

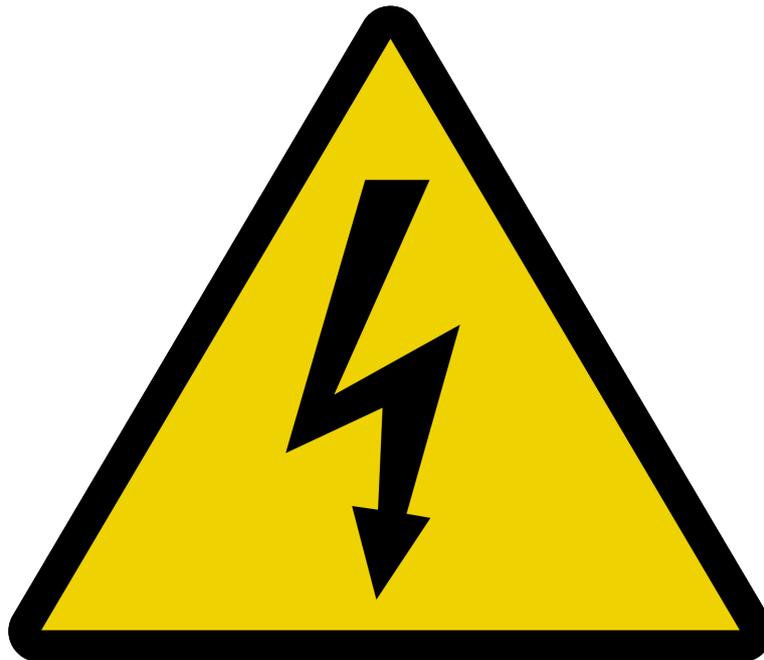
# MotorSport

New Zealand



*Live life faster*

## Electric and Hybrid Vehicles Guidelines



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## 1. Overview:

- 1.1** This document has been created by MotorSport New Zealand to provide guidelines that will allow Electric Vehicles (EV's) to compete in MotorSport New Zealand-permitted events. This document may be updated from time to time as new information comes to hand and requirements may be either increased or decreased. Please ensure you check the version you have is the current version.
- 1.2** The document has been broken into sections applicable to:
- Important information and notes
  - Guidance for Event Organisers
  - Emergency Response and Recovery requirements
  - Entrant / Competitor requirements
  - Unmodified Series Production Electric Vehicles
  - Modified Electric Vehicles
  - Scratch-Built Electric Vehicles
- 1.3** The information contained in the document has been sourced by referencing a wide range of literature including FIA regulations, other ASN's documentation and NZ Fire and Emergency procedures. The information contained here has been assembled in consultation with an appointed group of industry specialists with the following qualifications and credentials:
- Electrical Design Engineers with Electrical Engineering degrees
  - RNZAF Electrical Engineer with specialist battery background
  - Vehicle Manufacture EV and Hybrid Training Managers
  - Fire and Emergency Operations Advisor responsible for EV emergency response
  - Individual MSNZ Members involved with constructing EV's for motorsport use
- The completed guidelines have been independently reviewed and commented on by five Member Clubs prior to seeking Board approval.
- 1.4** These guidelines identify potential risk categories and provide guidance on how any assessed risks may be mitigated. Each event and circumstance will present its own unique features, so it is vital that a full risk assessment is carried out when planning your event. Not all risks will be applicable to all events, and there may also be some venues where additional risks not covered here may be identified.
- 1.5** Where 'EV's' are mentioned through this document the requirements apply equally to Hybrid vehicles regardless of battery type.
- 1.6** These requirements apply equally to competition and demonstration.

## 2. Important Notes

### **Warning !**

Electric and hybrid vehicles are constructed with high voltage electrical circuits which are capable of delivering a fatal electric shock. Within the context of this document 'high voltage' is defined as that exceeding 60V DC or 25V AC. Care should be taken at all times when working around EV's. The following guidelines should be used to establish appropriate measures and procedures to keep all personnel safe.

- 2.1** Any Electric Vehicle involved in a heavy impact should be always treated as dangerous until it has been confirmed to be safe through isolation of the HV system by a competent Crew Member or Official.

### **Warning !**

Electric and hybrid vehicles can be subject to 'battery thermal runaway' under certain circumstances. The following guidelines should be used to establish appropriate measures and procedures for dealing with thermal runaway.

