

PROTECT YOURSELF FIRST



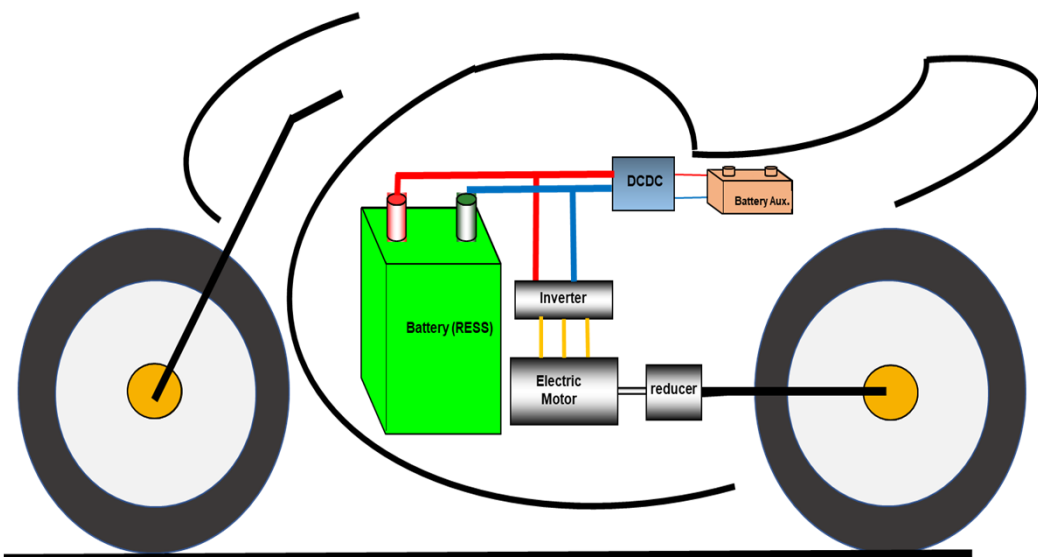
8. FIM – CTI

Guidelines for Electric Motorcycles (no electric assisted / e-bike)

Document for presentation
(from “FIM Electric Regulations”)

INTRODUCTION (No electric assisted – e-bike)

TECHNICAL DEFINITION - MAIN COMPONENTS



Main components:

Inverter: convert the direct current to the alternative current

RESS: Rechargeable Energy Storage System

Electric motor: alternative current for motor

DCDC: convert the high voltage to the auxiliary voltage (12V)- optional (to substitute the alternator)

Reducer: ratio between motor shaft and secondary shaft (may be invert the sense of rotation)

Main differences:

Battery Technology Li-ion → always survey then BMS

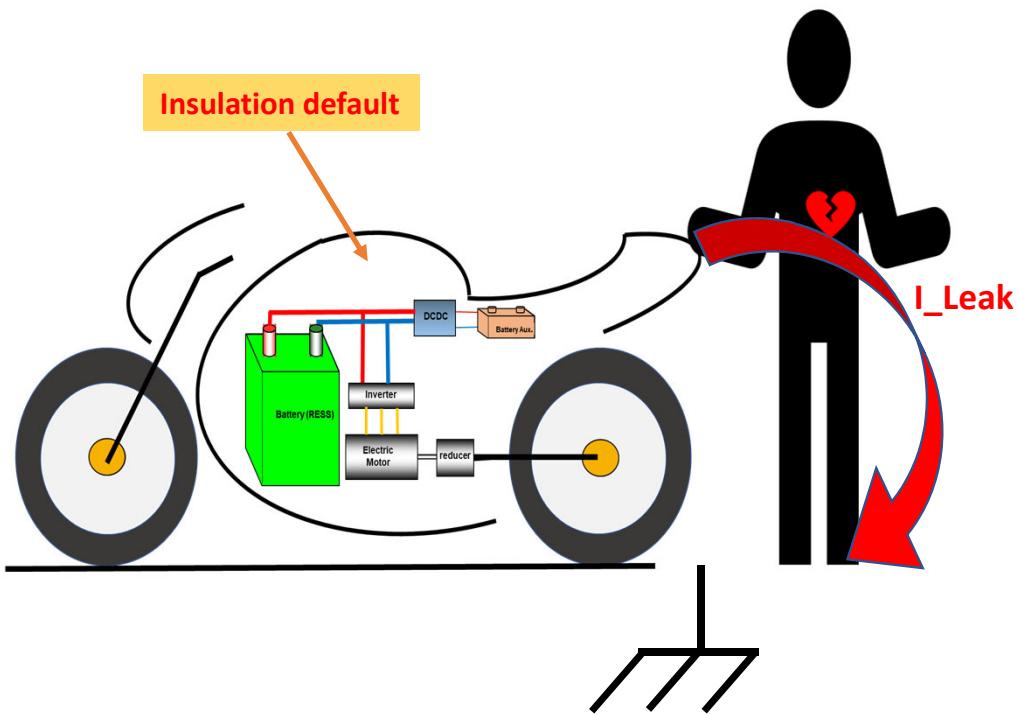
Electric motor → no sound – torque max at 0 rpm

