

RULE CHANGES

Decisions approved by the Motorsport UK Board
that affect regulations in the *Motorsport UK Yearbook*

Consultation and ratification

The Motor Sports Council must consider all new regulations proposed by the Specialist Committees. The regulations are first published on the Motorsport UK website so that comments may be received before they are presented to the Motor Sports Council for approval, incorporating any modifications that result from the consultation process (which may have included review by another Specialist Committee or Advisory Panel). Approved rule changes will be published here and will be incorporated into the next edition of the relevant Motorsport UK Yearbook(s).

(B) Nomenclature and Definitions

Date of implementation: Immediate

~~**Battery cell.** An electrochemical energy storage device, of which the nominal voltage is the electromechanical couple nominal voltage, made of positive and negative electrodes, and an electrolyte.~~

~~**Battery module.** A single unit containing one cell or a set of cells electrically connected and mechanically assembled.~~

~~**Battery pack.** A single mechanical assembly optionally housed by a battery compartment, comprising battery modules, retaining frames or trays.~~

Explanation of format

Regulation changes are shown as red additions or ~~struck through~~ deletions. A dotted line (...) indicates that the regulation contains further wording that is unchanged and has been omitted here for space reasons. The dates of implementation are stated immediately above the Regulations, while reasons for the changes are given below.

Specific definitions for Electrified Vehicles

General definitions for Electric and Hybrid Vehicles are according to FIA Appendix J – Article 251 (which can be found at www.fia.com) unless where stated otherwise.

Auxiliary battery. Definition according to Appendix J – Article 251-3.1.19.1

Auxiliary circuit. Definition according to Appendix J – Article 251-3.1.19

Auxiliary ground. Definition according to Appendix J – Article 251-3.1.19.2

Basic insulation. Definition according to Appendix J – Article 251-3.1.14.1.b.

Battery cell. Definition according to Appendix J – Article 251-3.1.7.6

Battery Management System (BMS). Definition according to Appendix J – Article 251-3.1.7.8

Battery module. Definition according to Appendix J – Article 251-3.1.7.5

Battery pack. Definition according to Appendix J – Article 251-3.1.7.4

Capacitor. Definition according to Appendix J – Article 251-3.1.7.2

Clearance. Definition according to Appendix J – Article 251-3.1.12

Conductive part. Definition according to Appendix J – Article 251-3.1.17

Creepage distance. Definition according to Appendix J – Article 251-3.1.13

DC-DC Converter. An electronic device whose function is to regulate multi-level voltage outputs for use by the electrical and electronic components of the car and power unit.

Double insulation. Definition according to Appendix J – Article 251-3.1.14.1.c

Driver Master Switch. Definition according to Appendix J – Article 251-3.1.20

Electric chassis ground, vehicle ground and earth potential. Definition according to Appendix J – Article 251-3.1.15

Electric Generator. Definition according to Appendix J – Article 251-3.1.23

Electric Motor. Definition according to Appendix J – Article 251-3.1.22

Electric Shock. Definition according to Appendix J – Article 251-3.1.8

Electric Vehicle Passport (EVP). The EVP is the EV equivalent of the existing CCLB/VP for internal combustion engine powered vehicles.

Electrified Vehicles (EV). All forms of Electrified Vehicles (including those defined in FIA Appendix J – Article 251): Electric Road Vehicle/Battery Electric Vehicle (BEV), Hybrid Electric Vehicle (HEV), Full Hybrid Electric Vehicle (FHEV), Plug-in Hybrid Electric Vehicle (PHEV) and mild Hybrid Electric Vehicle (mHEV)

Energy Recovery System (ERS). A system that is designed to recover energy from the car, store that energy and make it available to propel the car and, optionally, to drive any ancillaries and actuation systems necessary for its proper function.

Exposed conductive part. Definition according to Appendix J – Article 251-3.1.18

General circuit breaker (emergency stop switch). Definition according to Appendix J – Article 251-3.1.14.3

Insulation. Definition according to Appendix J – Article 251-3.1.14.1.e.

IP65. Ingress Protection code. 6 dust tight, 5 protection from water jets.

Live part. Definition according to Appendix J – Article 251-3.1.16

Main ground point. Definition according to Appendix J – Article 251-3.1.15.1

Material Safety Datasheet (MSDS). A MSDS is a document that contains information on the potential hazards (health, fire, reactivity and environmental) and how to work safely with the chemical product.

Maximum working voltage. Definition according to Appendix J – Article 251-3.1.9

Overcurrent trip (fuses). Definition according to Appendix J – Article 251-3.1.14.2

Power bus. Definition according to Appendix J – Article 251-3.1.14.1

Power circuit. Definition according to Appendix J – Article 251-3.1.14

Power circuit ground. Definition according to Appendix J – Article 251-3.1.14.5

Power Unit. The engine, complete with its ancillaries, the energy recovery system and all actuation systems necessary to make them function at all times.

Rechargeable Energy Storage System (RESS).
A RESS, using batteries, is a system that is designed to propel the vehicle via the electric motor and recover electric energy from the grid or from the on-board generator. The RESS comprises all components needed for the normal operation of the RESS.

Reinforced insulation. Definition according to Appendix J – Article 251-3.1.14.1.d

Safety indications. Definition according to Appendix J – Article 251-3.1.21

Service Disconnect. See service switch

Service Switch. Definition according to Appendix J – Article 251-3.1.14.6

Traction Battery. Definition according to Appendix J – Article 251-3.1.7.3

Traction Circuit. The Traction circuit includes the ES, its safety management, the inverter, the MGU and all parts in the higher voltage side of the DC/DC converter.

Types of insulation of cables and wires.
Definition according to Appendix J – Article 251-3.1.14.1

UL 94. The Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances testing is a plastics flammability standard released by Underwriters Laboratories of the United States. The standard determines the material's tendency to either extinguish or spread the flame once the specimen has been ignited.

UL-94 is now harmonized with IEC 60707, 60695-11-10 and 60695-11-20 and ISO 9772 and ISO 9773.

