WROCŁAW
SMARTMOTO CHALLENGE 2018

Rules 1.1.

PURPOSE OF THE PROJECT

The purpose of this event is to stimulate development of technology concerning electric motorcycles all around the world. This is an opportunity for students of engineering and design schools to collect and develop different practical skills. Not only the ones based on knowledge of technologies but also being acquainted with a team work, preparing and developing projects, fundraising and presenting the final results. The students can get familiar with modern technology and comprehend their market. On the other hand the manufacturers from the motorcycle industry will have a laboratory of ideas and an additional source of future market and product technicians.

OBJECTIVE OF THE PROJECT

The 2018 Wrocław SmartMoto Challenge edition will consist of manufacturing a fully functional electric light enduro motorcycle, following the European rules L1E or L3E, with lights and blinkers.

The phases during the project will include market analysis, definitions on product and its design, and as a consequence of this, building a real prototype of an electric motorcycle. It will be also mandatory to work on a business plan that explains how each team evaluates the launch of its vehicle in terms of production, prices, dealers, markets.

The purpose of this document is to define what are the variables, constraints and criteria to use during the execution until the event in Wrocław.

PROJECT SCOPE

The scope of the project is for engineering degree universities as well as the participation of mixed teams with departments or design schools from other European universities. Also teams from technical high schools will be accepted. In the case of submitting teams from outside the above-mentioned units, the organizer will consider their opportunity to participate in the competition. The final projects will be presented for verification in a competition (5 days) at the campus of Wrocław University of Science and Technology with no more than 20 teams.

1. WROCŁAW SMARTMOTO CHALLENGE 2018 RULES

1.1. EXECUTION TIME FOR PROJECT

The calendar project will be announced on the website **www.smcwroclaw.pl** and the project must be defended in Wrocław in the form, place and conditions that will be specified later in this document.

1.2. WHO CAN TAKE PART IN THE EVENT

The project is for multidisciplinary teams of students that during 2017 and 2018 are studying or have studied in any of these kinds of schools this period:

Which schools can participate:

- Universities
- Technical universities
- Technical high schools – by agreement

The number of students from each team must be between 8 and 12 students under the conditions described later, and it must have a faculty advisor as responsible. The faculty advisor must be present during the competition. The accommodation fee for faculty advisor is the same as for students. There is a possibility of participating in the WSMC more team members than 12, but for each additional person will pay €100, because such are the real costs of accommodation and a hot meal.

Mixed teams will be accepted from various training centers. Although, they must have only one faculty advisor that must be from the engineering university.

The geographical location of universities and educational institutions will have no restrictions in this edition.

Important: Teams should submit the list of the team members with the signature of the principal of the university or the person with legal capacity to sign that the students are enrolled in the school of the team they are working for.

In the case of submitting teams from outside the above-mentioned units, the organizer will consider their opportunity to participate in the competition.

1.3. STAGES OF THE PROJECT

The competition is composed of six stages. Each one evaluates different aspects of the project:

STAGE Ia	Registration and first part of payment from a form submitted by the organization.	From 1st November 2017 to 28th February 2018
STAGE II	Design brief. The document written as a file will be specified before 28h February 2018.	Deadline 31st March 2018
STAGE Ib	Second part of payment for registration and accommodation.	Deadline 15th April 2018
STAGE III	Presentation of the final product design. It will be previously specified before 31st March 2018.	Deadline 15th June 2018
STAGE IV	Presentation of the prototype during the competition.(*)	August 2018
STAGE V	Theory evaluation of the industrial development, design event and business plan presentation during the competition.	August 2018
STAGE VI	Dynamic testing of the prototypes during the competition.	August 2018

Table 1. Stages of the project

(*) Prototypes presented at the stage IV must pass all tests required for getting the approval, demonstrating that they are safe and that they meet all the requirements for driving on public roads under EU rules. Otherwise the vehicle will not be evaluated at stage VI.

1.4. MAIN CHALLENGE ADMINISTRATIVE ACTS

1.4.1. REGISTRATION (Stage I)

The teams wishing to participate in the first edition of the Wrocław SmartMoto Challenge should fill out and send the registration form between 1st November 2017 and 28th February 2018, following the procedure that will be announced on the Wrocław SmartMoto Challenge website: **www.smcwroclaw.pl**.