Sound signature replaced by Luminous signature

Electric risks: needs protection for humans and motorbike

Charge: must be survey and control

RISKS AND ROOT CAUSES FOR ELECTRIC OR HYBRID MOTORCYCLES



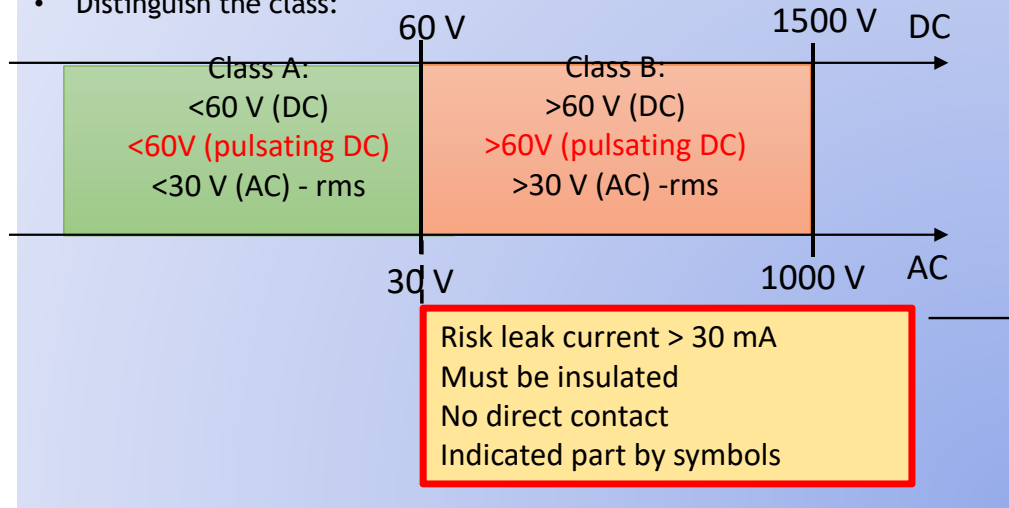
	Electrical Safety	Battery Li-ion	Electric motorcycle specificities
Risks	Fire Electrocution or more Projection burning	Fire Thermal runaway Gas emission explosure	Accident with moto Accident during charge
Root causes	Short circuit Insulation default Max. current Heating point contact with live parts	Under cell voltage Over cell voltage Over cell temperature Over current Over charge	Moto jump at stop (no sound and DRIVE-On) Moto move during plugged charge cable

ELECTRICAL SAFETY AND POWER BUS MAX. VOLTAGE

For human, DO NOT EXCEED 30 mA for the leak current

That's some caution pour high voltage $U > 60 \text{ V DC} / > 30 \text{ V AC}$ (class B):

- Key points
- Distinguish the class:



RULES:

It must be ensured that the components used cannot cause injury under any circumstances, either during normal operation or in foreseeable cases of malfunction.

It must be ensured that the components used for protecting persons or objects can reliably fulfil their function for an appropriate length of time.

It must be ensured that a single point of failure of the electric system cannot cause electric shock hazardous to the life whatever the conditions (rains, etc.) in normal operation.

There must not be any exposed live conductive parts in the voltage class B ($> 60 \text{ V}$ in or **pulsating DC** / $> 30 \text{ V rms}$ in AC). The protection elements (carter, protective covers, etc.) against the direct contact could not be removed using without tools.

The maximum allowed voltage in the main power bus is XXX DC and xxx V AC (rms). A secondary power bus may be used to supply energy to the critical systems at a maximum voltage of **60V DC, 60 V pulsating DC or 30V AC**.