UN38.3. The United Nations Regulations on the transport of lithium batteries: UN Manual of Tests and Criteria, 4th Revised Edition, Lithium Battery Testing Requirements.

Voltage class B. Definition according to Appendix J – Article 251-3.1.10

(J) Competitors: Vehicles

Date of implementation: Immediate

5.1. As a general principle in all Technical Regulations, it is prohibited to carry out any tuning or modification that is not specifically permitted. The fact that some modifications are mentioned as prohibited does not imply that others are allowed.

Vehicles that are not exclusively powered by an internal combustion engine are subject to the following regulations, those set out in (K) or SR's as appropriate. ~~Electric and Hybrid Vehicles must comply with FIA AppJ Article 253, Article 18, or be fully compliant with National Vehicle Type Approval.~~ **Electrified Vehicles must comply with Appendix 2.**

5.14.10 With the exception of Electrified Vehicles, the total quantity of recuperated energy stored in the car must not exceed 200 kJ; this energy may be re-used without exceeding 10 kJ by means of 1kW maximum.

(J) Competitors: Vehicles - Appendix 2

Table 1: Regulation Summary

| Regulation | Description | EV Tech Regs Applicability | | | |
|--|--|----------------------------|------------|------------|-----------|
| | | mHEV | HEV | PHEV | BEV |
| | | <i>LV</i> | <i>HV</i> | <i>HV</i> | <i>HV</i> |
| Section B: Nomenclature and Definitions | | Y | Y | Y | Y |
| Section J: Competitors Vehicles | | Y | Y | Y | Y |
| Section J Appendix 2 Electrified Vehicles Technical Regulations | | | | | |
| 5.22 | Electrified Vehicles | Y | Y | Y | Y |
| 5.23 | Permitted Vehicles | Y | Y | Y | Y |
| 5.24 | EV Passport and Inspection | Y | Y | Y | Y |
| 5.25 | Scrutineering | Y | Y | Y | Y |
| 5.26 | Charging | Y | Y | Y | Y |
| Bespoke BEVs | | | | | |
| 5.27 | Motors | <i>n/a</i> | <i>n/a</i> | <i>n/a</i> | Y |
| 5.28 | Rechargeable Energy Storage Systems | <i>n/a</i> | <i>n/a</i> | <i>n/a</i> | Y |
| 5.29 | Electrical Equipment and General Electrical Safety | <i>n/a</i> | <i>n/a</i> | <i>n/a</i> | Y |
| 5.30 | Safety Equipment | <i>n/a</i> | <i>n/a</i> | <i>na</i> | Y |
| 5.31 | Bespoke Vehicle Charging | <i>n/a</i> | <i>n/a</i> | <i>n/a</i> | Y |

Technical: Electrified Vehicles

5.22.1 The term Electrified Vehicle (EV) is used in these regulations to cover all forms of Electrified Vehicles (including those defined in FIA Appendix J – Article 251) : mild Hybrid Electric Vehicle (mHEV), Hybrid Electric Vehicle (HEV) / Full Hybrid Electric Vehicle (FHEV), Plug-in Hybrid Electric Vehicle (PHEV) and Electric Road Vehicle(ERV) / Battery Electric Vehicle (BEV).

5.22.2 High Voltage (HV) shall be as defined in FIA Appendix J Art 251 3.1.10 (from ISO 6469-1:2009): > 30V AC and ≤ 1000V AC or > 60V DC and ≤ 1500V DC.

5.22.3 An EV may contain a High Voltage (HV) or Low Voltage (LV) propulsion system.

5.22.4 As a general principle in all Technical Regulations, it is prohibited to carry out any tuning or modification that is not specifically permitted. The fact that some modifications are mentioned as prohibited does not imply that others are allowed.

5.22.5 Changes to these Technical Regulations made on grounds of safety may be enforced immediately without notice.

5.22.6 These General Technical Regulations are for individual vehicle builds. Championships for specific vehicles not in accordance with these regulations may apply for approval, which will be considered at the discretion of Motorsport UK.

5.23 PERMITTED ELECTRIFIED VEHICLE TYPES (Table 2)

5.23.1 These regulations apply to any modified National Type Approved or bespoke/prototype EVs intended for competition use. Standard and unmodified production EVs are subject to the existing requirements of Motorsport UK and the FIA where applicable.

5.23.2 A Standard vehicle is defined as-built by the manufacturer in accordance with its homologation/type approval with no modifications whatsoever, other than the

fitting of safety equipment which does not require the alteration of the vehicle structure. E.g. competition seats using the original mounting points and fasteners are permitted. A ROPS requiring fastening to the vehicle structure is prohibited.

5.23.3 A Modified vehicle is a Standard vehicle with non-powertrain modifications only (including fitment of safety equipment, including ROPS, which alters the vehicle structure). No modifications to the internal combustion engine (ICE) and/or electrified propulsion system are permitted.

5.23.4 A Bespoke vehicle is one designed and constructed from scratch, including prototypes. Only Bespoke BEVs are permitted. Bespoke includes prototype or otherwise unique competition vehicles.

5.23.5 A production vehicle with the ICE powertrain replaced by an electric one is classified as Bespoke.

5.23.6 Hydrogen powered fuel-cell hybrid and electric vehicles are prohibited.

5.23.7 These Technical Regulations cover all EVs, but not all regulations apply to all vehicles. For example, the HV safety related requirements do not apply to an mHEV, as these operate at a nominal DC voltage of 48V which is lower than the 60V DC limit (Table 1).

5.23.8 The discipline-specific Sporting Regulations will determine which category of EVs are allowed to compete in which discipline.

5.23.9 All EVs (including Standard) must undergo and pass a Vehicle Passport inspection and be in possession of a valid Passport to compete irrespective of discipline or category.

