Moto Engineering ITALY race for passion

# Competition Regulation

2022

MES

Motorsport Engineering Society

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# 1. INTRODUCTION

## 1.A Competition Overview

### 1.A.1 Competition objective

The MotoEngineeringItaly competition, organized by the Motorsport Engineering Society ltd. (MES), is an academic challenge between Teams from different universities around the world. In this competition the Teams must conceive, design, fabricate, develop and compete with electric motorcycles.

### 1.A.2 Competition Procedure

The competition starts with technical inspections described in the technical sections of these regulations to check the motorcycle safety and its compliance with the rules. After the scrutineering, Teams will challenge both in static and dynamic events, to assess their knowledge as well as the performance of the prototypes.
To each test corresponds a ranking, and to each position in the ranking corresponds an amount of points. The Team with the most overall points will win the competition.

### 1.A.3 Competition Information

The competition specific rules and information are defined in this document, which latest version will always be available on MES website.

The official language of the competition is English. As this competition will be under the supervision of the Italian Motorcycle Federation (FMI), references to specific topics may be in Italian. It will be possible to have a direct communication channel with the Organization to avoid any misunderstanding of the official regulations.

### 1.A.4 Moto Eligibility

The Competition is a multidisciplinary University challenge that allows students to develop a real industrial project in the motorsport sector. The participating students shall design and develop a racing motorcycle with electric powertrain applying their knowledge and challenging Teams from other Universities and other countries.

The student Team may use any information from professionals or from academics as long as the information is given as a discussion of alternatives with their pros and cons.

Professionals may not make design decisions or drawing. Students can not receive CAD files (2D and 3D), software or software portions, electrical harnesses, electronic boards customized for this race purposes from professionals. It is accepted to use commercially available components as far as they comply with these regulations.

Students should perform fabrication tasks whenever possible.

## 1.B Rules of Conduct

### 1.B.1 General Officials Authority

The Organization, in agreement with FMI, reserves the right to apply modifications to these regulations at any time. In the case of dispute about one of more articles of these regulations, the final decision will be taken from FMI officials, in agreement with the Organization.

All Team members are required to cooperate with the officials of the Organization and of the FMI and to follow all their instructions.

All the announcements shown official notice board shall be considered part of these rules.

Questions concerning the meaning or intent of the rules can only be resolved by the officials.

### 1.B.2 Official Instructions

Failure of a Team member to follow an instruction or command directed specifically to that Team or Team member will result in a 50 points penalty in the final MotoEngineeringItaly ranking.

### 1.B.3 Arguments with Officials

Arguments with, or disobedience to, any official can result in the Team being eliminated from the competition.

### 1.B.4 Unsportsmanlike Conduct

In the event of unsportsmanlike conduct, or any other behavior not compliant with the Regulations from any Team member, the Team will receive a 50 points penalty in the MotoEngineeringItaly ranking in addition to what is prescribed in the Italian Speed Championship (CIV) Regulations.

### 1.B.5 Questions about the Rules

Questions about the rules may be asked to the officials.

The frequently asked questions (FAQ) section on the competition website must be checked before submitting a question. The officials will only answer questions that are not already answered in the rules or FAQs or that require new or novel interpretation.

Refer to the competition website for specific directions how to submit a rules question.

# 2. TEAMS AND PARTECIPANTS

## 2.A Teams per University

**2.A.1 Team registration**

Every University can register multiple Teams. Every Team can register multiple prototypes. Admission fee is based on how many motorcycles will be registered (discount will applied for every additional motorcycle).

Teams which members come from two or more Universities are treated as a single Team.

**2.A.2 Number of Team members**

There is no limit to the number of members per each Team, but only a restricted number of people defined by the Organization will be allowed to work simultaneously inside the box. Names of these people should be listed during registration.

## 2.B Team Member

A Team member may only be part of one Team, work on one motorcycle and take part in static and dynamic events for only one Team.

Each Team must have one Team member identified as the Team Leader. The Team Leader is the main contact person for the Organization during the registration process and the competition.

Each Team must have a Tutor or a Faculty Advisor, who is a representative person of the related University. Faculty Advisor is responsible for the Team and in case of absence, this role will be assigned to the Team Leader.

## 2.C Student Status

Team members must be enrolled as degree seeking undergraduate or graduate students in any university. Team members who have graduated within the nine month period prior to the competition remain eligible to participate.

Students seeking a PhD degree/PhD students or equivalent are allowed to participate.

## 2.D Age

Team members must be at least 18 years of age.

## 2.E Insurance

All team members need to be personally insured for any physiological or property damage that may arise. Comprehensive insurance for personal effects, tools, equipment,

solar cars and other vehicles is the responsibility of the entrant. Please also note that all riders participate at their own risk and are not insured via the organizers of the Italian Solar Challenge.

### 2.F Liability waiver

Every Team member must sign a liability waiver provided by the Organization. This applies also Team Leaders, Faculty Advisors and Tutors.

# 3. RIDER

## 3.A Eligibility

There must be only one rider per each Team. Rider is considered a Team member, so the same rights and obligations apply, excluding the student status requirement.

One rider cannot ride another Team's prototype. If one Team has more than one motorcycle, there must be one rider per each motorcycle.

If, for any instance, the rider must retire during the Event, it will not be possible for a Team member to act in replacement.

Riders who have raced since 2012 (included) in competitions recognized as FIM International calendar of the following disciplines will not be allowed:

- Circuit racing
- Motocross
- Enduro
- Rallies
- Track Racing

### 3.A.1 Age

The rider must be at least 18 years on the first day of the Event.

### 3.A.2 Rider Federative requirements

The rider have a Federative License under FIM that allows its participation in a FIM International Competition such as MotoEngineeringItaly. Moto track day insurances or other federation licenses will not be valid for participation in MotoEngineeringITALY.

## 3.B Communication

During all dynamic events, radio, phone, or any other type of communication with the rider different from a board shown from the pit wall is forbidden. Information board should be exposed on track only when the rider is approaching the final straight and it should be stored back in pit lane as soon as possible.

# 4. DOCUMENTATION AND DEADLINE

## 4.A Required Documents and Forms

The following documents and forms must be submitted by the action deadlines defined in the competition handbook:

- FEC (Frame Equivalency Calculation) approval
- MSV (Motorcycle Status Video)

## 4.B Submission

Uploaded documents may only be viewed by members of the submitting Team, authorized judges and officials.

By submitting documents via the competition website, the Team agrees that they may be reproduced and distributed by the officials, in both complete and edited versions, for educational purpose.

Documents that are largely incomplete or not readable will be considered as not submitted.

## 4.C Late Submission or Non-Submission

Submissions later than the initial deadline will be penalized by ten points for every commenced 24 hours they are overdue. These will be deducted from the Team's overall score up to a maximum of 70 points for each deadline independently.

## 4.D Motorcycle Status Video (MSV)

All Teams must upload a video showing the motorcycle driving prior to the competition. The video must be uploaded 1 month before the beginning of the event.

The video must show the following sequences:

- Start from still;
- Straight riding;
- 180° cornering (left);
- Straight riding;
- 180° cornering(right);
- Straight riding back to finish point in correspondence the start point;

The video must fulfill the following criteria:

- Continuous video from a third person view - no assembled sequences;
- Vehicle must be clearly visible (light, video resolution, frames and frequency);
- Vehicle must run under its own power;
- Driving in a clearly separated and/or protected area;

- Motorcycle must be presented in ready-to-race conditions, including body work;
- Rider must wear all required equipment.

Each Team without a video upload prior to the specified deadline will receive 10 penalty points. Furthermore, the Team will receive two penalty points for each additional full 24 hours the upload is late. The last upload of a video is possible 336 hours (14 days) after the MSV deadline (max. 30 penalty points).

### 4.E FEC Approval

All Teams must upload a FEC document. The FEC must be uploaded before the deadline specified in the competition handbook, which will be released no sooner than one month prior the event.

FEC consists in a document that resumes all the calculations and simulations performed at vehicle and structure level, including the load cases and safety factors considered, where the safety of the vehicle is assessed. Also, it should state that the chassis and the vehicle itself has been designed and built according to these regulations. There is no template for this document, so it's up to each Team to prepare suitable documentation to submit.

The Frame Equivalency Calculation (FEC) must be checked, approved and signed by at least one of the following entities:

- Engineering firm for lightweight structures;
- Engineering consultancy company;
- Any other official competition.
- Faculty advisor

# 5. GENERAL RULES

## 5.A Removing the motorcycle from the Site

Teams who bring their prototype outside from the event location after the technical inspections will be disqualified from the competition.

## 5.B Forfeit for Non-Appearance

It is the responsibility of each Team to be in the right place at the right time.

If a Team is not present and ready to compete at the scheduled time, they forfeit their attempt at that event.

## 5.C Team Briefing

All Team Leaders and riders on a particular day must attend the Team briefing for that day. The noncompliance with this prescription will not allow the Team to take part to dynamic events of that day.

## 5.D Testing and Work Safety

Competition organizers are not responsible for the use of the vehicles outside of the competition.