The secondary power cannot use to charge the main battery or to participate at the traction.

Verifications:

- ✓ Battery voltage Measurement to check the class (especially for declared class A) and the power bus max. voltage for the discipline.

ELECTRICAL COMPONENTS

Key points

- International protection: parts, controller unit and connectors

IP66D

Totally protected against the dust

Protected against the water splash

Protected against the wire insertion

RULES:

All parts of the electrical equipment must be protected to at least the equivalent of IP66D type protection (dust proof, splash proof no object intrusion). Exposed connectors/wires must be protected against abrasion in case of accident (side covers).

Ingress Protection Classification			
First Number		Second Number	
IP	Protection Provided	IP	Protection Provided
0	No Protection	0	No Protection
1	Protected against solid objects up to 50mm e.g. accidental touch by hands	1	Protected against vertically falling drops of water e.g. condensation
2	Protected against solid objects up to 12mm e.g. fingers	2	Protected against direct sprays of water up to 15 degrees from the vertical
3	Protected against solid objects over 2.5mm e.g. tools	3	Protected against direct sprays of water up to 60 degrees from the vertical
4	Protected against solid objects over 1mm e.g. wires	4	Protected against water sprayed from all directions - limited ingress permitted
5	Protected against dust - limited ingress (no harmful deposit)	5	Protected against low pressure jets of water from all directions - limited ingress permitted
6	Totally protected against dust	6	Protected against strong jets of water e.g. for use on ship decks - limited ingress permitted
www.ControlAndInstrumentation.com		7	Protected against the affects of immersion between 15cm and 1m
		8	Protected against long periods of immersion under pressure

Verifications:

- ✓ Certification of water jet test and dust test
- Do not use directly the karsher on the electric parts

HIGH VOLTAGE SYMBOLS (ONLY CLASS B)

Key points



RULES:

Symbols warning of 'HIGH VOLTAGE' must be displayed on or near the electrical equipment protective covers; all symbols must comprise a black flash of lightning inside a yellow triangle with a black border.

The sides of the triangle must measure at least 80 [mm], but it may be larger if practical.

The cable or outer covering for voltage class B circuits not within enclosures or behind the barriers shall be marked in orange.

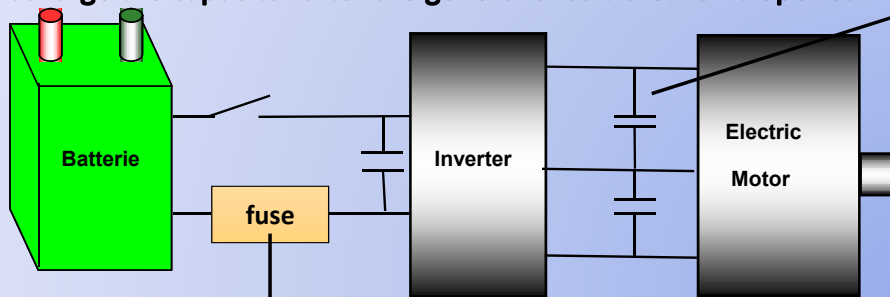
Verifications (only class B):

- ✓ Check the electric part and cables (yellow triangle and orange cable)

CAPACITORS AND FUSE

Key points:

Discharge the capacitor after the general circuit breaker is opened.



RULES:

- An over-current trip switch is a device which automatically interrupts the electrical current in which it is installed if the level of this current exceeds a defined limit value for a specific period of time.
- Fuses must under no circumstance replace the general circuit breaker (Emergency Stop). The fuses must be fitted inside the battery pack.
- The fuses will be used during the charge.

RULES:

Voltage across capacitors belonging to the power circuit should fall below 60 volts within 5 seconds after the general circuit breaker is opened or the over current trips of the accumulator are blown. An active discharge could be used.

Capacitive couplings between class B potential and electric chassis are used for EMC reasons. The manufacturer must provide to the FIM Technical Director the EMC self-certification (or external laboratory certification).

The energy caused by the discharge for the current DC shall be $< 0,2$ J.

For AC body currents cause by capacitive couplings when touching AC high voltage that the AC current shall not exceed 5 mA.