- 2.2** Electric Vehicles involved in a heavy impact can be susceptible to battery damage and associated thermal run-away, a reaction that once started is very difficult to halt.
- 2.3** A fire in an EV has the potential to create extremely volatile and toxic gases. Appropriate PPE should be available to first responders at events where a risk assessment and safety plan require it.

### 3. Guidance for Organisers:

**3.1** This section identifies a range of potential risk areas that event organisers should assess and mitigate where applicable.

**3.2** **In the first instance contact MotorSport New Zealand**. Initially, permits will be issued only by MotorSport New Zealand Office for events where EV's are to be used and must be detailed in the event Supplementary Regulations. The Event Supplementary Regulations, Safety Plan and completed Risk Assessment Form must be forwarded to MotorSport New Zealand for approval.

- EVs are not to be used at any event unless permitted under the Supplementary Regulations.
- A Risk Assessment must be carried out on the venue to identify any possible risk areas which may include; any particular fire-prone features, or course features that could prolong recovery of a seriously damaged EV. To accomplish this, please use the existing 'Temporary Venue Risk Assessment' form is available on the MotorSport New Zealand website under 'Organiser resources'.
- The Event Safety Plan must detail all risks identified and propose how those risks will be mitigated. These risks may vary due to; the type of EV competing, the number of EV's competing etc.
- The Event Safety Plan must detail procedures and processes for dealing with EV incidents and accidents, including the emergency arrangements for the safe handling and recovery of damaged EVs.
- The venue/property owners should be advised that EV's are to be included in the event
- The local Fire and Emergency Department will be a good source of information and should be informed that EV's are to be included in the event. They will likely be involved in any incident so pre-warning is a must.
- All EV's used for competition must have a 'MotorSport New Zealand Electric Vehicle Logbook'.
- All Officials, Marshalls and Competitors attending the event must be briefed that EV's are competing, how EV's are identified and what precautions are required when dealing with EVs. If spectators are present, there must be a system of notifying them that EV's are competing and how they are to be identified.
- Organisers should arrange for the safe storage of any EV involved in a significant accident until any risk period has expired. The location of the storage area must be detailed in the Event Safety Plan. Where multiple EV's are competing at the same event an appropriate sized area needs to be considered.
- Ideally, one member of the Rescue / Recovery team should be trained and proficient with methods of recovery and/or dealing with high voltage electrical systems and Li-ion batteries. If this is not possible organisers need to ensure the competitor is able to provide someone capable of managing and advising on the safe management of any recovery/rescue.
- Series production EV's should only be used in competition on road surfaces for which the manufacturer could reasonably have expected the vehicle to be used on.

- Competitors must provide the Organiser with a copy of the Manufacturer's High Voltage Emergency Response Guideline document, and a schematic drawing of the High Voltage Electrical Circuit, including high voltage system isolation procedures. A copy of these should be passed to recovery response personnel. If there are multiple entries of the same make and Model of vehicle only one set of documents needs to be obtained. Where possible, recovery/response personnel should be given the opportunity to familiarise themselves with the vehicle/s.
- Competitors should provide Scrutineers with an up-to-date battery service history for their EV.
- The Organiser must ensure that all EV's are identified as EV's with an appropriate identification. A universal ID Label will be confirmed in due course.
- Arrangements must be made for the safe transportation of any significantly damaged EV. It is not safe to Tow most damaged EV's. Follow any instructions contained in the vehicle's Emergency Response Guidelines. In most cases if the car needs to be moved it should be trailered or lifted.
- If EV charging is to take place at the venue there must be a designated charging safety zone provided and detailed in the safety plan. This designated area must be located well away from any stored fuel locations.
- The Organiser needs to ensure appropriate PPE is available for emergency personnel who could be involved in recovery / rescue. (Refer to List of equipment) This may be provided either by the Organiser or by the Competitor.
- A thermal imaging camera is recommended as a method to monitor battery temperature where batteries may have been damaged. This will provide valuable data on battery condition in any prone cars and could also avoid unnecessary use of water. Event shut-down due to fire concerns could be avoided.
- Arrangements should be made for adequate quantities of water to be available to suppress any battery reaction. Your local Fire and Emergency Department will be able to offer guidance. Quantities required in attendance at a venue will vary depending on the proximity of the nearest Fire Department or secondary water supply. If more than one EV is running in the event at the same time this quantity should be available per car.
- Event briefings for competitors and officials must include notifying all personnel that EV's are participating and include, how they are identified, what the hazards and risks are and what precautions to be taken when dealing with them.
- Organisers must ensure any damaged EV's have the details of any damage accurately recorded in the vehicle's EV logbook.