The competition officials disassociate themselves from all activities of the Teams besides their own competition and associated events.

All Teams are advised to follow common practices and common sense when working on the vehicle and when operating the vehicle, before, during and after a competition.

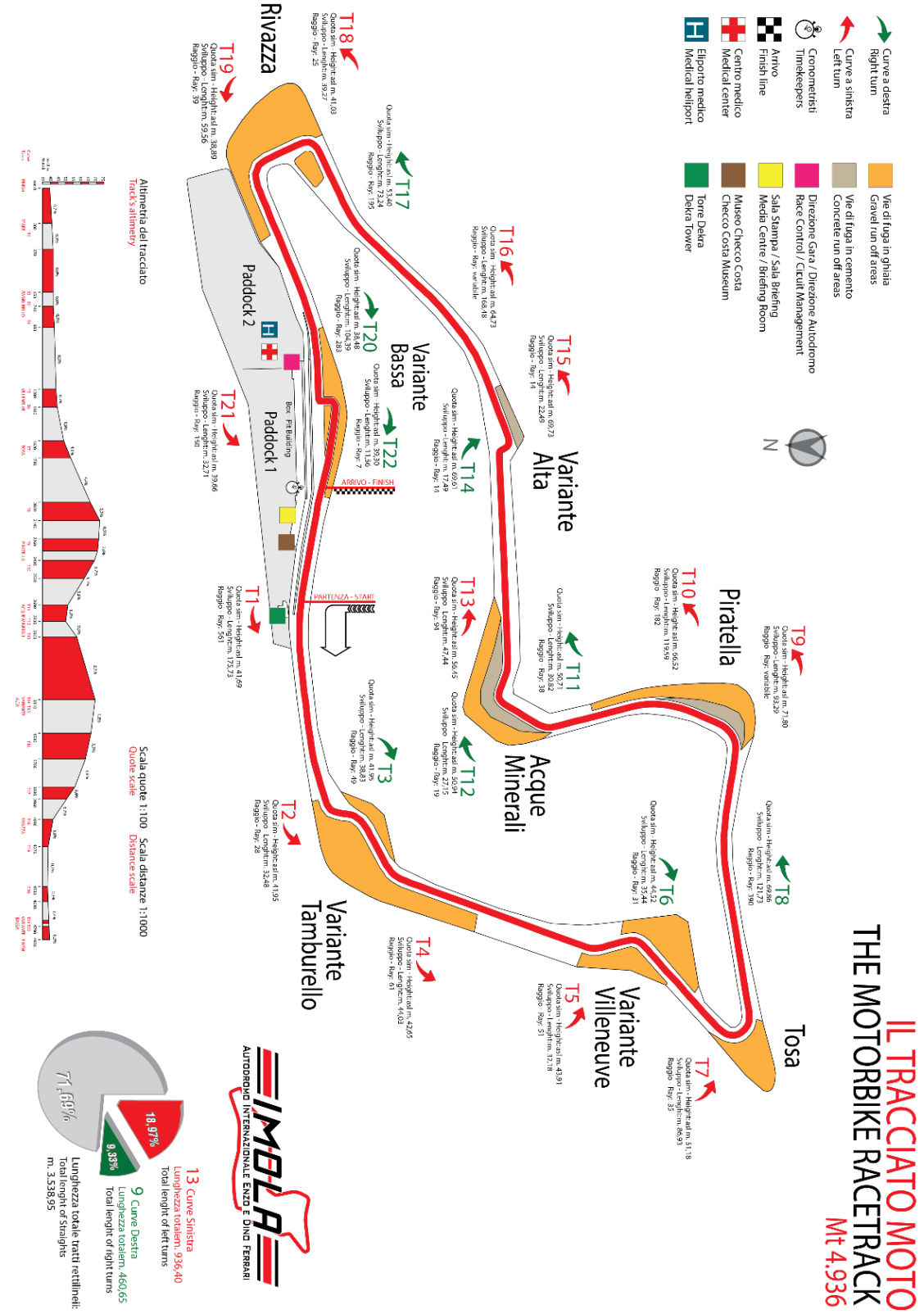
FMI officials reserve the right to disqualify a Team registered in competition in case of unsafe driving behavior, especially if the reputation of the competition, sponsors and other Teams is compromised.

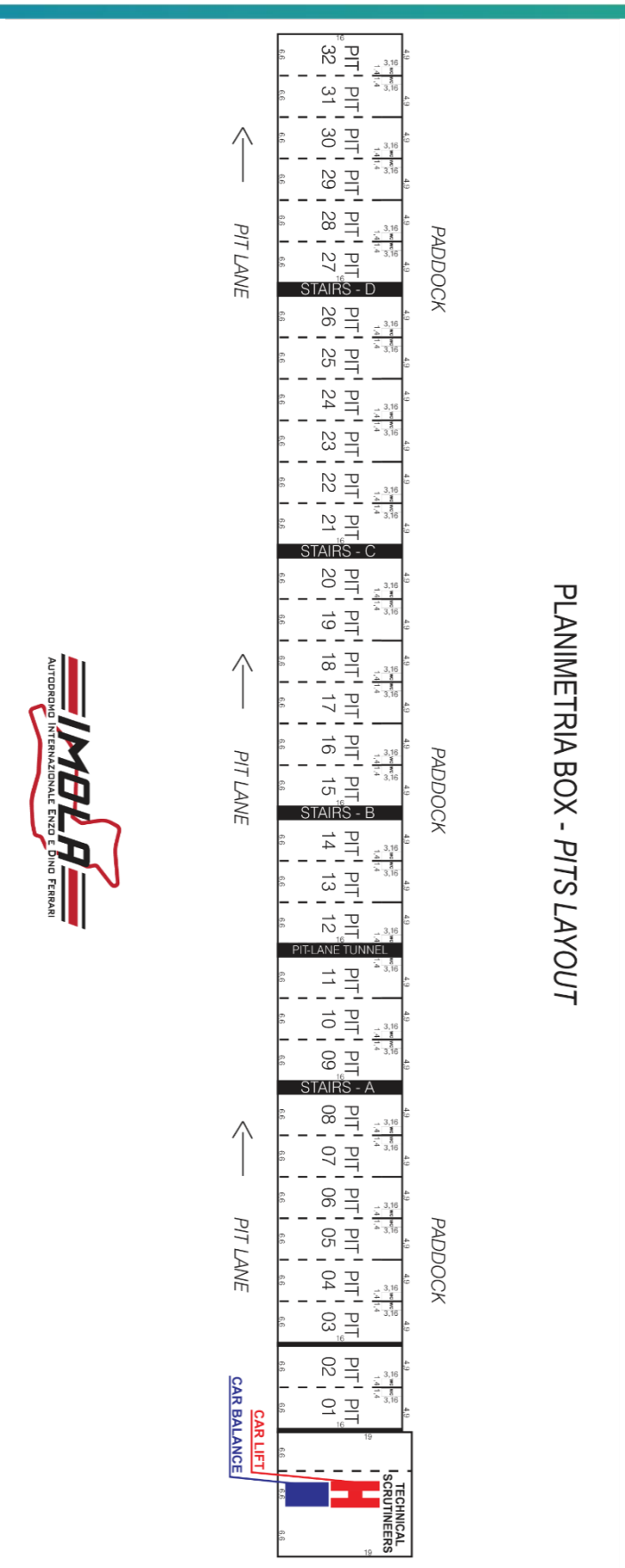
# 6. ADDITIONAL INFORMATION

Any modification to these regulations can be made by FMI and will be added to this document with a different font color in the respective sections.

**IN RELATION TO WHAT IS NOT EXPRESSLY BOUNDED BY THESE REGULATIONS (ALLOWED OR FORBIDDEN), MOTORCYCLE DESIGN IS FREE WITHIN THE LIMITS OF THE SAFETY REGULATIONS**

# 7. TRACK LAYOUT




PLANIMETRIA BOX - PITS LAYOUT
PADDOCK
PIT LANE
PADDOCK
PIT LANE
PADDOCK
PIT LANE
STAIRS - D
STAIRS - C
STAIRS - B
PIT-LANE TUNNEL
STAIRS - A
TECHNICAL SCRUTINEERS
CAR LIFT
CAR BALANCE
IMOLA
AUTODROMO INTERNAZIONALE ENZO E DINO FERRARI

Please always refer to the official notice board to verify is any modification to the track layout is being carried out by the FMI Officials.

# 8 GENERAL TECHNICAL REQUIREMENTS

## 8.A Manufacturing, dimensions and weight

### 8.A.1 General

Students registered in the Teams should create, design and manufacture the motorcycle without the direct involvement of professional engineers, race engineers, professional mechanics, etc. Professionals are not allowed to make decisions about the design. The tutor shall also sign the declaration of compliance.