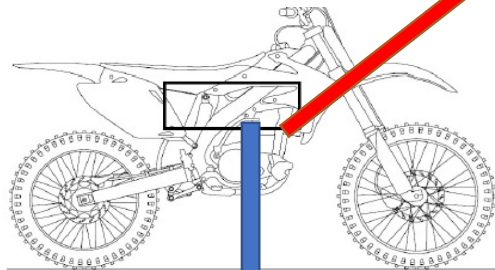
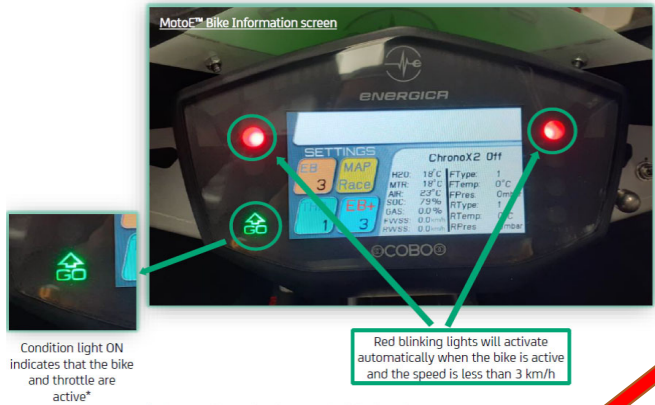
Verifications:

- ✓ Check the main fuse rating and the max. declared current
- ~~✓ Check the EMC (Electro-Magnetic Compatibilities) — EMC certificate ECE R 10~~

POWER INDICATORS

MotoE™ BIKE SAFETY DEVICES

Dashboard indicators when the bike is active



RULES: Motorcycle condition identification by the Power indicators/LEDs:

Compulsory for classes A and B: One light or instruction message on the instruction panel/dashboard (located in the identified area).

Compulsory for class B only: 2 lights (as LED repeaters) must be visible from 10 M. away positioned on the both sides of the motorcycles (located in the identified area, see the diagram). These two sides indicators must be protected from any possible direct contact (rider, environment, etc.)

LED colours **strategy-protocol:** the indicators warn if the motorcycle is:

SAFE: GREEN **PERMANENT** (Power ON, voltage > 60V DC and Drive mode is OFF)

SAFE IN DRIVE MODE ON: ~~different than GREEN or RED permanent lights (examples: GREEN BLINKING (blinking frequency: 1Hz) or PERMANENT YELLOW OR WHITE)~~

Strongly recommended: Indication on the dashboard: GO (example: MotoE)

NOT SAFE: RED **PERMANENT** or NO LIGHT (in a hazardous state (insulation failure, etc.))

For the Class B only: The indicators must show when there is a voltage on the power circuit above 60 V in DC – for ready to move or interventions.

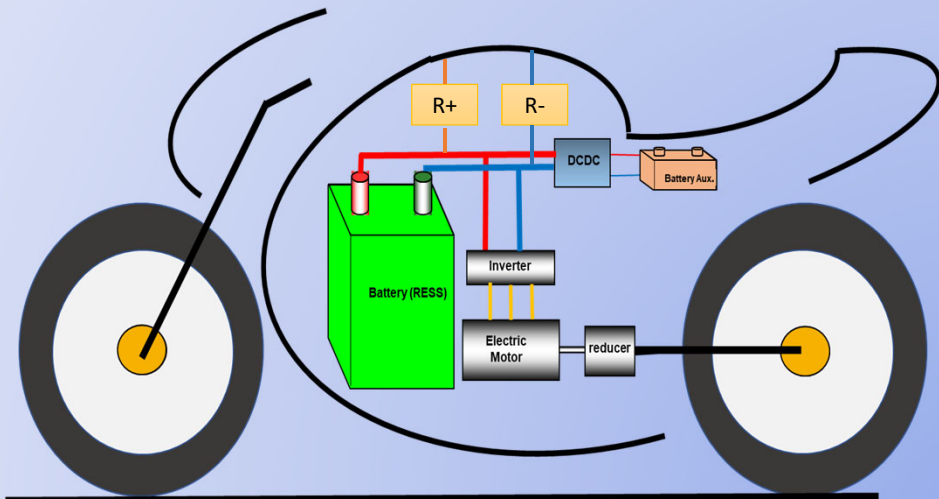
Verifications:

- ✗ ~~Check the led on the both sides~~
- ✓ Check the led or instruction message on the dashboard
- ✓ Check the 3 indicator states
- ✓ No brand luminous signature hides the indicator

INSULATION (ONLY CLASS B)

key points

- Insulated chassis (no connection between minus battery & chassis - between plus battery & chassis)



RULES:

Every part of the electrical equipment (class B) must be electrically insulated relative to all live components and system ground.