5.23.10 Electric Vehicle Passports will be issued by Motorsport UK.

5.23.11 See 5.24: EV PASSPORT AND INSPECTION PROCESS for more details.

5.23.12 Additional requirements or restrictions from discipline and/or category specific regulations shall apply

5.24 EV PASSPORT AND INSPECTION PROCESS

5.24.1 Anyone considering building a Bespoke EV for competition use must supply a project outline, including details/qualification of those engineering the vehicle for review by Motorsport UK Technical Department prior to starting construction. On-going dialogue between the entrant and Motorsport UK throughout the build process is encouraged to minimize the risk of non-compliance with these regulations when vehicle is inspected

5.24.2 All EVs (including Standard) must undergo and pass a Vehicle Passport inspection and be in possession of a valid Passport to compete irrespective of discipline or category. For a modified production vehicle, the inspection will include a comprehensive visual inspection to ensure that installation of the ROPS and non-powertrain modifications have not compromised the HV system Note: no repositioning of HV components (incl cables) is permitted. For a bespoke vehicle a detailed technical inspection of the entire vehicle including the EV system and its safety systems will be required. An EVP will be issued once the vehicle has passed the inspection.

5.24.3 See Table 2 for EVP requirements.

5.24.4 Where a Bespoke or Modified OEM EV is intended for a single make/one make series and all vehicles are built/modified by the same organization, then only the first vehicle in a batch will require full inspection. All subsequent vehicles from the batch will be issued with an EVP following written confirmation by the build organization that the follow-on vehicles are identical to the first vehicle.

5.24.5 Electric Vehicle Inspections must be arranged by appointment with Motorsport UK and will be carried out by a Motorsport UK HV qualified Technical Official.

5.24.6 The entrant must provide all data/evidence to Motorsport UK 3 months prior to the vehicle inspection as summarized below:

- (a)** RESS impact protection details (5.28.9) if mounted underfloor. RESS Structural calculations or crash test/simulation results (5.28.11).
- (b)** UN 38.3 and MSDS for cells (5.28.20).
- (c)** Cell chemistry details (5.28.21).
- (d)** BMS including cell temperature monitoring details (5.28.25).
- (e)** Isolation Surveillance System details (5.29.20).
- (f)** Vehicle specific Emergency Services Guide (5.29.21).
- (g)** Detailed EV system schematic (5.29.22).
- (h)** Vehicle specific functional switching diagram (5.30.5).
- (i)** Crash HV Isolation FMEA (5.30.12).
- (j)** Details of throttle fail safe system (5.30.18).
- (k)** Off-board charger details (5.26.1).
- (l)** On-board charger details (5.31.2).

5.24.7 In addition to the vehicle, the entrant must provide the following to enable the inspection to proceed:

- (a)** Completed Technical Inspection form.
- (b)** Detailed Build log with photos of the HV system components and installation.

(c) Photos of the EV components/features to be added to the EVP.

(d) Evidence of team personnel HV qualifications.

(e) An Emergency Services Guide specific to the vehicle undergoing inspection.

(f) The team HV qualified person.

(g) HV tools and safety equipment required to support the inspection.

(h) Example of the off-board charger to be used.

5.24.8 The vehicle will be examined at a location mutually agreed between the entrant and Motorsport UK. If inspection of the EV system requires access to the underside of the vehicle a suitable vehicle hoist or lift will be required. The use of jacks and axle / chassis stands is not permitted. The venue must have a mains power supply suitable for the off-board charger.

5.24.9 A second inspector may be present (for training and / or HV safety reasons) at the inspection.

5.24.10 The entrant will bear all fees arising from and the costs incurred by the inspection.

5.24.11 The entrant is responsible for ensuring that the vehicle satisfies all the Motorsport UK EV requirements and is presented for inspection in a finished and competition-ready condition.

5.24.12 All items on the Inspection Checklist must be clearly visible to the inspector without using instruments such as endoscopes or mirrors. Visible access may be provided by removing body panels or via removable access panels. Covers on the traction battery must only be removed by the nominated team HV qualified person if requested by the technical inspector.

5.24.13 Demonstration of the correct function of the indication and safety systems and the on/off-board charging systems forms part of the inspection. Correct response to a simulated crash event must also be demonstrated by the HV safety system.

5.24.14 The inspection of Bespoke EVs will examine all items included on the EV Inspection Checklist plus any other items the inspector may wish to examine. The exact procedures and instruments employed for inspection and testing are entirely at the discretion of the Technical Inspector.

5.24.15 The Inspection of Standard and Modified National Type Approved EVs will focus on ensuring that the installation of the safety items (ROPS, seat, fire extinguisher) has not damaged or disturbed any part of the EV system. It is prohibited to reposition any part of the EV system (including cables).

5.24.16 If any part of the vehicle EV system does not comply with the requirements or is deemed to be a concern, the entrant must correct the problem and re-present the vehicle for inspection. Minor faults may be rectified immediately, major issues will require a new inspection to be arranged and paid for.

5.24.17 The decision of the Motorsport UK inspector concerning compliance with the EV regulations is final and cannot be appealed.

5.25 SCRUTINEERING

Safety

5.25.1 Only Motorsport UK EV qualified Scrutineers will perform safety scrutineering on EVs.

5.25.2 A valid VP or EVP must be provided at Safety Scrutineering.

5.25.3 HV Vehicle Safety scrutineering procedures will include but not be limited to

visual inspection of the EV system and demonstration of the correct function of the safety and indication systems.

5.25.4 The Team HV qualified person must be present at Safety scrutineering equipped with their own set of HV safety equipment and tools as required.

5.25.5 The vehicle specific Emergency Response Guide must be provided to the circuit/venue/organiser's emergency services team before the vehicle is allowed to compete.

5.25.6 Motorsport UK Technical Officials can require the vehicle to be re-inspected at any time during an event.

Eligibility

5.25.7 Only Motorsport UK EV qualified Scrutineers will perform eligibility scrutineering on EVs.

5.25.8 Motorsport UK Technical Officials reserve the right to request access to any set-up information or data from the vehicle ECU(s) and other electrical devices at any time during an event including data that proves compliance with 5.28.3 and 5.28.5.