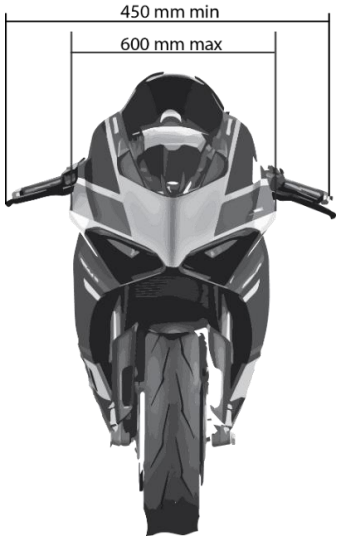
Only minor changes to the motorcycle set-up can be done after the scrutineering and without the supervision by the Organization (e.g., secondary transimission, brake system, tire pressure, fluids refilling and power management calibrations).

All the motorcycles will be subjected to technical inspections performed by FMI Officials. The chassis will be marked. In case of crash or malfunction, it is possible to mark another component only after FMI approval. Before and after every dynamic session the FMI Officials can perform additional checks on the prototyipes, and FMI reserves the possibility to prevent the motorcycles from entering the track if any non-compliance is found out.

The responsibility of the conformity of the motorcycle to the safety standards before every access to the track and during practice, warm-up and race is up to the Rider.

### 8.A.1 Dimensions

Few constraints on the overall motorcycle dimensions are summarized in this chapter. The minimum distance between the external ends of the semi-handlebars must be 450mm while maximum width of the fairing must be 600mm:

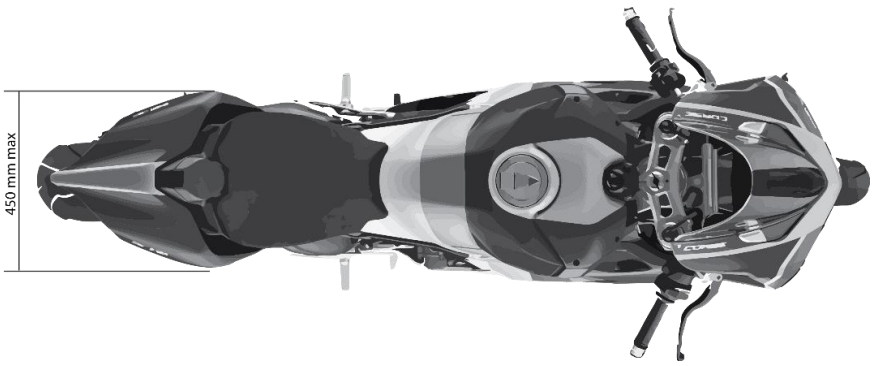



A minimum distance of 100mm between any part of the prototype body and the track surface must be respected, except from the wheels. Measurement must be performed in

upright position and in rest situation. This measurement will be done with the prototype in ready-to-race condition (all fluids and equipment), but without the rider.

The front and rear vertical lines drawn tangentially to the external circumference of the front and rear tires are the the limits where no component can protrude beyond:

The maximum saddle width must be 450mm:




There must be a 15mm minimum clearance between the outer circumference of the tires any part of the prototype, regardless the position or the set-up.

**8.A.2 Weight**

The prototype's minimum weigth in ready-to-race condition (fluids included) with the rider (fully dressed) must be 150kg at any time during the event, even at the end of any dynamic event.

It is possible to use of ballast if the minimum weight of the prototype is not reached, but they must be fitted in the motorbike frame only (i.e. it is not possible to add weight to the rider or to the rider suits). In case of using them, weight and position of the ballasts must be declared to the FMI Technical Staff during the scrutineering and must be approved from FMI.

It is not possible to use mobile ballasts.

## 8.B Chassis

### 8.B.1 Design

Off-the-shelf frames will not be accepted. This applies also to subframe and swingarm. The design of these components is up to the Teams and it is free as far as the final parts are compliant with the regulations.
Any kind of simulation report, test report, manufacturing documentation may be requested from the Organization or from FMI officials.

The responsibility for the safety of the motorcycle is totally up to the Team Responsible.

The Organization and the FMI officials may decide not to accept a motorcycle if considered not safe.

### 8.B.2 Materials

Teams are allowed to use every kind of material except from:

- Magnesium for the manufacturing of any part of the motorbike;
- Titanium for the manufacturing of the frame/chassis, swing arm, swing arm spindles, wheel spindles (for wheels spindles, the use of light alloys is also forbidden), the handlebars, the front suspension inner and outer tubes and bottoms (i.e. axle mounting point), the shock absorber piston shaft and damper tube.
- Composite materials for the manufacturing of steering plates, handlebars, semi handlebars, handlebars clamp, footboard and footrest

The material should be compliant with the safety restriction imposed by the specific use of the element (e.g. it is not allowed to use flammable materials for any part that will be in direct contact with the fuel).

### 8.B.3 Crash protectors

Nylon crash protectors are mandatory to protect safety related components (e.g. battery pack) in case of crash or fall. Other fiber or materials of similar hardness will be accepted. The crash protectors must be fixed to the frame, but they can be both inside and outside the fairing. Also other locations will be accepted, provided that the protection of the propulsion system and other safety related components is ensured.

## 8.C Fairing

### 8.C.1 General requirements

Fairing edges must be covered with soft material or rounded.

Rider's sideways cannot be covered by the fairings, except for the forearms when the Rider is in the minimum aerodynamic resistance position.

Material selection is free.

Active or passive aerodynamic devices are permetted, as far their dimensions are compliant with the overall dimensions constraint (considering any position they can assume during functioning).

### 8.C.2 Lower fairing

The lower fairing should be able to contain, in case of a failure of any system incorporating fluids such as cooling or transmission (suspension or brake systems are not considered), at least half of the total liquid volume or 2.5 litres, whichever is greater. If a prototype does not have any system with fluids, this rule does not apply.

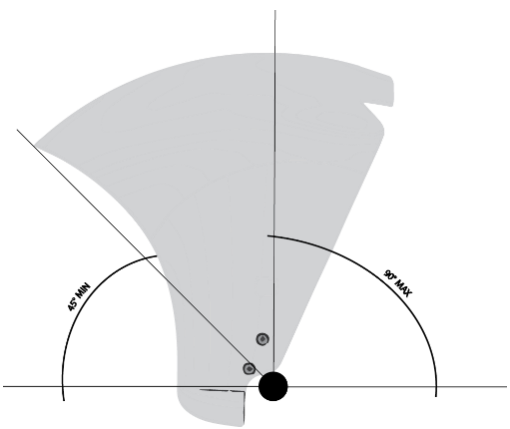
A 25mm diameter draining hole must be fitted in the lower point of the lower fairing. It should stay closed in dry conditions and must be opened in case of rain. The cap must be wire-sealed to prevent its loss on track.

### 8.C.3 Mudguards

Mudgards are mandatory.

Maximum coverage of the front wheel is 135°, taking as starting point for the angle calculation the horizontal line crossing the wheelshaft.

Maximum coverage of the rear wheel circumference is 180º.



### 8.C.4 Chain guard

There must be a guard to prevent trapping between the chain and the sprocket. If the swingarm does not act as protection, an additional chain guard must be bolted with screws. It cannot be glued or connected differently.

## 8.D Handlebars and footrests

### 8.D.1 Handlebars

Handlebars or semi-handlebars made of magnesium or titanium or composite materials are forbidden. A minimum radius of 2 mm must be used in the parts that constitute the handlebars and their anchorages.

All the levers must be terminated with a sphere. Handlebars and semi-handlebars must be fitted with spherical caps.

In order to ensure that the throttle will suddenly be shut down as soon as the rider lets it go, an auto-return feature (e.g., spring) must be included.

The distance between the pivot point and the outer part of the hand lever for the clutch cannot exceed 200mm. All the prescriptions applied to the clutch lever must be applied also to the brake lever.

Front brake lever must be protected with a suitable protection element. This protection must prevent the brake activation in case of contact with another object. A fairing extension that covers the brake lever (in front view) will not be accepted as protection.

### 8.D.2 Restrictions and geometry

The steering must have a minimum turning angle of 15º. This constraint applies both for the right and left steering. Angular stroke must be limited with nylon stoppers (or materials with similar hardness). No other part of the motorcycle can act as stopper.

There must be a 30mm minimum clearance between the handles, actuators and any other element of the chassis or the fairings. This is to prevent hands and fingers to get trapped in case of a fall.

### 8.D.3 Steering dampers

Steering damper are permitted.

Steering damper can have only manual or mechanic/hydraulic adjustment systems

The steering damper cannot be the steering angle limiter.

### 8.D.4 Footrests

Footrests can either be fixed or folding type. If they are folding type, it is compulsory to have a device that brings back the footrest to the normal position to avoid any unwanted folding.
Footrests must have rounded edges with 8mm spherical radius.

Footrests must act as trapping protection from the chain or any other mobile elemet.

Choice for the rear brake pedal and for the gear shift pedal is free.

The position of the rear brake pedal must be on the right side of the motorcycle.

# 8.E Brake system

## 8.E.1 General requirements

The motorcycle must be equipped with disc brake systems on both wheels.

The only materials allowed for the brake discs are steel alloys.