Wiring insulators can be required to be checked at any time by the FIM Technical Director/Chief Technical Steward. Double insulation will be required in high voltage or high current wires. Technical datasheets of the wires used will prevail under all circumstances.

For class B, the power circuit wire shielding must be connected to chassis ground. The isolation surveillance system will serve device for an isolation fault.

For class B, plus and minus wires from the battery must be insulated with respect to the chassis to withstand battery maximum voltage at least. The isolation resistance requirements of 100 Ohms/V for DC or 500 Ohms/V for AC allow body currents of 10 mA and 2 mA respectively.

For class B, an isolation surveillance system must be used to monitor the status of the isolation barrier between the class B system and the chassis.

All electrically conducting non-live parts must be connected with the system ground.

For class B, it is mandatory that all major conductive parts of the body are equipotential the motorcycle chassis with cable or conductive parts. The resistance < 0,1 Ohms between the exposed conductive parts which can be touched by a person simultaneously.

In cases where the voltage of the power circuit exceeds 60V DC or 30V AC (rms), the power circuit must be separated from the on-board circuit by an appropriate insulator.

Insulating material not having sufficient mechanical resistance, i.e. paint coating, enamel, oxides, fibre coatings (soaked or not) or insulating tapes are not accepted.

If you repair after initial check (using tape for example), the technical director must check.

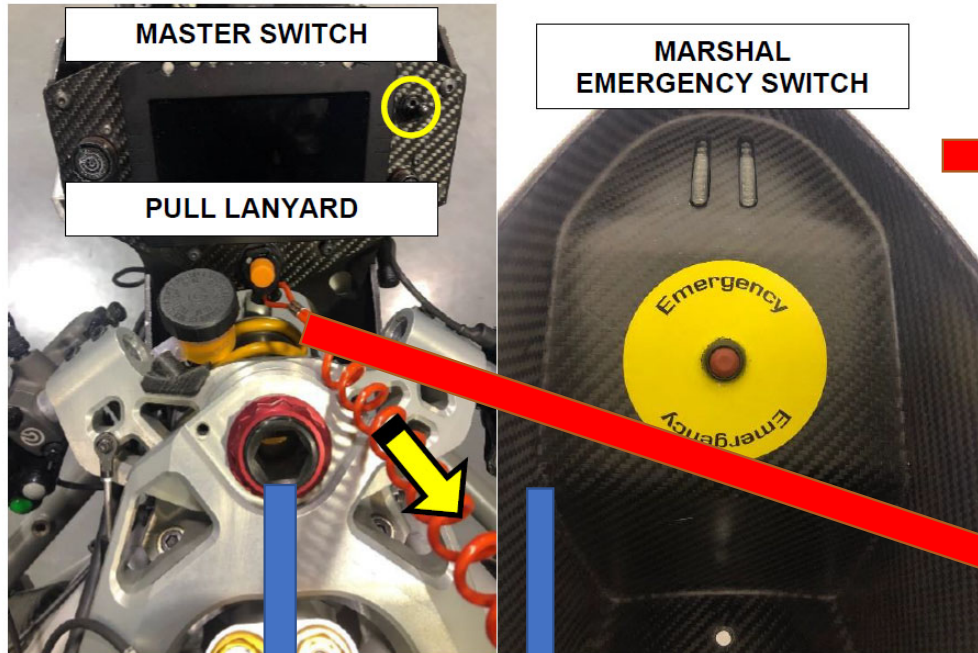
Electric cable and equipment must be protected against any risk of mechanical damage (stone, mechanical failure, ...) as well as any risk of fire and electrical shock.

Every part of the electric equipment, including wires and cables must have an appropriate insulation resistance between live components and chassis.

Verifications (only class B):

- ✓ information of insulation resistance measurement (R- and R+) >100 Ohms/V in DC
- Check if the minus or plus battery is connected to the chassis?