5.25.9 It is the responsibility of the competitor to prove that the vehicle has not exceeded any control parameter limits during an event (e.g. maximum power, maximum voltage etc.).

5.25.10 Motorsport UK Technical Officials reserve the right to request that the vehicle be fitted with a data logger.

5.25.11 The Team HV qualified person must be present at Eligibility scrutineering (equipped with their own set of HV safety equipment and tools as required) and be prepared to safely isolate the HV system and remove any HV components for more detailed inspection at the request of the Scrutineer.

5.25.12 Sealing requirements for HV system components will be developed and published in due course.

5.26 CHARGING

5.26.1 Off-board chargers must be commercially available and meet all UK Electrical safety requirements. Details must be supplied to Motorsport UK 3 months prior to the vehicle inspection.

5.26.2 Standard and Modified vehicles must use the unmodified on-board charger, charge port and charging cable(s) supplied with the vehicle.

5.26.3 Charging of the RESS must be done with the battery(s) in-situ.

5.26.4 Any temporary charging installation must be 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.

5.26.5 The charging system must be automatic and must ensure that the battery cannot be overcharged or damaged if left permanently connected to the charger.

5.26.6 The use of diesel or petrol generators to provide the energy to charge EVs is strongly discouraged. Motorsport UK are working with circuit / venue owners to investigate provision of sustainable charging facilities.

IN ADDTION A BESPOKE ELECTRIFIED MUST COMPLY WITH Appendix 2 5.27 – 5.31

5.27 MOTOR AND INVERTERS

5.27.1 A maximum of two motors, whose output are combined mechanically driving the wheels through a mechanical gearbox and

differential are permitted. A maximum of two inverters are permitted.

5.27.2 Only a single driven axle is permitted i.e. FWD or RWD.

5.27.3 Any system that achieves torque vectoring across or between axles is prohibited.

5.27.4 Hub / wheel motors are prohibited.

5.27.5 Only commercially available production motors and inverters are permitted.

5.27.6 Repurposing of OEM motors and inverters is permitted.

5.27.7 The inverter may be integrated with or separate from the motor. The motor may be integrated with or separate from the gearbox.

5.27.8 Brushed DC motors are permitted and motors with exposed commutators must be fitted with a commutator shield.

5.27.9 If the motor or inverter is liquid cooled, >51% water-based coolant must be used. The use of Dielectric fluid is prohibited.

5.27.10 If the motor is air cooled, all ventilation holes must be small enough to prevent the passage of a 12mm diameter spherical test object through all holes.

5.27.11 When an electrical motor casing is rotating around the stator, a scatter shield must be included to surround the rotating parts of the motor. The shield must be constructed from min 2mm steel or 3mm thickness aluminium alloy. Does not apply to motors fully enclosed in the transmission housing.

5.27.12 All motor and inverter connections that use bolted HV terminals must be fitted with moulded insulated terminal covers that are sealed to satisfy a minimum IP65 rating.

5.28 RECHARGEABLE ENERGY STORAGE SYSTEM (RESS)

General

5.28.1 The RESS must be comprised of a maximum of 2 separate traction battery enclosures per vehicle.

5.28.2 Capacitor and flywheel energy storage systems are prohibited.

5.28.3 For Bespoke EVs, the maximum total power going out of the RESS at any time is limited to 250kW.

5.28.4 For National Type Approved EVs, the power out of the RESS may not exceed the homologated power.

5.28.5 For Bespoke EVs, the maximum voltage on the Power Bus must never exceed 450V.

5.28.6 For National Type Approved EVs the maximum voltage must not exceed the homologated maximum voltage.

5.28.7 The RESS must include appropriately specified fuses or circuit breakers to prevent over-current in the event of short circuit. The protection devices must be located inside the RESS as close as possible to the main power bus connectors.

5.28.8 The RESS must be capable of being isolated from the Power Circuit by at least two independent systems (e.g. contactor or a manually operated Service Switch). There must be at least one manually operated system and one automatic system (under control of the BMS or Electronic Control Unit).

Enclosure

5.28.9 The RESS must be installed within the survival cell, passenger compartment, engine compartment or boot of the vehicle. Underfloor installation of the RESS is permitted if full impact protection is provided to meet the 60kN FIA impact energy requirements. Full details of the impact

protection must be provided to Motorsport UK 3 months prior to the vehicle inspection.

5.28.10 The RESS must not be used as a stressed member.

5.28.11 Calculations must be provided to Motorsport UK 3 months prior to the vehicle inspection to confirm that mechanical and electrical safety is ensured in a crash. The RESS may be required to pass a crash test defined by Motorsport UK.

5.28.12 The RESS enclosure must be to a minimum rating of IP65.

5.28.13 Cells/modules must be mechanically secured inside a metallic or composite enclosure. Any covers or access panels must be sealed and secured with fasteners requiring tools to remove.

5.28.14 The RESS must be designed to prevent short circuit of the conductive parts. In the event of compartment or component deformation, the design must ensure that no fluids enter the cockpit/passenger compartment.

5.28.15 The RESS must prevent the build-up of an ignitable gas/air or dust/air concentration inside the compartment by means of a burst valve or vent tube, positioned away from the driver. Any vent tube if fitted, must discharge direct to atmosphere external to the passenger compartment or survival cell.

5.28.16 All HV connections to the RESS must be made using either proprietary HV connectors with High Voltage Interlock Circuitry (HVIL) or the cables must pass through HV rated cable glands of suitable size to match the cable and which preserve the IP rating of the external enclosure.

5.28.17 The enclosure containing the cells, must also contain the BMS voltage and temperature sensing elements associated with

the cells, service switch, fuses/circuit breakers and contactors.

Cells

5.28.18 Off-the-shelf commercially available cells / modules must be used.

5.28.19 It is prohibited to modify individual cells or off-the-shelf/repurposed OEM battery modules except for the modification of cell tab/connections to enable connection together into modules, fitment of an approved BMS to comply with 5.28.22 and addition of temperature sensors to comply with 5.28.26.