For the front brake, it is allowed to use a couple of discs, i.e. one for every side of the rim.

Brake discs must be installed on the front and rear wheels.

The use of electronic systems to command the brakes is not allowed.

The brake fluid is free.

Brake fluid pipes must be reinforced type with external braid and the terminals must be made from iron alloy (crimped or threaded). It is compulsory to use terminals, banjo and fixing nuts made from iron alloy. Any splice in the brake fluid pips must be placed in a higher position than the lower fork bridge.

The brake pump can be of any commercial type. A document assessing the provenience of the Brake pump can be checked during the technical inspections (model, serial number or similar).

The choice of brake fluid tanks is free.

## 8.E.2 Command and control

Front brake system must be completely independent from the rear brake system. It must be operated with a hand lever located on the right semi-handlebar (or on the right side of the handlebar).

Rear brake system must be completely independent from the front brake system. It must be operated by the right foot with a cam system close to the footrest.

## 8.E.3 Callipers

The callipers can be of any commercial type without any structural modification allowed. A document assessing the provenience of the callipers can be checked during the technical inspections (model, serial number or similar).

It is compulsory to perform safety-wiring on calliper’s fixing screws or nuts to prevent accidental unscrewing.

The minimum grade of the screws that fix brake calliper shall be 8.8 according to the EN ISO 898-1 standard.

Choice of brake pads is free. Pins of the brake pads can be changed.

In order to reduce the heat transfer to the brake fluids, it is allowed to add metallic plates to the brake callipers.

# 8.F Suspensions

### 8.F.1 General requirements

Active or semi-active suspension systems are forbidden. Any type of electronic control on the suspension is forbidden.

Suspensions set-up can only be made manually, with mechanic or hydraulic refinements.

Commercial, modified, or self-developed suspension systems are allowed both on the front and rear.

### 8.F.2 Front suspension

Any kind of front suspension system is permitted: conventional fork, inverted fork, Telelever, Duolever, front swingarm, etc.

The front suspension assembly may have mechanical or hydraulic adjustment systems, but they can only be adjusted manually.

Any front suspension adjustment system must be integrated into the fork body itself. External control systems communicated by means of hoses, cables, etc. are not permitted.

### 8.F.3 Rear suspension

Rear shock absorbers are free.

The rear suspension assembly may have mechanical or hydraulic adjustment systems, but they can only be adjusted manually.

Any rear suspension adjustment system must be integrated into the shock absorber body itself. External control systems communicated by means of hoses, cables, etc. are not permitted.

## 8.G Wheels

### 8.G.1 General requirements

The use of wheels made of composite materials is not allowed.

The wheels may be of any commercial type, but they cannot be modified structurally by the Teams, neither in the shaft accommodation. A document assessing the provenience of the rims will be checked during the technical inspections (model, serial number or similar).

Wheel shafts cannot protrude more than 30mm from their housing. Nylon protectors are not considered in this measure.

Inner tubes are forbidden.

It is allowed to use only spoked wheels. Valves and cush rubber can be changed. Balancing ballasts are free.

It is allowed to use anti-slip surface treatment on the inner part of the wheels.

# 8.H Tires

## 8.H.1 General requirements

Tire selection is free as long as they are compatible with the following rims:

- Front: 2,5” R17
- Rear: 3,5” R17

Teams are responsible to provide themselves all the tires that will be needed for the entire duration of the event, that must be compatible with the constraints stated in the regulation. The organization is not responsible of providing new tires during the development of the event.

Teams will be asked, prior the event, to provide information about brand and model of the tires they will use.

If the director defines “wet race”, every kind of rain tire will be allowed. Rain tires model and brand must be shared as well with the Organization prior the event.

Tire heaters are allowed, but it will be possible to plug them in only inside the box.

Tire service to mount/dismount tires from rims will be present in the paddock. No tires purchasing is possible inside the event location (nor dry or wet tires).

## 8.I Electronic systems

### 8.I.1 Riding assistance

Every kind of electronic control system for riding assistance during traction is allowed, (e.g. traction control, anti-wheelie, etc.), except from ABS (Anti-lock Braking System).

It is allowed to install speed sensors on the wheels or on the motor shaft, but it is not allowed to make additional holes in any component to fix the speedwheels.

The dashboard can display freely any kind of information or warning to the rider.

### 8.I.2 Data recording

It is allowed to record data concerning engine/motor parameters, motorcycle dynamics, temperature and pressure, and every other kind of data that each Team consider as important.

It is allowed to use commercial data logger or to use self-developed ones or to adapt any commercial solution.

Any kind of sensors is allowed if its installation does not affect any other constraint listed in this document.

The software used may be of a commercial type or self-created.

Live reading telemetry system is allowed.

Live communication with the rider is forbidden.

### 8.I.3 Transponder

Prior to the beginning of the dynamic tests, the Rider must collect the transponder from the timekeepers and it must be installed according to their directives. The correct fixing of the transponder may be checked by the FMI Officials, and the responsibility of these operations are up to the Rider.

### 8.I.4 On-board cameras

The use of video (recording and / or transmission) devices, such as cameras and video cameras, is normally prohibited. The organizer of the event, or the promoter of the championship, can ask the race director for authorization for some pilots to mount and use these devices for commercial and / or promotional purposes.

The race director has the right to refuse the use of the aforementioned devices.

The installation of video devices on the pilot's equipment is prohibited.

The Clerk of the Course must send to the 1st Technical Commissioner, via the Competition Secretariat, a list of any pilots authorized to install the devices, so that the Technical Commissioner can carry out the checks specified in the following articles.

Riders who have obtained authorization from the race director for the assembly and use of video devices must bring the motorcycles with the devices to their final assembly for viewing, in order to ensure their safety. The Technical Commissioner has the right to refuse assemblies deemed unsafe.

Whatever the type of main fixing, video devices must be secured in at least one point by means of a safety wire.

The assembly of video recording or transmission devices not authorized by the Race Director and / or not verified by the Technical Commissioner can be sanctioned with: the application of the fine provided for by the Sports Regulations for non-compliance with the drivers' obligations, or technical irregularities for repeated or more serious cases from the point of view of assembly safety. The final decision on the type of sanction to be applied is up to the Delegate Race Commissioner after hearing the opinion of the 1st Technical Commissioner

The video recording or transmission devices (including any memory media) must remain mounted on the motorcycle for the entire time it remains in the closed park.

The race director has the right to confiscate the storage media and / or delete the recorded images.

### 8.I.5 Lights

It is mandatory to mount a light with the following characteristics:

- Have a red light beam with a power of 10-15 Watt, for incandescent lamps and 0.6-1.8 Watt, for LED lamps.
- When the motorcycle is on the track, the light beam must be continuous (not intermittent), the intermittent light beam is allowed (but not mandatory) only when the electronic device is activated to limit the speed of the motorcycle in the pit lane (pit-limiter).
- Be firmly mounted under or above the tail, in the rear, near the center line of the motorcycle and be oriented in such a way as to be clearly visible to those behind the motorcycle at an angle of 15 ° to the right and left of the longitudinal plane of the motorcycle.
- It must be connected to the motorcycle's electrical system and activated by a switch preferably positioned on the handlebar or semi-handlebar so as to allow the rider to turn the rear light on or off while riding the motorcycle. At the discretion of the 1st Technical Commissioner, rear lights powered by an internal

battery with switch that can be activated by the rider when he is riding the motorcycle may be allowed.
- Having a watertight casing that prevents water from entering, compromising its operation.

The rear light must remain mounted and kept operational (ready for use) throughout the duration of the event. The Technical Commissioner has the right to verify the presence of the rear light and its correct functioning during the entire duration of the event (even in dry track conditions).

The light should only be turned on when:
- The race director declares the tests or race wet.
- In case of conditions of reduced visibility at the discretion of the Race Director.

The obligation to turn on the rear light, in case of reduced visibility, is reported to the pilots by displaying the appropriate sign.

## 8.J Identification

### 8.J.1 Numbers

Each motorcycle must carry 3 identifying competition numbers on the fairing, one in the front part of the faring and one for every side of the motorbike.