The total cost of registration has two charges. One as the registration fee (1) and the other as the accommodation fee (2a or 2b). The registration fee is €1200 but it is paid in two parts. In this way if a team does not finish the project at time, it is not necessary to pay the second part of the registration fee. The accommodation fee applies if the team is going to use Wrocław's dorms with one hot meal per day included. It is possible pay total costs of the registration before 28th February 2018.

(1)	Registration fee part 1	€600 + VAT per team
(2a)	Part 2 - Accommodation fee using Wrocław's dorms	€600 + €50 per student + VAT
(2b)	Part 2 without using dorms	€600 + VAT

Table 2. Total costs of the registration

The registration fee (1) is mandatory for all the teams participating in the Wrocław SmartMoto Challenge. Accommodation fee with charge per student will only be charged to the teams that need to stay in Wrocław dorms during the days of the competition. If team is not going to use Wrocław dorms part 2 of registration fee is only €600 + VAT.

The dorms have running water, toilettes, showers, shops nearby, means of public transportation and energy (230 V).

There is a possibility of participating in WSMC more team members than 12, but for each additional person will pay €100, because such are the real costs of accommodation and a hot meal.

There is a possibility to pay a registration fee and accommodation fee in PLN. The fee will be converted at the current Euro rate.

1.4.2. PROJECT DOCUMENTATION AND SPECIAL TASKS

STAGE II	Presentation of design briefing with main features of the prototype.	Before 31st March 2018 at 20:00 (GTM+1)
Between **STAGE II** and **STAGE III** the team should send the list of all the team members signed by an academic authority of the corresponding university where the team members are studying. If any change occurs in the team along the project, the team responsible has to inform the WSMC organizers.		
STAGE III	Presentation of the final product design and technical justification of the project	Before 15th June 2018 at 20:00 (GTM+1)

Table 3. Project documentation and special tasks

The documentation listed in Table 3 must be sent to mail: mikolaj.ostrowski@smcwroclaw.pl before deadlines mentioned above.

1.4.3. TEAMS

The teams will consist of a minimum of 8 and a maximum of 12 members, which will formalize the registration before 28th February 2018, coordinated by a tutor as faculty advisor, from the university they belong to. In addition to the tutor, one of the team

members should be appointed as a manager who will be responsible for the partner functions and contact with the organizers.

The maximum number of teams for this year is 20. If the number of requests exceeds this maximum, there will be a filter between those candidates who meet the eligibility requirements, according to the filing date of registration.

1.4.4. INSURANCE

Entered universities should integrate the work done, during the days in Poland, in the training curriculum for challenge inside the activities covered by school insurance. However, each team should have a private insurance for each member of the team as cover against any accident that may happen. This information must be shown in writing to the organizer during the competition. In addition, each participant of the Wrocław SmartMoto Challenge will have to sign a safety statement prepared by the organizers. The organizers are not liable for material or physical damage that may be caused during the event by each team.

1.5. PROJECT EVALUATION

During the days of projects presentation in Wrocław, jury will rate the prototypes. For this, it has been necessary define a scale from 0 to 1000 for evaluating the dynamic and static aspects of each project. The competition will include only one category containing projects with engines a nominal power of less than 30 kW and limitation of 122,1 V on battery as nominal value and 140 V on battery as maximum value, but there will be bigger amounts of point for off-road events and static events to test true abilities in business and in action both teams and motorcycles.
If enough teams are reported, the second category will be created. The second category will contain projects with engines a nominal power of less than 8 kW and limitation of 59,2 V on battery as nominal value and 68 V on battery as maximum value.

1.5.1. STATIC EVENTS

1.5.1.1. Product design analysis

This document must justify in detail the bearing capacity of the vehicle. This document will have had a previous evaluation during project development. It will be analyzed each and every one of the documents of the equipment by the judges for this purpose defined by the organizing committee. For evaluation some questions may be done by the judges assigned to that purpose by the organizing committee. From 0 to 150 points divided into: body and brakes 50 points, lights and ergonomics 25 points, smart components 25 points, energy recovery and reuse of components 25 points, usability and maintenance 25 points.