5.28.20 The competitor must supply documents from the Cell/module producer specifying safety relevant data, including manufacturers' datasheet: UN38.3 report and Material Safety Data Sheet (MSDS). Including battery characteristic diagram showing the battery limits of voltage (U), power (W), temperature (T) and State of Charge (SoC). These documents must be provided to Motorsport UK 3 months prior to the vehicle inspection. Equivalent data from a 3rd party test house may be submitted in place of manufacturers data. Evidence of test house capability must be included as part of the submission.

5.28.21 Any type of commercially available cell chemistry is allowed subject to prior agreement from Motorsport UK. Full details of the chemistry and safety handling must be provided to Motorsport UK 3 months prior to the vehicle inspection.

Battery Management System

5.28.22 A Battery Management System (BMS) from an approved supplier is mandatory.

5.28.23 For Modified EVs the architecture of and functionality of the BMS must not be changed from standard.

5.28.24 The BMS must ensure that all cells do not exceed the manufacturers stated

limitations for voltage, current and temperature under any circumstances.

5.28.25 The BMS in all cases must monitor every serial cell for voltage and a minimum number of cells (evenly distributed throughout the modules/pack) for temperature in order that the hottest, coldest and average cell temperatures are monitored. Full details of the temperature monitoring must be provided to Motorsport UK 3 months prior to the vehicle inspection.

5.28.26 In the event that any cell exceeds the manufacturers stated limitations for voltage and/or temperature, within 2 seconds the BMS must reduce power to less than 5kW in order to leave the course or automatically isolate the battery from the traction circuit if it is not safe to reduce power.

Cooling

5.28.27 If the RESS is liquid cooled, >51% water-based coolant must be used.

5.28.28 The cooling liquid must not come into direct contact with any active components within the RESS.

5.29 ELECTRICAL EQUIPMENT AND GENERAL ELECTRICAL SAFETY

5.29.1 Specifications for general electrical safety are laid down in Appendix J – Article 253-18.1.

5.29.2 Specifications for the Power electronics (inverters, DC/DC converters, on-board charger etc.) are laid down in Appendix J – Article 253-18.5.

5.29.3 Any vehicle with an electrical system operating at a voltage exceeding 60V DC or 30V AC must display the label detailed in Section J Drawing 5.14 next to all competition numbers. Label minimum size 75mm x 75mm x 75mm.

5.29.4 In cases where the voltage of the Power Circuit belongs to voltage class B (2.9), symbols warning of "High Voltage" must be displayed on or near the protective covers of all electrical equipment that may operate at high voltage (Drawing 5). The symbol background must be yellow, and the bordering and the arrow must be black, in accordance with ISO 7010. Each side of the triangle should measure at least 120mm but may be reduced to fit onto small components.

5.29.5 No HV potential should be exposed anywhere on the vehicle during normal operation.

5.29.6 The design of the system must be such to ensure that a single point of failure cannot cause an electric shock hazardous to life.

5.29.7 HV Electrical cables and electrical equipment must be protected against any risk of mechanical damage (stones, corrosion, mechanical failure, etc.) as well as any risk of fire and electrical shock.

5.29.8 The voltage class B components and wiring must comply with the applicable sections of IEC 60664 on clearances, creepage distances (3.4.2) and solid insulation; or meet the withstand voltage capability according to the withstand voltage test given in ISO/DIS 6469-3.2:2010.

5.29.9 A plug must physically only be able to mate with the correct socket of any sockets within reach. All HV Power Circuit connectors must not have live contacts on either the plug or the receptacle unless they are correctly mated.

5.29.10 All parts of the electrical equipment must be protected using an appropriate IP class with min IP65 protection on all HV components.

5.29.11 The H traction circuit must be isolated from the vehicle chassis.

5.29.12 All HV cabling must comply with LV 216-2, ISO 6722 and ISO 14572 Construction of HV wiring systems for hybrid and electric vehicles. All cables must be orange and shielded, either internally or by conduit and must be securely fixed to the vehicle chassis using insulated fixings. Tie wraps are not acceptable. Cable conductor material must be copper. The use of aluminium bus bars and terminals is permitted.

5.29.13 All cable terminals must be crimped, or laser welded with a certificate of conformity if not OEM produced. The use of soldered terminals is prohibited.

5.29.14 All HV cable runs must be a single contiguous piece of cable between connectors / terminals. Any cable joins or splices must be achieved using bolted terminals securely fixed in a min IP65 rated enclosure with glands/strain relief on the cable entry points. Any covers or access panels must be sealed and secured with fasteners requiring tools to remove.

5.29.15 Any HV ancillary equipment (contactors, relays, fuses, current shunts etc.) not located in the battery enclosure(s) must be securely located in a min IP65 rated enclosure with glands/strain relief on the cable entry points. Any covers or access panels must be sealed and secured with fasteners requiring tools to remove.

5.29.16 All Class B Power Circuit connectors must not have live contacts on either the plug or the receptacle unless they are correctly mated. An automatic HViL (High Voltage Interlock) system must be present in every HV connector and detect if a Power Circuit connector is de-mated, for example with shorter alarm contacts within the same connector and inhibit/remove High Voltage from both the plug and the receptacle. If the connector was live when de-mated, the high voltage must be switched off immediately and any residual voltage on the contacts of both the plug and the receptacle discharged to

<60V DC within 2 seconds. Re-mating of the connector must not re-energise the circuit.

5.29.17 All class B Power Circuit connectors and cabling must provide mechanism for locking, strain relief and sealing to the cable assembly.

5.29.18 All major conductive parts of the body must be connected e.g. with wires of appropriate dimension to obtain equipotential bonding.

5.29.19 No part of the chassis or bodywork should be used as a current return path.

5.29.20 The distribution of high currents in the HV DC network must be made in a star-point configuration and not in a loop, in order to avoid potential shifts resulting from current flows. The star-point of the electrical reference potential is referred to as "Power Circuit Ground".