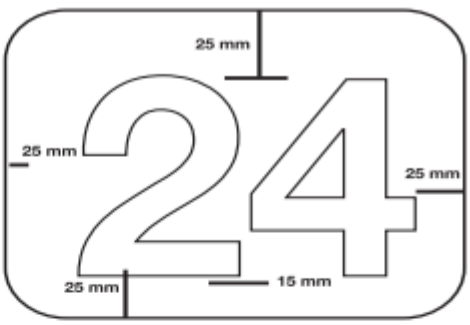
Numbers height:

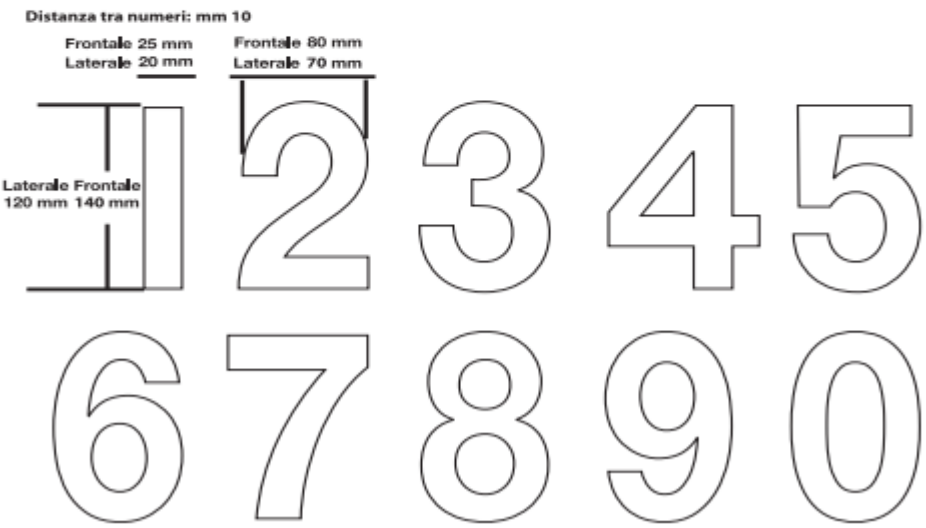
- Front: 140mm
- Side: 120mm

Numbers width:

- Front: 80mm (each number)
- Side: 70mm (each number)

Distance between numbers: 10mm




The only numbers to be used are 1 to 99.

Each Team will be responsible for placing the competition number on the motorcycle.

The competition number will be chosen by each Team, except from the numbers 1, 2 and 3 which will be reserved to the winners of the past editions. If two Teams chose the same number, the organization will decide what Team will use the selected number in function of the time of the enquiry.

**8.J.2 Identification**

The name of the represented University must appear on the motorbike. The dimension of the logo is free.

There must be a space on the frame for the inspection labels (static, administrative and dynamic inspections). The labels will be added next to the headtube, and they must be visible with the mounted fairing. The minimum space to be left is a rectangular shape with dimensions LxH 120x50mm.

During the technical inspections, Teams will be asked to stick the logo of the event and of the Organization on the fairing of their prototype. A minimum clean space with dimensions 200x40mm.

It is forbidden to include advertising or other messages that violate human dignity (violence, xenophobia, racism, intolerance, etc.), or that mayoffend the sensibilities of some people, both on the bike as in any other corporative environment of the Team. Likewise, the Organization reserves the right to review and analyze the advertising content and ban it if it is considered appropriate.

## 8.K Rider equipment

All the specifications and requirements related to the rider equipment will rely on the official federation annex that will be provided from the Organization to all the Teams.

# 9. POWERTRAIN AND ELECTRONICS

## 9.A Definitions and general aspects

### 9.A.1 High voltage, low voltage

Any circuit or part of circuit that can operate at more than 40V is considered High Voltage (HV). Below this threshold, it will be Low Voltage (LV).

Maximum voltage (both in operating and non-operating condition) of HV system is 126V.

### 9.A.2 HV system

Any HV circuit must be galvanically insulated from the motorcycle chassis or from any metallic part that can protrude outside the vehicle.

The electrical energy storage system, defined as batteries, supercaps or other systems installed in the vehicle cannot be directly connected to the motor: a control device must be put in between.

It is mandatory to stick labels indicating unequivocally the presence of HV (hence, danger) next to or on every part of HV system, so they are clearly visible. Text must be present.


There must be a display showing the potential difference of the battery terminals and of the DC bus (defined as battery terminals after contactor). Display must be visible to the Rider and to Technical Staff at any moment, without removing any part.

Those voltages may be measured by the FMI Officials and Organization technical committee at any time to check they are equal to the values displayed. When the main contactor is closed, displayed values can be different by a maximum of 3V.

### 9.A.2 LV system

Every circuit that is not part of the HV system, and so it operates below 40V, is part of LV system. GND of LV system must be the motorcycle chassis. LV system has to be galvanically separated from any part of HV system.

If the LV circuits are supplied from the HV through a DCDC, all the prescriptions are applied to this component as well.

If parts of HV and LV systems must be in the same box or container, the following distances must be respected between each other:

| HV Voltage | Minimum distance from LV |
|---|---|
| < 100VDC | 10mm |
| > 100VDC | 20mm |

This prescription is not applied if suitable insulation layers are placed, that can resist to humidity and temperature up to at least 150°C

If parts of HV and LV systems must be on the same PCB, a creepage distance of 6,4mm minimum must be respected on the board surface and a clearance distance of 3,2mm minimum through air. Suitable insulating coating can reduce the minimum clearance distance to 2mm. Optocouplers with the suitable rated voltage (higher than 130V) are accepted: in this case, the clearance and creepage prescription is not applied.

HV parts must be protected so that a rigid cylindrical probe (6mm diameter) cannot enter in direct contact. Insulating protection for HV connections are accepted.

HV cables must be orange, non-flammable, grade UL-94V0, FAR25 or equivalent.

### 9.A.4 Positioning and grounding of the HV

Every HV component (and the connection between each other) must be protected in case of accident. Motorcycle's frame or specific protection boxes are accepted, provided that the materials, design, construction and installation are capable to whitstand a crash load case.

All the exposed elements which material is able to conduct electricity and that is closer than 100mm from a HV or LV component or circuit, must be grounded to the frame.

## 9.B Motor and motor controller

### 9.B.1 Motor general aspects

The nominal power of the motorcycle's electric motor must not exceed 13 kW. Only Engiro 205A_04016_ABC, Motenergy ME1507 and Heinzmann PMS150 motors are allowed.

It is possible to install only one electric motor, and it must drive the rear wheel of the motorbike by means of a chain/belt transmission system (i.e., it is not allowed to put the motor directly on the rim).

### 9.B.2 Motor power limitations

The powertrain power at the outlet of the battery pack must not exceed 45kW. This can be measured constantly for the entire duration of the event by a power meter provided by the organization.

Energy regeneration is allowed and unrestricted, but the only energy source allowed is the same electric motor used for traction.

### 9.B.3 Throttle potentiometer

A throttle rotary potentiometer must be installed on the right-side of the handlebar (or on the right semi-handlebar). This sensor must control the torque (positive or negative) or the speed (only in the forward direction) of the motor.

### 9.B.4 Motorcontroller HW and SW specifications

Motorcontroller is part of HV, even if some internal parts can be part of LV. In this case, all the prescriptions about insulation, clearance and creepage distance, and any other safety measure is applied to this component.

Self-developed controllers are allowed. Off-the-shelf controllers or modified ones are allowed. In any case, HW must be compatible with the voltage and power rating.

Control software is free, as long as every working condition is compliant with the regulations and with the safety measures. Multiples energy management strategies allowed.

### 9.B.5 Precharge circuit

Precharge circuit is needed and mandatory to bring the DC bus voltage close to the battery terminal voltage before closing the contactor. The maximum difference between battery voltage and DC bus voltage at the moment of contactor closing shall be 10V. The precharge must be performed every time the HV system is enabled, regardless what is the residual voltage on the DC bus.

As long as voltage on DC bus rises above 40V, a red warning light must be displayed on the dashboard, and it must stay on until the voltage drops back below 40V.

## 9.C Energy storage

### 9.C.1 Type of storage systems

Cells and supercapacitors (or both of them) are accepted. Thermal batteries (molten salt) or fuel cells are not allowed

### 9.C.2 Battery housing

All the cells or supercaps must be enclosed in a housing. It is accepted to have several housings, displaced along the motorcycle. The same prescriptions are applied to each of them.

### 9.C.3 Electrical layout

A correct level of insulation must be respected between the terminal of the cells and the other parts of the battery structure or of the battery housing, especially if they are made from electrically conducting materials.

Each container must be equipped with circuit protection devices:

- At least one fuse, properly sized according to the expected current rating and which must be co-ordinated with the contactor in terms of maximum cutting power. If the battery is made with several strings in parallel, each string must be protected by an independent fuse. Short circuit current calculations and fuse size can be checked during the technical inspections;
- At least a contactor, normally open type;

It is allowed to connect directly the cells terminals by mean of welding or soldering, or a conductive material can be placed in between the cells.

It is allowed to weld the BMS connection to the cells terminals.

### 9.C.4 Mechanical configuration

Battery housing(s) must protect the battery in every condition. Suitable materials and fixing methods to the frame must be adopted. It is allowed to use part of the frame as battery housing, as long as it complies with all the prescriptions.

Cells or supercapacitors inside the battery housing must be kept firmly in position: no relative movement of any part is allowed inside the battery (this applies also to BMS, wiring, fuse(s), contactor(s) and any other element inside the battery housing).

Battery housing should be closed on every side. Holes can be made to make wiring, cables or busbars pass through it, or for cooling. If openings are made for ventilation, they cannot cover the whole area of one or more sides of the housing. In addition, regardless the dimension of the ventilation hole, it must be protected with a filtering element to protect the battery from dust and liquids.

If a battery housing is sealed, a venting valve should be installed to avoid any overpressure inside in case of thermal event on one or more cells.
It is allowed to use or to modify off-the-shelf containers, as long as they comply with all the prescriptions.