### 3.3 Sample Emergency Management Plan:

It is a good idea to create and document a management plan for any potential EV emergencies, so everyone is aware of what needs to be done and who the best people are to engage.

	Description	
1	Venue owner advised and acknowledge if applicable	
2	Local Fire and Emergency advised	
3	Risk assessment carried out	
4	Safety Plan updated with risk assessment details	
5	Off-site vehicle storage arranged if required	
6	PPE and safety equipment arranged	
7	Trained response personnel identified and appointed	
8	Water supply arranged including arrangements for secondary water supply	
9	Transport for damaged EV's arranged (Not towing) if required	
10	Absence of voltage detector arranged	
11	Thermal imaging camera arranged (Recommended)	
12	Prepare and arrange briefings with Competitors and Marshalls	

### 3.4 Risk Assessment Examples

1. A Motorkhana held in a large open car park should have a risk assessment carried out but is highly likely that won't reveal any significant risks other than perhaps those posed to personnel. A risk assessment here should be very straight forward and require little more than including notification of EV's competing in the Supplementary Regulations and a briefing of all personnel at the event.
2. A Hillclimb in a forest with trees or obstacles in close proximity to the course and / or large drops off the roadside, or a Street Sprint amongst buildings and power poles, may hold significant risks of vehicle damage in the event of an accident and could pose recovery challenges. A risk assessment here may require a number of considerations and details included in the Safety Plan.

#### 4. Event Emergency Response Guidelines:

4.1 There are two risk categories Emergency Response personnel need to be aware of when dealing with an EV accident or incident.

- High voltage electric shock, and
- Battery 'thermal run-away' in the case of non-lead-acid batteries

The following points provide guidance on how any risks to personnel may be mitigated at an event.

##### High Voltage Electric Shock

- It is important that someone trained or competent in EV High Voltage systems is used to oversee any recovery or rescue operation. This may be an appointed Official or someone competent supplied by a competitor. Personnel working for this person must be familiar with or briefed on the hazards associated with EVs.
- The vehicle's crew, including the driver if available, should be used to assist in any rescue or recovery as they should have intimate knowledge of the vehicle systems.

##### IMPORTANT

EV's rely on capacitors in the HV system which can store high voltage for up to 15 minutes after the HV system has been isolated. Do not touch any part of the HV system until this period has expired or absence of voltage has been properly confirmed by someone competent

- If the driver is still in the vehicle, ask them to isolate the HV system and self-extricate if possible.
- Personnel involved in any rescue / recovery must be familiar with how to isolate the vehicle's high voltage electrical system. There are usually three methods of isolation detailed in the vehicles Emergency Response Guidelines document.
- Personnel involved in rescue or recovery should wear PPE appropriate to the situation and as recommended in Emergency response Guidelines.
- Personnel should approach EV's from either side and avoid approaching from the front or rear due to risk of un-commanded movement of the vehicle.
- If the driver is unresponsive, locate the high voltage isolation switch if accessible and switch off. Refer to manufacturer's instructions. There will usually be multiple options for doing this, including disconnecting the 12V battery. Refer to the vehicles Emergency Response Guidelines document. In some cases, a member of the competitors crew may be the best person to accomplish this.
- Some EV's contain capacitors that can retain a full charge for up to 15 minutes after isolating the high voltage system. The location of these capacitors must be identified before any activity is started.
- Do not make any contact with the vehicle until the HV status of the vehicle is known.

- If vehicle cutting equipment is required to extract the occupant, the operator must be fully conversant with the high voltage circuitry and the location of high voltage cables / wiring.
- Where significant vehicle damage has occurred, a thermal imaging camera, if available, should be used to assess and monitor high voltage battery temperature.
- Avoid towing a damaged EV if at all possible. If it has to be moved use a low-loader or lift the vehicle on to trailer etc. High voltage may be produced by rotating the vehicle's driveline. Some Vehicles are protected from this so check the Manufacturers Emergency Response Guidelines.
- In case of fire use Class A or Class D hand held extinguishers or water from the fire tender. F500 Encapsulater Agent may also be used.

***Note:** HV batteries powering EV's can be made of differing materials. If there is battery spillage it is important to identify what battery type is being used as each will may a different treatment.*

### **Battery Exothermic Run-away**

- Make sure the HV system is isolated before beginning any activity.
- Large quantities of water would be required to cool batteries if a reaction begins.
- Some vehicles may also have combustible metals in their construction that could complicate and extend extinguishing any fire.
- Damaged vehicles must always be stored in an isolated area well away from buildings, flammable substances and cordoned off due to extended risk of battery reaction. A minimum of 15 metres clear open area must surround the vehicle for up to five days.
- There should be appropriate signage placed on the stored vehicle to indicate that it may be in an unsafe state.
- Consideration should be given to how the vehicle is to be stored after the event where there is possibility of battery damage.