5.29.21 Every part of the electrical equipment must have a minimum insulation resistance between all live components and earth of **500 Ohms per volt**. The measurement of the insulation resistance must be carried out using a DC voltage of at least **100 volts**.

5.29.22 Unless the function is already provided by the BMS, a proprietary isolation surveillance system must be used to continuously monitor the status of the isolation barrier between the voltage class B (2.9) system and the chassis while the HV system is energised.

5.29.23 If not part of the BMS, the proprietary isolation surveillance system must be located within the battery enclosure and wired in series with the main battery contactors. If an isolation fault is detected, the system shall open the circuit breaker automatically and trigger the "Danger" state of the RESS Status Indicator. Full details of the isolation surveillance system must be provided to Motorsport UK 3 months prior to the vehicle inspection.

5.29.24 The competitor must provide a detailed "Emergency Services Guide" documenting all aspects of the HV system including component locations and details of the standard and emergency HV isolation procedures. This document should be structured in the same way and have similar content to the guides provided by OEM's for production EVs and must be provided to Motorsport UK 3 months prior to the vehicle inspection.

5.29.25 See Drawing 1 for an example of the EV System Schematic showing all components and connections. The vehicle specific version must be provided to Motorsport UK 3 months prior to the vehicle inspection.

5.29.26 On vehicles without a 12v alternator, a DC/DC converter of suitable power rating must be provided to charge the auxiliary battery and electrical system.

5.29.27 The auxiliary battery must never be used to recharge the traction battery.

5.30 SAFETY EQUIPMENT

Driver master switch

5.30.1 All vehicles must be equipped with a general circuit breaker, of sufficient capacity and which can be operated easily by a switch from the driver's seat when the driver is seated in a normal and upright position, with the safety belts fastened and the steering wheel in place, and from the outside, to cut off all electric transmission devices.

5.30.2 This switch MUST act as a General Circuit Breaker that interrupts ALL electrical transmission between the RESS and all other HV circuits by means of a spark-proof circuit breaker providing galvanic switching which MUST NOT be short-circuited by any components such as a pre-charge resistor. Low power batteries provided for low voltage circuits, for example auxiliary circuits, do not have to be isolated by the general circuit

breaker provided that they are completely isolated from the main power accumulators.

5.30.3 In the event that the circuit breaker is activated, the HV potential, outside the RESS, must

drop below 60V DC with 2 seconds.

5.30.4 Specifications for the General Circuit Breaker are laid down in Appendix J – Article 253 18.17.

Fire Extinguisher

5.30.5 All cars must be equipped with a plumbed in extinguishing system with a nozzle discharging into each battery pack. Only ABC extinguisher types compatible with the battery chemistry and specified for the voltage level at the power bus are allowed.

Extinguisher switches

5.30.6 There must be two exterior horizontal handles which are capable of being operated from a distance by a hook. These handles must be situated at the base of the main rollover structure on both sides of the vehicle for a single seater or at the lower corners of the windscreen for a closed cockpit vehicle.

5.30.7 A means of triggering from the outside must be combined with the general circuit breaker switches.

5.30.8 The handles must be marked with a letter "E" in red at least 80mm high, with a line thickness of at least 8mm, inside a white circle of at least 100mm diameter with a red edge with a line thickness of at least 4mm. See Drawing 3 for an example.

Marshal Neutral Switch

5.30.9 To enable a marshal to isolate the RESS from the power bus in less than 2 seconds, external switch(es) which operate the general circuit breaker must be provided, which:

5.30.9.1 For a single seater, a single switch must face upwards and be recessed into the top of the survival cell no more than 150mm from the vehicle centre line and less than 150mm from the front of the cockpit opening and less than 70mm from the extinguisher switches defined in 5.29.6.

5.30.9.2 For a saloon, two switches must face upwards and be recessed into the windscreen scuttle on either side, no more than 150mm from the side of the vehicle, 350mm from the door aperture and less than 70mm from the extinguisher switches defined in 5.29.6.

5.30.9.3 Each switch must be designed such that the power circuit cannot be accidentally re-energized.

5.30.9.4 Each switch must be marked with a red spark in white edged blue triangle with a base of at least 120mm. The angle of the triangle where the spark is pointing to, must point to the button. It must be associated with a letter "N" in blue inside a white circle at least 50mm in diameter and with a blue edge. The height of both symbols must be at least 100mm. See Drawing 4 for an example.

5.30.10 It is prohibited to cover the external switches in any way whatsoever.

5.30.11 In a crash, all energy sources of the Power Circuit must be switched off automatically and the full RESS must be isolated. The arrangements must be validated by the Failure Mode and Effects Analysis (FMEA) which must be provided to Motorsport UK 3 months prior to the vehicle inspection. An FIA approved Accident Data Recorder may be used to initiate the shutdown.

5.30.12 All switches (Driver Master, Neutral and Extinguisher) must operate at a nominal 12V.

5.30.13 See Drawing 2 for an example of the functional switching diagram. The vehicle specific version must be provided to

Motorsport UK 3 months prior to the vehicle inspection.

5.30.14 Safety Indicator requirements are based on the specifications laid down in Appendix J – Article 253 18.22.

5.30.15 All indicators must have a viewing angle of at least 120° and a luminous flux of at least 8 lumens.

HV RESS status light

5.30.16 All Bespoke vehicles with a HV RESS must be fitted with a HV RESS Status indicator light, which:

5.30.16.1 Is a Red/Green light that indicates the safety status of the RESS.

5.30.16.2 Must be in working order throughout the event even if power on the vehicle has failed.

5.30.16.3 For a single seater, faces upwards and is recessed into the top of the survival cell no more than 200 mm from the vehicle centre line and the front of the cockpit opening.

5.30.16.4 For a saloon vehicle, is fitted into the windscreen apron no more than 200mm from the driver's side of the vehicle and 50mm forwards from the lower edge of the windscreen.