### 9.C.5 Battery management system

It is mandatory to fit the battery with a BMS. All the cells voltage must be monitored, so that they stay within the limits stated in their datasheet. Also cells temperature must be monitored: a minimum of four temperature sensors must be installed, where the highest and lowest temperatures are expected to be reached.

If there is a balancing circuit, it can be only passive and the resistances used must be able to dissipate the energy and power required for the balancing operation. Resistances and PCB temperature limits must be respected. Cooling system can be used during this operation.

The BMS must open the contactor (so to disconnect the battery or batteries from the DC bus) if a voltage, current, power or temperature limit is exceeded.

The responsibility of the proper working of the BMS is up to the Team, and it will be checked during the technical inspections.

## 9.E HV disconnection

### 9.E.1 HVS disconnection circuit

This circuit is needed to disconnect the battery from the DC bus in case of emergency or if any safety threshold (voltage, current, power, temperature, insulation) is exceeded.

The proper insulation of the HV from the LV or from the chassis must be controlled by a IMD (Insulation Monitoring Device). Minimum insulating resistance must be 100kΩ.

The correct functioning of the disconnection circuit will be checked during the technical inspections.

If the contactor is being opened by a triggering condition abovementioned, the system must stay in “non active” condition until the Rider or a Team member enables it back manually.

### 9.E.2 LV disconnection

LV system must be able to be turned on and off independently from the HV. A LV master switch must be fitted in the motorcycle.

If a DCDC is used to supply the LV system, it should be disconnected in “non active” condition to avoid battery self-discharge.

### 9.E.3 Switches

There must be at leas an emergency button to shut down the HV. It must be mushroom-push-rotary type, with minimum head diameter 22mm.

The accessibility to this button must be granted in every condition: it can be placed in a central position, on the upper part of the motorcycle, or on each side of the motorcycle. Also, it must be protected in case of crash.

Another switch must be present, to enable the HV. This tractive system switch will enable the HV circuit to perform the DC bus precharge phase, and it works only if the master switch is already in the “on” position.

### 9.E.4 Insulation Monitoring Device

It is compulsory to install an Insulation Monitoring Device. This device has to measure the electrical insulation between the HV system and the chassis of the prototype.

The only IMD allowed by the regulations is the BENDER “ISOMETER IR155-3203” or “IR155-3204”. Please contact the organization for any doubt about the right p/n of this device.

The proper working of the IMD and of the electronic devices listed in the regulations can be checked during the technical inspection or at any time during the event.

### 9.E.6 LV fuses

All the LV circuits must be protected by a fuse, correctly sized according to the current rating and the cables cross section and material.

## 9.F Accumulator Recharging

### 9.F.1 Chargers

All types of commercial chargers accredited to CE standard are permitted. Rated power should be lower than 22kW, with 32A as current limit for the three-phase side.

Single-phase connection (230VAC, 50Hz) is allowed, as well as three-phase connection (400VAC, 50Hz)

It is accepted to put multiples chargers in series or in parallel provided that their specifications allow such a configuration. Total power and current limits are the same as the single-charger configuration.

Each charger must have a ground connector connected to its case and to the socket base.

### 9.F.2 Connection to the battery

The connection must have an automatic or manual shut-down system (High Voltage Interlock or shut-down button).

Battery or connectors conductive parts must be inaccessible with 6mm diameter cylindrical rigid probe during the charge. Minimum protection degree for the charging connector is IP65 when plugged.

Battery charging connector must be protected from crash or impacts.

### 9.F.3 Recharging process

At least one Team member must be present during the charging process. Team member must be well trained about the charging process and about how to quickly and safely disconnect the battery from the charger. This aspect may be checked during the event.

During the charging process there must be a fire extinguisher for electric fire (CO2 or similar) no further than 2 meters from the motorcycle. This aspect may be checked during the event.

It must clearly visible that the motorbike is under charging, by means of fences, barriers or similar devices. The only person allowed to be nearby the motorbike is the one in charge of the recharging process.

BMS must control the charging phase and notify the Team member if any safety threshold is exceeded.

## 9.G Cabling

### 9.G.1 General insulation

All cables must be properly insulated according to the voltage rating and the expected environmental conditions.

Ground connections can be non-insulated.

### 9.G.2 Sizing

All cables must be properly sized by selecting the correct cross section according to the expected current.

### 9.G.3 Protection against humidity

The suggested protection degree for HV components is IP65.

### 9.G.4 Wiring

The cables must be fixed so that it is not possible to trap any part, tool or bodypart in it. There must be a fixing point every 150mm or less.

FMI Officials and Organization technical committee will verify the compliance with the regulations during the technical inspections and can perform additional checks at any time during the event for every aspect related.

# 9.H Control and control elements

## 9.H.1 Dashboard

Rider must be able to easily see the information displayed on the dashboard when in riding position.

## 9.H.2 Control elements

All the switches to enable the tractive system must be easily accessible by the Team members (without removing any part) and by the Rider (in riding position).

# 9.I Transmision

### 9.I.1 Types of transmission

The configuration of the transmission system is free. Direct or primary transmission systems are allowed.

Clutches are allowed.

Any rotating part must be duly protected.

### 9.I.2 Secondary transmission

Secondary transmission system is free (chain, belt, etc..).

Any moving part must be duly protected.

# 9.J Cooling

### 9.L.1 Design

Cooling system design is free. It can be an air or liquid cooling system, or a combination of both.

### 9.L.2 Air cooling systems

It is permitted to use both aerodynamics ducts or forced ventilation to cool down components.

### 9.L.3 Liquid cooling systems

The only permitted liquid coolant is distilled water. No additives are allowed.

Multiples radiators are allowed, but their size and location must comply with the general dimensions constraint listed in the regulations.

All the leakages from pressure relief valves must be conducted to a catch can with minimum volume 500cc.

# 10. DYNAMIC EVENTS

## 10.A General

### 10.A.1 Objectives

There will be six dynamic events to prove the motorcycle performance on track:

- Brake Performance
- Handling Test
- Best Acceleration
- Free practice;
- Timed practice (Qualy);
- Race.

The rider, who represent the Team, will carry out all the dynamic tests.

The schedule and description of the dynamic events indicated in this article may vary and change in the Final Event, if the FMI Officials so had to determine it for any reason. In case of possible safety related issues, the Race Director can also apply such modifications.

Each of these events will be described in the following articles, and the score will be added to the score achieved with the static events in order to form the overall ranking.

### 10.A.2 Requirements

Only the prototypes that have passed successfully the Technical Inspections to participate in the dynamic events, and must be presented in suitable conditions. The FMI Officials and the Organization Technical Service can check the conditions of the prototypes at any time.

### 10.A.3 Weather conditions

There are two possible track conditions:
• Dry
• Wet;

If the Race Direction establishes “Dry”: Teams will be able to carry out all the dynamic events and it will be compulsory to use slick tires.

If the Race Direction establishes "Wet”: Teams will be able to carry out the dynamic events but will be possible to use wet weather tires.

For any other situation or unforeseen weather, the FMI Officials will decide and announce if there is any postponement or cancellation.

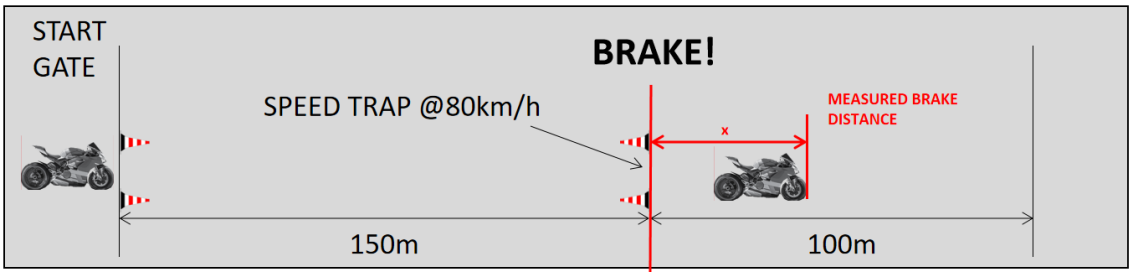
## 10.B Brake Performance

### 10.B.1 Brake Performance Description

This test will evaluate how many meters are needed to fully stop the motorcycle from an initial speed of at least 80km/h.

The area dedicated to this test will be composed by a start gate, an acceleration area, a braking area, and an exit gate. The speed of the prototype will be recorded just before the entrance of the braking area

The following picture shows a graphic representation of the area:




If the speed at the speed trap is lower than 80 km/h, 2 meters will be added to the measured braking distance for every 1km/h below the threshold.

### 10.B.2 Brake Performance Score

The maximum score during the brake performance is 50 points. The first classified will gain the maximum score, while the other Teams will receive points according to the following formula:

$$S = 50 - 49 * \left(\frac{D_B - D}{D_B - D_W}\right)$$

Where $D_B$ is the best distance, $D_W$ is the worst distance, D is the distance to evaluate, and S is the respective score. The result will be rounded to nearest.