CUT-OFF MOTORS AND GENERAL CIRCUIT BREAKER



RULES:

The general circuit breaker must disconnect from the cut-off switch and discharge the main bus voltage below 60V. This system will be referred to as general circuit breaker or "Emergency stop". It could be a RED button (no electrical conductor) on the handlebar near the dashboard.

Low power accumulators provided for low voltage circuits, e.g. auxiliary circuits, do not have to be isolated by the general circuit breaker (Emergency Stop) provided that they are completely isolated from the main power accumulators.

The rider circuit breaker must be accessible by the rider when the rider is sitting on the motorcycle. The rider circuit breaker must be separate from the general circuit breaker.

In case of an emergency stop, the general circuit breaker must isolate the plus and minus of the battery, not motor torque, enable the active discharge, isolate the auxiliary battery from the auxiliary circuit.

All motorcycles must have a cut-out switch fitted to operate when the rider leaves the motorcycle. This cut-out system must **cut- out the traction**.

This **traction** cut-out switch must be operated by a lanyard of non-elastic string of adequate length and thickness. Once the rider steps off the motorcycle, the lanyard must disconnect from the cut-off switch and the engine. The lanyard must be fastened to the cut-out switch firmly in a way that it cannot be disconnected inadvertently but only when the rider leaves the motorcycle. **If the lanyard doesn't cut-out, the lanyard must cut- out the traction.**

The cut-out switch cannot be taped, glued wired or fitted solidly in place

Verifications:

- ✓ Check: After **emergency stop**—pushing the red button then the circuit voltage <60 V (DC)
- ✓ Check the lanyard cut off the drive state

ACCUMULATOR OR RESS (RECHARGEABLE ENERGY STORAGE SYSTEM)



RULES:

The type, dimensions and weight of accumulator/s cannot be changed between official practices and race.

All on-board electrical equipment, unless consisting of items originally powered by dry batteries, small accumulators or their own solar cells, must receive its energy supply from the vehicle's official accumulators.

For the assistance operation, the battery must be capable of being isolated from the power circuit by at least two independent systems (relays, ...) and disconnection device.

In case of relay failure, the electrical technician with appropriate PPE disconnects the battery.

The battery system must avoid the overvoltage, overtemperature, overcharge.

A drop test is required (height of 1m then charge/discharge at 1C). The manufacturer must proceed to the drop test procedure (in 6 impact points) and provide to the FIM Technical Director the self-certification form of this test.

A splash test (or under rain) is required, then a cycle discharge/charge.

The battery compartment must prevent the build-up of an ignitable gas/air, dust/air or hydrogen concentration inside the compartment. The hydrogen exhaust must not be excessive.

The BMS (Battery Manager System) must protect against the overvoltage, overtemperature and prevent thermal runaway, during overcharge or battery failure.

The BMS is a security system that detects internal defaults then can trigger the power reduction (charge or discharge) until the switch off.

IMPORTANT: As a condition of entry, a Material Data Safety Sheet must be supplied with the race entry for the machine, including all relevant details as to the accumulator chemistry, human and environmental hazards, handling and specific fire risks and precautions.

Verifications:

- ✓ Check: Battery architecture information (parallel/serie)
- ✓ Check Tests certificates (overcharge, overvoltage, splash, drop, overtemperature)

ACCUMULATOR OR RESS (RECHARGEABLE ENERGY STORAGE SYSTEM)



Verifications:

- ✓ Check: Fuse on the charger
- ✓ Check No possible drive if the charge cable is plugged
- ✓ Check an ventilated area - safe of sun and rain

RULES:

Energy supply will be provided in the paddock at the times and locations determined by the race Organiser.

The charge is operated safe of the sun and rain, in the ventilated area.

Charging may only be done with the energy supply provided by the race Organiser.

The charging system must be separate from the machine and comply with all electrical safety requirements including thermal overload trip, fusing and be equipped with an earth leakage protection breaker.

Charging must always be done with the control of the BMS.

The traction system is off during the charge or charge cable is plugged without power. No movement of the motorcycle during the charge (Drive mode OFF).

No operation during the charge (no mechanical or electrical intervention)

The charger must be connected by the grid's earth to the motorcycle ground. The motorcycle traction system must be checked for ground faults before the charge start.

The charger must have a fuse to protect the charging cable.