## 5. List of Equipment and PPE Recommended at Events

	Description	Detail Location
1	Water source	Refer Fire and Emergency
2	PPE Class 0 Insulating Gloves	
3	PPE Insulating Mat	
4	PPE Absence of Voltage Detector	
5	PPE Insulating over-shoes	
6	PPE Breathing Apparatus	
7	Thermal Imaging Camera	
8	Vehicle Storage Area	
9	Recovery / Tow / Lift vehicle	
10	Portable defibrillator (Recommended)	

## 6. Recommended Procedure for Dealing with Damaged EV

**6.1** This section details the recommended process for dealing with damaged EV vehicles.

- Determine extent of damage.
- Any persons involved in the recovery of a damaged EV must be protected with appropriate PPE until the vehicle is confirmed safe. Make sure any personal metal adornments are covered/insulated.
- Ask the Competitor to isolate the HV system and self-extricate.
- If the driver is incapacitated have a competent person in PPE locate the HV Isolation switch and turn off. There are varying methods of isolating HV systems so use the material provided for the vehicle and the Car's Crew to assist.
- Series production EV's usually have a dash display that will advise the HV status. Refer to the vehicle's manufacturer Emergency Response Guidelines document provided at the event. If no display is visible the vehicle should be treated as live until the HV system has been confirmed isolated.
- Modified and Scratch built EV's will have guidelines provided to the event Organiser. Follow these guidelines in consultation with the Car's Crew.
- Be aware off any unusual signs of potential of battery damage.
- Where possible the competitors crew should be utilised to assist/advise during recovery.
- Only when the vehicle is confirmed safe can any recovery actions begin.
- Towing a damaged EV should be avoided in the case of most vehicles.
- If there is suspicion that battery damage has occurred arrangements need to be made to monitor battery condition and arrange appropriate water supplies as per the event safety plan. Thermal imaging cameras would be extremely valuable determine and monitor battery condition. Refer to table below for indicative high temperature.

**6.2** If there are indications of battery damage the following is recommended.

- If thermal imaging camera is available begin monitoring the battery compartment.
- If battery temperature is stable for 10 minutes, recovery can begin observing guidelines.
- If battery temperature is not stable and is increasing, immediately start applying water to the battery compartment.
- Continue this for 10 minutes while monitoring battery temperature.
- Ensure secondary water supply required under the safety plan is notified or arranged.
- If battery temperature stabilises cease water flow and monitor battery temperature for 5 minutes.
- If battery temperature remains stable begin recovery maintaining battery surveillance.
- Repeat this procedure as many times as is necessary to fully stabilise the battery.
- If the vehicle is confirmed safe arrange for it to be moved to the 'safe storage location' as detailed in the event safety plan.
- The vehicle should be isolated in the pre-arranged storage area for a minimum of 5 days
- Organisers must ensure any damaged EV's have the details of damage accurately recorded in the vehicle's EV logbook.

Battery Type	Lithium ion	Lithium Nickel	Lithium Cobalt
Risk Temperature	250°C	170°C	130°C

## 7. Eligibility

**7.1** This section details the eligibility of EV vehicles which Entrants and Competitors may want to entering into a permitted event.

- All electric and hybrid cars must have a valid MSNZ Electric Vehicle Logbook.
- Currently no equivalency factor has been established for electric vehicles. Event/Series organisers should establish their own requirements. It is recommended that electric vehicles are classified separately to conventionally powered cars.

## 8. Entrants / Competitor Responsibilities

**8.1** This section details the responsibilities and obligations for Entrants and Competitors when entering an EV into a permitted event.