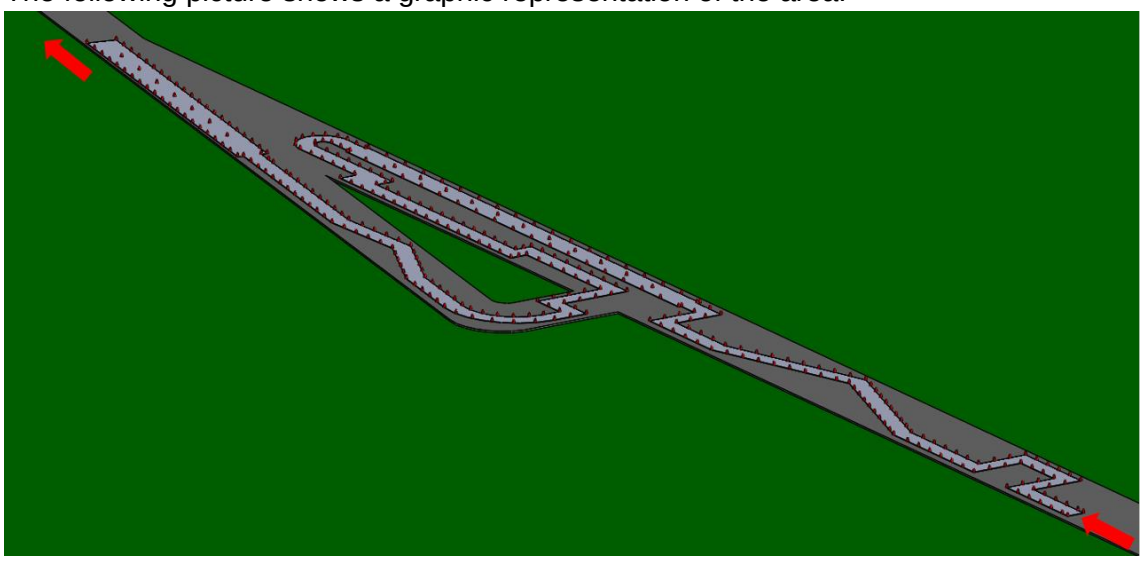
## 10.C Handling Test

### 10.C.1 Handling Test Description

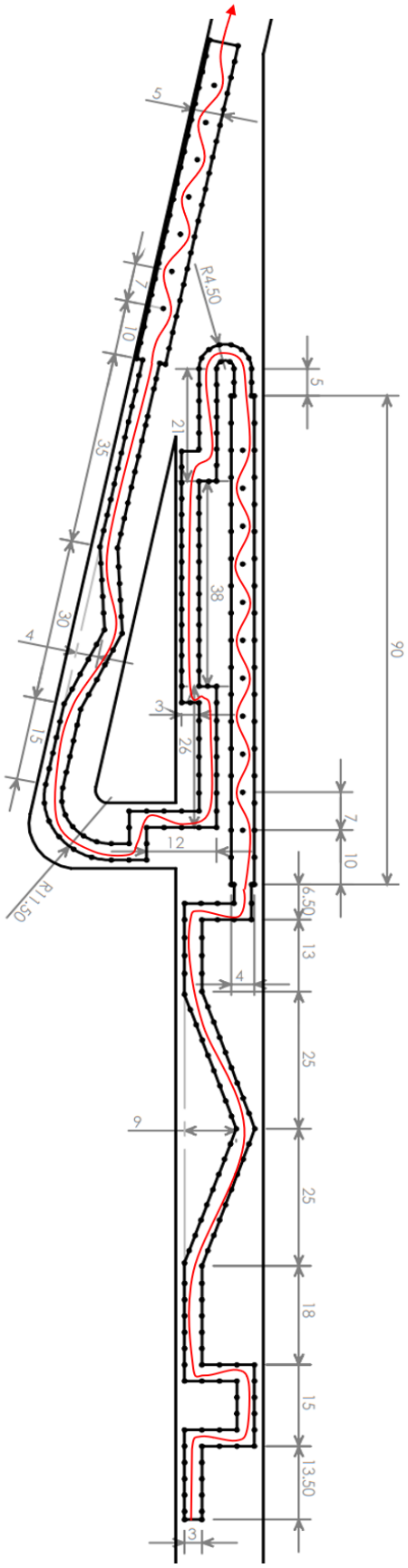
This test is aimed to verify the handling of the prototype in a narrow-cornering circuit. The route will be signaled by mean of cones. Cells will be placed at the start and finish gates to record the time over the route. This test will take place right after the Brake Performance.

There will be penalties for failures: if a cone is touched, 5 seconds will be added to the final time, while if a cone is “bypassed” the penalty will be 10 seconds.

The following picture shows a graphic representation of the area:



Detailed dimensions of the Handling track are showed in the next page. Dimensions are expressed in meters.


5
7
10
R4.50
5
21
35
38
90
4
30
3
15
26
12
7
10
R1.50
6.50
13
4
25
9
25
18
15
13.50
3

### 10.C.2 Handling Test Score

The maximum score during the Handling Test is 100 points. The first classified will gain the maximum score, while the other Teams will receive points according to the following formula:

$$S = 100 - 99 * \left(\frac{T_B - T}{T_B - T_W}\right)$$

Where $T_B$ is the best time, $T_W$ is the worst time, T is the time to evaluate and S is the respective score. The result will be rounded to nearest.

## 10.D Best Acceleration

### 10.D.1 Best Acceleration Description

This test is aimed to find what is the best acceleration time of each prototype on a 150m long strip. This test will take place right after the Handling Test.

The following picture shows a graphic representation of the area:


### 10.D.2 Best Acceleration Score

The maximum score during the Best Acceleration is 100 points. The first classified will gain the maximum score, while the other Teams will receive points according to the following formulas:

$$S = 100 - 99 * \left(\frac{T_B - T}{T_B - T_W}\right)$$

Where $T_B$ is the best time, $T_W$ is the worst time, T is the time to evaluate, and S is the respective score. The result will be rounded to nearest.

## 10.E Free practice (FP)

### 10.E.1 Development of the session

Teams will have one round of 20 minutes free practice session on the racetrack. If the number of riders exceeds the maximum allowable for the track, the Organization will divide the Teams in groups.

If a rider is unable to obtain a qualifying time during the official qualifying practice, it will be possible to use the best free practice lap time to access the starting grid. There is no maximum qualifying time. In the case a Team uses the free practice lap time to access the starting grid, it will start from the last position.

A chequered flag will be used to notify the end of the session. All the motorcycles that are still on track must take the chequered flag and leave the track after the following lap.

## 10.F Timed practice (Q)

### 10.F.1 Warm-up session

Teams will have 1 round of 10 minutes of warm up in the circuit, prior to the Qualifying session. There will be independent rounds for each category.

A chequered flag will be used to notify the end of the session. All the motorcycles that are still on track must take the chequered flag and leave the track after the following lap.

### 10.F.2 Qualifying session

Teams will have a 20 minutes timed practice session.

A chequered flag will be used to notify the end of the session. All the motorcycles that are still on track must take the chequered flag and leave the track after the following lap.

The Organization will record the lap times and will use the results to define the starting grid of the Race

### 10.F.3 Score

During the Qualifying session, a score based on the final position will be awarded.

The score will be awarded according to the classification of the lap times obtained (from lowest to highest time) based on the following table:

| Position | Score | Position | Score | Position | Score |
|---|---|---|---|---|---|
| 1 | 50 | 14 | 26 | 27 | 13 |
| 2 | 46 | 15 | 25 | 28 | 12 |
| 3 | 44 | 16 | 24 | 29 | 11 |
| 4 | 42 | 17 | 23 | 30 | 10 |
| 5 | 40 | 18 | 22 | 31 | 9 |
| 6 | 38 | 19 | 21 | 32 | 8 |
| 7 | 36 | 20 | 20 | 33 | 7 |
| 8 | 34 | 21 | 19 | 34 | 6 |
| 9 | 32 | 22 | 18 | 35 | 5 |
| 10 | 30 | 23 | 17 | 36 | 4 |
| 11 | 29 | 24 | 16 | 37 | 3 |
| 12 | 28 | 25 | 15 | 38 | 2 |
| 13 | 27 | 26 | 14 | 39 or more | 1 |

## 10.G Race

### 10.G.1 Procedure

The race will follow the Official FMI procedure, except from the absence of the sighting lap.

There will be a total of two races, with a suitable amount of time in between to allow the Teams to recharge the motorcycles.

The race will be held for 6 laps (approximate distance of 29.5km).