1.5.1.2. Business Plan

A document with a presentation in ppt, prezi or equivalent, by the teams which shall contain the following mandatory items:

1. *Detailed product cost (parts and labour). This cost report will be oriented to know what could be the total prototype cost for a company that could be interested in producing such e-motorcycle. All the numbers in the presentation must have a justification and they can be represented e.g. in charts or tables.*
2. *Structure for mass production (where and with which costs).*
3. *Product Marketing.*
4. *Plan Projected sales and profits the first 3 years.*

The score is from 0 to 350 points divided into 100, 75, 75 and 100 in the order of the previous sections.

It must represent the real cost of your *Smart Moto.*

For each subsystem you must specify the cost of each item, in terms of price if it has been purchased or the cost of manufacturing. In this last case you must consider the labor hours cost and raw material. A complete *Smart Moto* split is mandatory in order to know your all subsystems. **Ask your providers about costs**.

This will be a document that judges will read and ask on them to each team.

You will dispose 20-25 minutes with a ppt. or similar tool for explaining:

Your presentation must be referred to one specific country and must contain:

1. *Executive summary (resume)*
2. *Innovation Team*
3. *Industry background*
4. *Competitor analysis*
5. *Market analysis*
6. *Marketing plan*
7. *Production plan*
8. *Operational plan*
9. *Financial and economic plan.*

No separate report is required for your Business Plan.

1.5.2. PREVIOUS TEST BEFORE START THE MOTOR

Before start the vehicles, they must pass the following tests and standard safety check carried out by personnel authorized scrutineering companies.

1.5.2.1. Rules verification

Engineers from mentioned companies will control that the model fits the design and standards sent to the organizers before 15th June 2018.

1.5.2.2. Sealing

During 120 seconds the vehicle will be submitted to a rain test. The traction must be ON from the beginning, and the test will be passed if the system remains ON.

1.5.2.3. Brakes

- Verification following Homologation Test for braking vehicles.
- Leaving standing start and operating the front brake at 5 meters, the motorcycle must stop in 3 meters sector.
- Leaving standing start and operating the rear brake at 10 meters, the motorcycle will stop in 5 meters sector.
- If the motorcycle has full braking on one lever only the second criterion is applied.

The usage of the brakes must disable the throttle, i.e. it is not possible to brake and accelerate simultaneously.

1.5.2.4. Noise

There must be a beep of over 70dB in a radius of 2 meters around the motorcycle when the system state switches to ready to drive. The duration of the sound shall be between 1 and 3 seconds. The sound shall be easily recognizable, i.e. no animal sounds, human voices, songs, etc.

1.5.2.5. Emergency button

There must be an emergency button to stop the whole system if necessary. A wristband that disconnects the system in case of being at more than 50cm of the handlebar will also be accepted.

1.5.2.6. Kickstand

The motorcycle must dispose of a kickstand. In case it is in use, the traction system shall be deactivated (the system cannot be in drive ready state if kickstand in use).

1.5.2.7. Light

Front and rear lights must be on always when the system is in drive ready state, to ensure that pedestrians and other drivers know the motorcycle is ready to drive.

1.5.2.8. Drive ready indicator

The display on the handlebar shall have a drive ready icon to know the system is in this state. Taking in consideration new 2017 European rules, driver must access to this state doing two volunteer actions (eg. Key on + button).

1.5.3. DYNAMIC EVENTS

All dynamics events must be done with the complete body and accessories of each *Smart Moto* which will be presented on design event. It is not allowed change some parts of the body during dynamic events except tires. The evaluation will have a total of 500 points and consist of:

1.5.3.1. Acceleration

With 1 driver on the motorcycle, 50 meters, standing start. The fastest time wins. 4 attempts each team and choose the best result. Before measuring rides, there will be a possibility of a test drive. 4 runs (2 runs per driver) on asphalt. Maximum 50 points.