- All EV's must have a MotorSport New Zealand EV Logbook before entering an event
- The entrant must provide the Organiser with a copy of the Manufacturers Emergency Response Guidelines document at the time of entering the event
- The entrant may be required to provide a competent Crew member who is familiar with the vehicle and who can assist in any incident or recovery

## 9. Vehicle Safety- Series Production Vehicles Unmodified With Road Use Compliance

**9.1 Series Production vehicles** that carry current licencing for use on public roads and a current WOF with a drive system that is unmodified shall comply with the following:

### 9.1.1 Vehicle requirements:

- It is permissible to remove internal fittings, upholstery, accessories and components but no modification of the bodyshell is permitted other than fitment of an approved safety cage and removal of attachment brackets

**Note:** *EV construction will generally include significant structure designed to protect the battery compartment from accident damage. This structure must remain fully intact and must not be modified in any way.*

- If a safety cage is installed, where practical, that structure should include side intrusion members that extend longitudinally at least the length of the battery compartment.
- Vehicle weight may be lightened but can't weight less than 200Kg below manufacturers kerb weight.
- The high voltage system including batteries and drive train must remain as per manufacturers specification.
- Any manufacturer installed battery monitoring system, temperature control or override shall remain operative.
- A service history of the HV batteries should be presented where available
- It is recommended that a HV system status warning system/light is installed that is clearly visible from outside the vehicle.

**Note:** *A purpose built bespoke, universal system is currently under development.*

## 10. Vehicle Safety- Series Production Vehicles with Modified HV Systems or Batteries

### 10.1 Series Production Vehicles with Modified HV System requirements:

- Prior to beginning any modification to an EV that will be used in competition contact MotorSport New Zealand with a detailed description and plans of the modification.
- In addition to the requirements details below all modified EV Series Production Vehicles carrying current road licencing for road use must also have a valid LVVTA Certification Plate detailing the HV modifications.

### 10.2 Warnings, Notifications and Identification:

- If the SRS airbag system is removed/disabled the control unit may be retained and configured to trigger an impact warning that is clearly visible from outside the vehicle. This warning should also display the status of the HV bus (>60Vdc)
- The vehicle must carry high voltage ID sticker adjacent to the competition number on both sides of the vehicle.
- Vehicles must carry a sticker identifying the battery type adjacent to the competition number. For example; 'Lithium-Ion', 'Lithium-Nickel, Lithium Cobalt.
- A high voltage isolation switch must be installed and location must be clearly marked on the vehicle.
- A copy of the vehicle manufacturers Emergency Response Guidelines must be available in the vehicle at all times.
- A detailed schematic drawing of the high voltage electrical system must be carried in the vehicle at all times. This diagram must show the location of the high voltage system isolation switch and the location of any high voltage system capacitors.

### 10.3 Series Production Vehicles that have any modification to the high voltage system including batteries and/or drive system shall comply with the following:

#### 10.4 Vehicle requirements:

*Note: Custom designed and built batteries will only be accepted from an industry recognised manufacturer.*

- Must have a certificate of compliance demonstrating that the High Voltage Electrical system has been inspected and carries no inherent dangers. Certification can be provided by LVVTA.
- Must have a MotorSport New Zealand Electric Vehicle Logbook. This will only be provided once the High Voltage Electrical System Certificate and any other safety related data relevant to the application has been received and reviewed by MotorSport New Zealand.
- A battery monitoring warning system must be fitted that is capable of providing advanced warning of battery over-temperature.
- The car must be fitted with a battery temperature control or override system operative at all times.
- If a custom battery is fitted it must have multiple temperature sensors installed. Each battery cell must have at least one sensor installed in contact with the cell wall.

- The accelerator must be of a fail-safe design where any failure in the system will result in loss of power to the drive system.
- An automatic high voltage system isolation function must be incorporated.
- A High Voltage System Isolation Switch must be installed in an easy to reach external location and be clearly marked.
- An impact activated warning light system set to activate at 4 -5 G must be installed that will trigger an impact warning that is clearly visible from outside the vehicle which will also display the HV bus status.
- It is permissible to remove internal fittings, upholstery, accessories, and components but no modification of the bodyshell is permitted other than fitment of an approved safety cage and removal of attachment brackets.
- It is recommended that a safety cage is installed that must include side intrusion bars located along the sill and extend longitudinally at least the length of the battery compartment.
- The battery compartment must be fitted with accessible couplings (inlet and outlet) capable of delivering a minimum of 100 litres per minute of water for emergency cooling of batteries.

**10.5** It is mandatory that a crew member who is familiar with the design and construction of the vehicle is present for the duration of the event.

## 11. Vehicle Safety- Scratch-Built Electric Vehicles

### 11.0 Scratch-Built vehicles:

**Note:** *Anyone planning to build a scratch-built electric car must in the first instance contact MotorSport New Zealand for approval.*

- Scratch built vehicles shall be constructed and comply with FIA Appendix J Article 253.
- The vehicle must have a safety cage installed that includes side intrusion members that extend longitudinally at least the length of the battery compartment.