineering team that a Motorsport UK HV qualified Scrutineer is required to oversee the recovery operation and the return of the vehicle to the designated exclusion zone.
- Vehicles with damaged HV batteries must be stored 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, 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 specialist extinguishants, sometimes requiring application for a prolonged period. If the application of fire extinguishers do not extinguish the fire, 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.

**Note: Recommend use of F500 extinguishant for lithium battery fires.**

## Charging of vehicles

Off-board chargers must be commercially available and meet all UK Electrical safety requirements. Details must be supplied to the organizer with the vehicle entry.

Charging of the battery must be done in-situ with the charging cable(s) supplied with the vehicle. It is prohibited to remove a HV battery for charging.

It is prohibited for any work to be carried out on the vehicle whilst the HV battery is charging and/or an external power supply is connected to the vehicle.

The entrant/team must ensure that any temporary charging installation is installed and connected to the mains supply by a trained competent person following the Code of practice for Electric Vehicle Charging Equipment Installation, 3rd edition and meet all the requirements of BS7671: 2018 (the 18th Edition wiring regulations), with particular attention paid to earthing.

The vehicle should be charged in a designated charging/safety zone and the charging operation must be monitored by a suitably experienced person.

## Remember

- Human contact with high voltage can kill or result in life changing injuries.
- EV battery systems are designed to be safe under normal use and certain fault conditions, however they are not designed to cope with physical breach of the battery.
- Gasoline and other hydrocarbon fuels offer the potential for fire and explosion and the risk is managed by methods of storage and use: the same applies to electrical energy.
- Whatever the energy storage medium or propulsion system, the risks must be identified, managed and respected.

## Appendix 1 Table 1 - HV Safety Equipment Provision Summary

Equipment Who/Where	HV Gloves (Inner & Outer)	Insulated Rescue Pole	Arcflash Helmet	Portable Defibrillator	Voltage Proving, Insulation Measuring & Infra-red Temperature Measuring Device	Insulation Tools	Special Tools (service disconnect)	Vehicle Specific Emergency Service Guide	EV Capable Extinguisher (e.g. F500)
Rescue Crew	x				x				
Rescue Unit	x (spare set)	x	x	x	x	as required – minimum is set of insulated cable cutters for cutting safety loop		x (each unit)	X
EV Scrutineer	x				x (only if trained)				
Scrutineering Bay	x	x	x	recommended					x
Designated Charging Area	x	x	x	recommended					x
Team	x	x	x	recommended				x (for each vehicle)	recommended
Team HV Representative (bespoke vehicles)	x		x		x	as required	as required	x	