1.5.3.2. Acceleration +

With 1 driver on the motorcycle, 50 meters, standing start. Before the competitions there will be drawn couples to create a competition tree. The team goes to the next stage of the competition after winning at least 2 of 3 rides on asphalt. Maximum 50 points.

1.5.3.3. Cones

With 1 driver on the motorcycle. There will be set a track to test maneuverability of a motorcycle. Each cone fallen down 2 seconds added to the total time of the lap. 4 runs (2 runs per driver) runs on asphalt or off-road track. Maximum 100 points.

1.5.3.4. Enduro Track

With 1 driver on the motorcycle, one lap (approximately 1km long) on the off-road track, standing start. The fastest time wins. 4 attempts each team and choose the best result. 4 runs (2 runs per driver). Maximum 150 points.

1.5.3.5. Endurance

With 1 driver on the motorcycle. 20 laps on an off-road track whose total distance will be approximately 20 km. 1 mandatory change of driver at the beginning of lap number 11. The fastest time wins.
Motorcycles must start with all body components installed. Only in case of danger for driver, the motorcycle will be stopped during event and organization will allow to repair it without stopping time.
1 batteries change will be optional and time will be stop during change batteries. Maximum 150 points.

1.5.4. SCORE TABLE FOR THE PROJECT

In dynamic events, points will be assigned as follows:
In each event the best team will be assigned with the highest possible score, the worst with 20 points, rest will be assigned proportionally. The time difference will be used to proportionally distribute the subtraction of points from the winner to the other.
If team does not finish one of the event, team will get 0 point for this event.

Score	25	50	75	100	150	350	500
TOTAL STATIC EVENTS							**x**
Product Design Analysis					**x**		
Body and brakes		**x**					
Lights and ergonomics	**x**						
Smart Components	**x**						
Energy recovery and reuse of components	**x**						
Usability and maintenance	**x**						
Business Plan						**x**	
Detailed product cost				**x**			
Structure for mass production			**x**				
Product Marketing			**x**				
Projected sales plan and profits the first 3 years				**x**			
TOTAL DYNAMIC EVENTS							**x**
Acceleration		**x**					
Acceleration +		**x**					
Cones				**x**			
Enduro Track					**x**		
Endurance					**x**		

Table 4. Score table for the project

1.6. ORGANIZATION

The organization of the event is provided by the Wrocław University of Science and Technology.

Politechnika Wrocławska,
Wybrzeże St. Wyspiańskiego 27
50-370 Wrocław

Coordinator of Wrocław SmartMoto Challenge:
Mikołaj Ostrowski
+48 724 614 815
mikolaj.ostrowski@smcwroclaw.pl

To review the various project areas SMC has defined three commissions for evaluation:

Theoretical project evaluation Commission
Static events evaluation Commission
Dynamic events evaluation Commission

Those committees will evaluate the project based on a score table that will be published together with the regulations. Their decisions will be final.

1.7. AWARDS

1.7.1. For the 1st place in general classification.
1.7.2. For the 1st place in static part classification.
1.7.3. For the 1st place in dynamic part classification.
1.7.4. To the fastest motorcycle (for the best time of all 50m races).
1.7.5. To the best body design.

1.8. INDUSTRIAL PROPERTY

Due to the direct relationship with industry, project has defined the following clauses that refer to industrial property of the projects presented:

- Each university can reach economic agreements along the event with any company involved directly or indirectly as a sponsor at the event.
- If the university has patented the business object, only university can negotiate with any company.

1.9. LANGUAGE

The official language for the event is English. All written documentation submitted by the organization and/or participants will be written or spoken in English. The final decisions of the projects will be in English.

1.10. WEB PAGE

The Wrocław SmartMoto Challenge official website is www.smcwroclaw.pl.

1.11. TEAMS AND EVENTS AREAS

Teams will be hosted in a Wrocław's dorms.

The static events and dynamic events will be carried at Wrocław University of Science and Technology campus and a special race track, following schedule on the website.

Schedule of events in Wrocław will be published in April on the website.

1.12. MANDATORY EQUIPMENT FOR RIDERS

Homologated helmet, gloves, off-road boots, body/arms/legs/knees protection, heavy long pants and glasses will be mandatory. Never short and short sleeve will be allowed.