### 10.G.2 Score

The race scores will be assigned according to the race classification and using the following table:

| Position | Score | Position | Score | Position | Score |
|---|---|---|---|---|---|
| 1 | 150 | 14 | 75 | 27 | 21 |
| 2 | 140 | 15 | 70 | 28 | 18 |
| 3 | 130 | 16 | 65 | 29 | 15 |
| 4 | 125 | 17 | 60 | 30 | 12 |
| 5 | 120 | 18 | 55 | 31 | 10 |
| 6 | 115 | 19 | 50 | 32 | 8 |
| 7 | 110 | 20 | 46 | 33 | 6 |
| 8 | 105 | 21 | 42 | 34 | 5 |
| 9 | 100 | 22 | 38 | 35 | 4 |
| 10 | 95 | 23 | 34 | 36 | 3 |
| 11 | 90 | 24 | 30 | 37 | 2 |
| 12 | 85 | 25 | 27 | 38 | 1 |
| 13 | 80 | 26 | 24 | 39 or more | 1 |

The final score of the “Race” dynamic event will be the average of the scores achieved in the two races.

## 10.H Dynamic Events Score

### 10.H.1 Maximum scores

The maximum score of the dynamic events is the sum of the maximum score of every test, as shown in the following table:

1. Brake Performance: 50 Pts
2. Handling Test: 100 Pts
3. Best Acceleration 100 Pts
4. Timed Practice: 50 Pts
5. Race: 150 Pts (average of two races)

For a total of **450** points.

### 10.H.2 Special awards

The dynamic events may grant special awards that will be specified in the competition handbook.

# 11. STATIC EVENT

The static event, named “Tech Talk”, should describe the evolution of the project for each Team. The participant Teams should give to the Jury and to the Organization insights and explanations about the technical choices taken during the prototype design and development.

## 11.A Procedure

According to the event schedule, each Team will have 15-20 minutes to expose their project in front of a jury composed by members of the sponsor Companies. The full list of the Companies will be shared on the event website prior the event day.

The presentation will happen in a dedicated room where digital support (i.e. television or projector) can be used by the Teams via HDMI connection. Audio playback is allowed. Team’s prototype must be exposed in front of the Jury during the presentation.

There is no limit in the number of Team members that will perform during the tech talk, proven that each member has a role during the presentation. Additional audience is allowed, but non-performing members will stay behind judges table.

Analog support (e.g. posters, physical components, etc.) are allowed.

## 11.B Contents

The Tech Talk suggested topics are the following:

1. Project Duration and Team Organization Chart
2. Powertrain Description
    a) Battery Pack Design and Simulation
    b) Motor Control Design and Simulation
    c) Powertrain Integration and Control Strategy
    d) Powertrain Safety
    e) Energy Management Strategy
    f) Prototyping and Validation Testing
3. Vehicle Description
    a) Chassis Design and Simulation
    b) Drivetrain Design and Simulation
    c) Brake and Suspension System
    d) Aerodynamics
    e) Prototyping and Validation Testing
4. Full Prototype Testing Plan

It is not mandatory to discuss about all these topics during the oral exposition: each Team is free to select the topics where they claim the major technological innovations or where they think to be more advanced than their competitors.

In addition to the Tech Talk, a full written document called “Tech Details” that includes all the elements listed in previous list must be prepared: this document will be provided to the jury members and it will be considered to create the final ranking.

### 11.C Static Event Score

Each Team will be evaluated considering both the “Tech Talk” performance and the “Tech Details” contents. Each topic will gain a score according to the following table:

| | TOPIC | POINTS |
|---|---|---|
| POWERTRAIN | Battery Pack Design and Simulation | 30 |
| | Motor Control Design and Simulation | 20 |
| | Powertrain Integration ad Control Strategy | 20 |
| | Powertain Safety | 20 |
| | Energy Management Strategy | 30 |
| | Protyping and Validation Testing | 40 |
| VEHICLE | Chassis Design ad Simulation | 30 |
| | Drivetrain Design ad Simulation | 20 |
| | Brake and Suspension System | 20 |
| | Aerodynamics | 30 |
| | Protyping and Validation Testing 50 | 40 |
| TESTING | Ful Protype Testing Plan | 50 |
| TECH TALK | Oral Exposition | 100 |

**TOTAL 450**

# 12. TECHNICAL INSPECTION

## 12.A Objective and methodology

### 12.A.1 Objective

The objective of the pre-event scrutineering is to check the compliance of the motorcycles with the regulations in terms of specifications, performance and (mainly) safety.

Technical inspection will not give any points for the final ranking, but a non-compliance could result in the exclusion of the motorcycle or of the Team from the competition.

The pre-event scrutineering will be carried out by qualified FMI and Organization Technical Staff, mainly composed by electronic, electrical, aerospace and mechanical engineers.

Whenever it will happen to dispute or debate about a non-compliance of the motorcycle with the technical regulations, or in case of safety-related situation on track, the final decision will be up to the technical staff after a proper justification to the Team. Any decision made from the FMI and Organization staff will be final.

Safety checks must be performed by FMI technical stewards.

### 12.A.2 Teams responsibility

Teams are responsible of the compliance of the motorcycle with with the Regulations. Every Team acknowledges to be sure that the motorcycle registered for the event complies with the Regulations.

### 12.A.3 Procedure

There will be three phases of inspection: a pre-inspection, a mechanical inspection and a specific inspection for the powertrain.

Teams must pass all the three phases in order to have their motorcycle approved for the dynamic tests. At the end of the technical inspections, each Team will receive a sticker to be applied on the chassis of their prototype that assesses the compliance with the regulations.

## 12.B Pre-inspection

### 12.B.1 Purposes

The aim of the pre-inspection is to check the compliance with the regulations of the rider's equipment and the presence of all the documents requested by the organization. If the pre-inspection is passed, the motorcycle will proceed to the second phase. The

Organization, in agreement with FMI Officials, reserves the right to take pictures of the motorbike during the entire event and to use them in case of desputee.

**12.B.2 Required items**

The following items must be presented for the pre-inspection:

- rider helmet(s), rider equipment and other safety gear
- at least one unused fire extinguisher and a copy of all the documents required in these regulations.

All these items will be checked by FMI officials and Organization officials.

## 12.C Mechanical inspection

### 12.C.1 Purposes

The aim of the mechanical inspection is to verify that both the motorcycle and the powertrain/electronic systems comply with the regulations. The motorcycle must be compliant with these regulations at any time during the event. In the case of an accident or crash, the motorcycle will be subjected to an additional technical inspection.

### 12.C.2 Required items

The following items must be presented at mechanical inspection:

- The motorcycle in ready-to-race condition;
- Tools needed for the (dis)assembly of parts if requested by the FMI and Organization inspectors;
- Electrical schematics and pictures of the assembly of the battery pack;
- All the spare elements (any component or part of the motorcycle) that Teams may seem fit.

### 12.C.3 Procedure and measurements

For the static checks, only 2 Team members shall be present in the Technical Control Area. The same 2 Team members will have to bring the motorcycle, its supports and the documentation.

The technical staff will perform the measurements and can ask the Teams all the questions they consider appropriate during the inspection.

### 12.C.4 Static safety check on test bench

In order to be admitted to the pre-event scrutineering, motorcycles have to pass the static safety check on test bench. This test will be performed by the Organization in a dedicated area and the result of the test is binding for the participation to the rest of the event. It will be possible to repeat the test until the end of the established time.

Force will be applied in two directions: front wheel will be subjected to a horizontal force while the seat will have to withstand a vertical force. These load cases will be run alternately and progressively. Force value are:

- Horizontal: 300kg;
- Vertical: 250kg;

The aim is to verify the mechanical integrity of all the components and that none of them clashes with others. No residual deformation or crack must be present on any element after the load is released.

# 12.D Specific technical inspection for the electric powertrain

### 12.D.1 Insulation Measurement and IMD functionality

This is a test to assess the insulation between HV and chassis and the proper working of the Insulation Monitoring Device.

Insulation between the HV circuit and the chassis will be checked by the organization. A minimum resistance of 100kΩ must be reached.

After that, Team members will be asked to perform the closing contactor procedure. When the motorcycle is in ready-to-ride conditions, a 50kΩ resistor will be connected alternately to the HV+ terminal and chassis and/or HV- terminal and chassis. Automatic disconnection of the battery from the HV bus is expected within 30s.

### 12.D.3 Emergency button test

This is a test to verify the functionality of the emergency button.

Team members will be asked to perform the closing contactor procedure. When the motorcycle is in ready-to-ride conditions, the emergency button will be activated. Battery contactor must open immediately. Same test can be performed with the tractive system switch.

When shutting down these switches, the motorbike has to go from “ready-to-ride” state to an “not operational” one, with 0V on HV bus.

### 12.D.4 Rain test

If the motorcycle passed the previous tests, they can access the rain tests. This is mandatory to take part to the dynamic events in case of rain or wet conditions.

It will be possible to repeat the test multiple times until the end of the established time for the inspections.

During the test, the motorcycle must be switched on but in a “not operational” state.

A fine rain over the motorcycle will be simulated by mean of light water sprays for 60 seconds. High pressure jets will not be used. It is also recommended to design all the elements so that there will not be any accumulation of water in dangerous area (next to HV systems and circuits).

The IMD warning signal (so insulation resistance lower than 100kΩ) must not be triggered for the entire duration of the simulated rain and for the next minute.

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