5.30.16.5 Remains powered for at least 15 minutes after the general circuit breaker is activated.

5.30.16.6 Is marked with a "HIGH VOLTAGE" symbol (see Drawing 5).

5.30.16.7 Has repeater indicator light on the dashboard the replicates the states of the main light. This does not have to comply with 5.28.13

5.30.16.8 See Table 3 for the HV RESS Status indicator states.

Ready-to-Move-light

5.30.17 All Bespoke EVs that have an EV system that is capable of propelling the vehicle must be fitted with a Ready-to-Move light, which:

5.30.17.1 Is a white light that will illuminate to indicate that the vehicle can move if the throttle pedal is pressed.

5.30.17.2 For a single seater, faces forward and is fitted to the top of the roll hoop.

5.30.17.3 For a saloon vehicle, is fitted to the front roll over structure to be visible through the windscreen.

5.30.17.4 Will flash "on" for 0.05 seconds and "off" for 2 seconds whilst the vehicle is charging.

5.30.17.5 Will flash "on" for 0.5 seconds and "off" for 0.5 seconds if, when the system has been requested to energize and the bus voltage has not exceeded 50V.

5.30.17.6 See Table 4 for the Ready-To-Move indicator states.

Throttle failsafe

5.30.18 All Bespoke vehicles must be equipped with a throttle fail safe system, which in case the throttle and brake pedal are pressed at the same time, overrides the throttle and cuts the power to the propulsion system. The details of the fail-safe system must be provided to Motorsport UK 3 months prior to the vehicle inspection.

5.31 BESPOKE VEHICLE CHARGING

5.31.1 Bespoke vehicles must use a charging system compliant with a recognized charging standard and be able to use public chargers (SAE J1772, IEC 62196, CHAdeMO or Combined Charging System (CCS)) and must follow standard protocols for connecting/disconnecting the charge

connector and initiating/stopping the charging process. Only a single external charge port is permitted.

5.31.2 Bespoke vehicles must use a commercially available on-board charger (if fitted) and if liquid cooled, >51% water-based coolant must be used. Details must be provided to Motorsport UK 3 months prior to the vehicle inspection.

Appendix 2 – Tables and Drawings

Table 2: Permitted Electrified Vehicle Types

| Vehicle Type | Permitted EV's | | | | EV Inspection | | | | Vehicle Passport Requirement | | | |
|---|----------------|-----|------|-----|---------------|-------|-------|-------|------------------------------|-----|------|-----|
| | mHEV | HEV | PHEV | BEV | mHEV | HEV | PHEV | BEV | mHEV | HEV | PHEV | BEV |
| | LV | HV | HV | HV | LV | HV | HV | HV | LV | HV | HV | HV |
| Standard Electrified Vehicle 5.23.2 | Y | Y | Y | Y | N | N | N | N | VP | VP | VP | VP |
| Modified Electrified Vehicle 5.23.3 | Y | Y | Y | Y | Y 2/. | Y 2/. | Y 2/. | Y 2/. | EVP | EVP | EVP | EVP |
| Bespoke Electrified Vehicle 5.23.4 | N | N | N | Y | n/a | n/a | n/a | Y 3/. | n/a | n/a | n/a | EVP |

Key:
mHEV = Mild hybrid
HEV = hybrid
PHEV = plug-in hybrid
BEV = battery electric vehicle
LV = Low Voltage (<30V AC or 60V DC)
HV = High Voltage (>30V AC or 60V DC)
VP = Vehicle Passport (existing)
EVP = Electric Vehicle Passport (new)

Notes:
1/. Category or discipline specific regulations may impose further restriction on permitted vehicles
2/. Submission of OEM vehicle specific Emergency Services Guide and visual inspection only
3/. Full submission of all data requirements contained in EV Tech Regs plus visual and technical inspection and functional test

Table 3: HV RESS Status indicator states

| Light Status | RESS Status |
|--------------|-----------------------------|
| Green | Safe |
| Red | Danger (Isolation fault) |