ACCUMULATOR (RESS) FASTENING



Verifications:

- ✓ Check the fastening system for battery

RULES:

The accumulator must be installed securely inside the vehicle and be protected against short-circuits and leakage. The accumulator must be attached to the frame or chassis using metal clamps with an insulating covering (for Class B only).

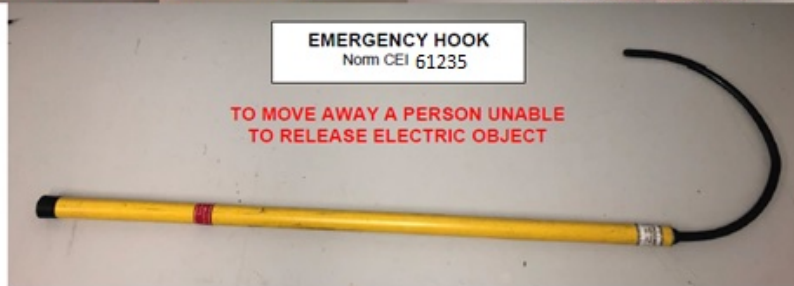
The fixing method must be designed in such a way that neither the accumulator nor the fastening device itself nor its anchorage points can come loose, even when subjected to a crash. A solid partitioning bulkhead must separate the location of the accumulator from the rider.

Each accumulator box must provide its own cooling and/or venting system. In modular battery systems, a heat shield is strongly recommended between modules, by means of an adiabatic shield or intumescent.

The accumulator installation must ensure that in the event of accumulator cell leakage or explosion, the contents are kept away from the rider and do not interfere in any way with the rider's vision or the safe handling of the machine.

The battery shall be installed in the motorcycle in order to avoid the possibility inadvertent or unintentional detachment. The battery shall not be ejected when the motorcycle is tilted.

PPE (Only Class B)



**EXTINGUISHER F500
FOR LITHIUM FIRES**



RULES:

Equipment required to be used for each box:

- Gloves : class 0 CEI 60903-2002 or CEI 60903-2003 (until 1000 V) – classe 1 (above 1000 V.)
- Robust shoes with insulated soles
- Safety glasses (helmet or visor)
- CO2 fire extinguisher for HV system (min. 1 with a valid certification) - optional
- F500 extinguisher for Lithium-Ion battery (min. 1 with a valid certification)
- Insulation Matting around each bike.
- Emergency hook: CEI 61235 (provided by the team)

Voltage detector

For main garage:

- Automatic defibrillator
- Trauma first aid kit

Verifications:

- ✓ Check all PPE (Personal Protective Equipment) for staff, and stewards

CHECK SYNTHESIS

INITIAL TECHNICAL VERIFICATIONS	Class A	Class B
Inspect PPE (gloves, wear, glasses, hook, matting,)	●	●
Measure battery voltage (fully charged)	●	●
Visual check indicators and message on dashboard (3 states)	●	●
Inform the battery architecture (number of serie/parallel)	●	●
Check cut-off (main swith and lanyard)	●	●
Check no drive on if charge cable is plugged	●	●
Check extinguisher and insulated matting	●	●
Check voltage detector, defibrilator and extinguisher	●	●
Visual check battery fastening	●	●
Visual check insulation (no connection between minus or plus battery)	□	●
Check the certificate EMC (ECE-R-10) (Recommended)	●	●
Check the MSDS (for battery transport)	●	●
Chek the marks and symbol (yellow triangle & orange cable)	□	●
Visual check fuse charger	●	●
Check charge area and access restriction	●	●

FIM E-XPLORER REGULATIONS ABOUT EQUIPMENT AND PROTECTIVE CLOTHING DURING PRACTICE AND RACE

3.01 Clothing and protectors for riders

- Tear off
- Airbag vest/system
- Long sleeves
- Chest protector
- Recognised International Helmet
- No Go-pro on the helmet

CASES Description

From the document: «2023 08 september Electrical Procedures»

Place	Hazards	Rider	Article
Paddocks or pits	Smoke or fire	NC	Art 8.1
Track	Smoke or fire	Contact with bike	Art 8.2
Track	Smoke or fire	No contact with bike	Art 8.3
Track	Red LED or LED Off	Contact with bike	Art 8.4
Track	Red LED or LED Off	No contact with bike	Art 8.5
anywhere	Others hazards		Art 8.6
Track	Severe crash – Green LED		Art 8.7

PPE for marshals (Art 8.0)



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