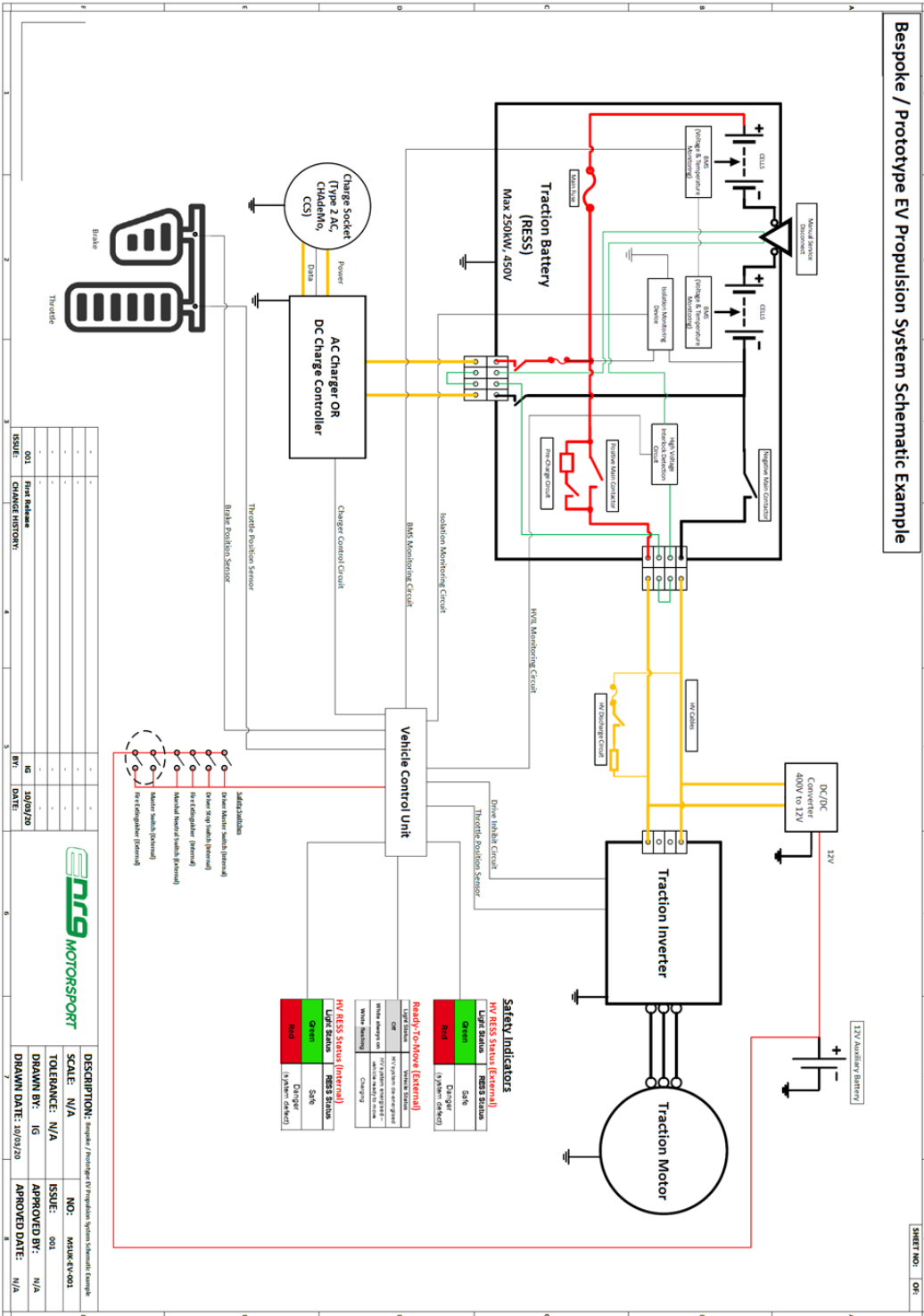
Table 4: Ready-to-move indicator states

| Light Status | Vehicle Status |
|-----------------|---|
| Off | HV system de-energised |
| White always on | HV system energised – vehicle ready to move |
| White flashing | Charging |

Table 5: Table of Electrified Vehicle Safety Requirements

| 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 | |

Drawing 1: Bespoke EV Propulsion System Schematic Example



Bespoke / Prototype EV Propulsion System Schematic Example

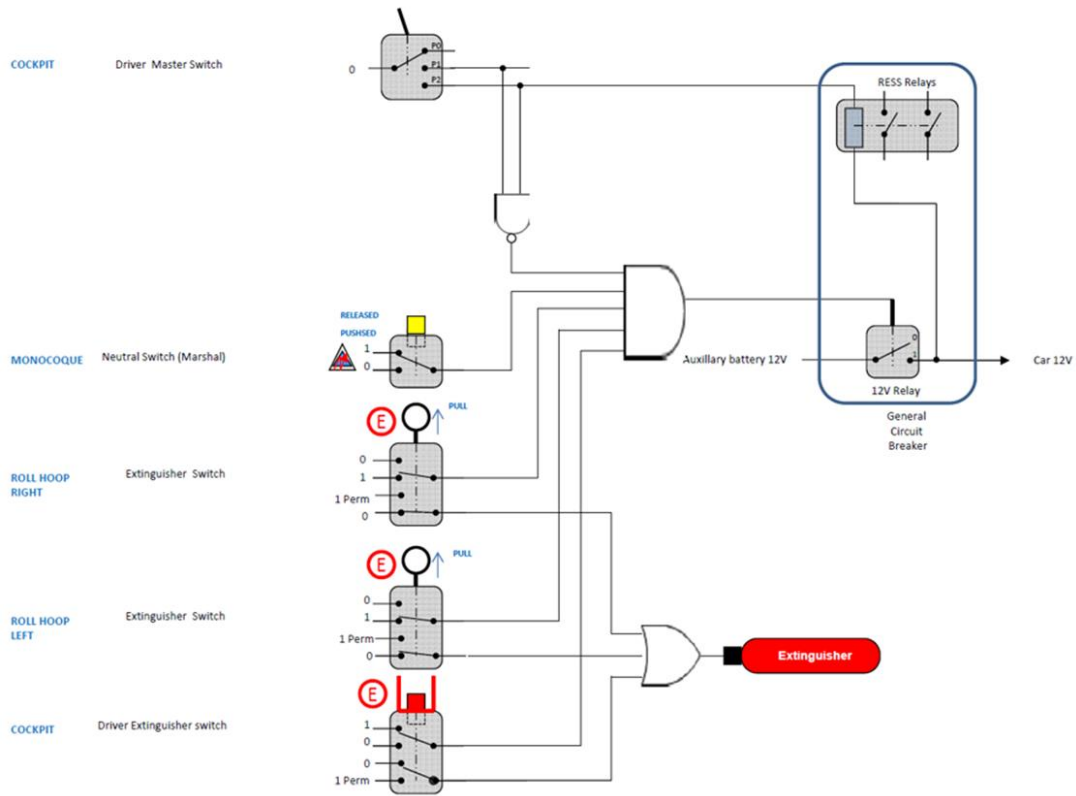
SHEET NO: 001

| NO. | DESCRIPTION | DATE | BY | CHKD |
|------------------------|---------------|----------|----|------|
| 001 | Final Release | 10/09/20 | IG | |
| ISSUE: CHARGE HISTORY: | | | | |
| | | | | |
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DESCRIPTION: Bespoke / Prototype EV Propulsion System Schematic Example
 SCALE: N/A
 TOLERANCE: N/A
 DRAWN BY: IG
 DRAWN DATE: 10/09/20
 NO: 4850K-EV-001
 ISSUE: 001
 APPROVED BY: N/A
 APPROVED DATE: N/A

Drawing 2: Functional switching diagram example



Drawing 3 - Fire Extinguisher Warning Symbol



Drawing 4 - Marshal Neutral Switch Warning Symbol



Drawing 5 – High Voltage Warning Symbol



Reason: Introducing general vehicle regulations and definitions for Electrified Vehicles.