2. TECHNICAL REGULATIONS

Described below are the rules to apply in the construction of the vehicle which should be under the category L1E or L3E. Maximum nominal voltage is 122,1 V on battery and maximum nominal engine power is 30 kW for main category until 30 kW. While maximum nominal voltage is 59,2 V on battery and maximum nominal engine power is 8 kW for second category.

2.1. ACCEPTABLE PARTS AND MATERIALS USED IN THE PROJECT

All components and materials used to build a motorcycle must be approved in Europe.

2.1.1. FRAME

They may use any material that is used in frames of bikes already on the market. For using a different material, it must demonstrate its technical feasibility on the Design Brief.

2.1.2. SWINGARM

They may use any material that is used in swingarms of bikes already on the market. For using a different material, it must demonstrate its technical feasibility on the Design Brief.

2.1.3. SUSPENSION

They may use any commercial suspension for front and rear position.

2.1.4. WHEELS

Only vehicles with 2 wheels will be accepted. The only restriction is that the minimum size for rims in main category is 16” and for second category is 15”. All tires used must exist in the market. No tyres prototype are allowed.

2.1.5. LIGHTS

The lights must be powered from the same source as the engine and must form a structure following the European Standard. You can use light bulbs, halogen headlamps or with LED technology or any technology that meets the Standard, with a maximum supply voltage of 12 volts.
Must have 4 turn signals in amber color (blinkers) with hazard warning option (4 lights working at time) included.
The lights must remain on during all dynamic events. Penalty in case of finishing some dynamic event with some light off.

2.1.6. BRAKE SYSTEM

Brakes should be powered by cable, hydraulic or electric circuit to one or both wheels simultaneously. They can have an energy recovery system. The components of the braking system, except in the subsystem of energy recovery, must follow the European Standard. Systems ABS and brake assist are allowed.

2.1.7. VEHICLE SMART COMPONENTS

Because the development is related with a motorcycle for adventure and fun, we must be sure that in case of problems we can be safe. Because of that reason this year the motorcycle must be able to send a message with position, kilometers that can run and level of battery when we define a minimum level that we can define previously. This information must be sent as web page, e-mail or sms message to some friend, company etc.

2.1.8. BODY AND SEAT

It can use any type of material approved for building motorcycles in Europe. The body can partially cover the wheels of the vehicle. Designs will not be accepted with sharp edges capable of producing incisions in the body at speeds below 10 km/h. The seat must have a part permanently attached to the frame or body it can swing on. Motorcycle may be optionally ready for two people. The vehicle must have 2 mirrors, one for each road side.

2.1.9. POWER TRAIN

2.1.9.1. Engine

For main category projects nominal engine power must be between 8 and 30 kW.
For second category projects nominal engine power must be smaller than 8 kW.
For both cases it is mandatory to include the technical sheet on the Design Brief.
Engine could be in wheel or not.
Nominal power of the engine will be checked on the basis of the engine technical card. The judges reserve the right to check the nominal engine power on a special dyno during the competition.

2.1.9.2. ECU

For both categories, ECU can be developed for teams or a commercial one.

2.1.9.3. Battery

Cells used must be homologated in Europe. Teams can use any brand, but with the limitation of 122,1 V on battery as nominal value and 140 V on battery as maximum value for the main category. The limitation of 59,2 V on battery as nominal value and 68 V on battery as maximum value for the second category.
Battery Management System (BMS) can be commercial or developed for team members.

2.2. MANDATORY PARTS AND MATERIALS USED IN THE PROJECT

2.2.1. SAFETY SYSTEMS

- The usage of the brakes must disable the throttle, i.e. it is not possible to brake and accelerate simultaneously.
- The motorcycle must start to only move after two conscious actions. For example: key + switch button.
- If using high voltage system some added safety considerations included in Appendix A must be used.
- Bodywork and metal work must be without sharp edges.
- Protected chain or belt transmission is mandatory.
- Mandatory wear the clothes described on 1.12. chapter must be used.

APPENDIX A. SAFETY RULES FOR HIGH VOLTAGE PROJECTS

All those rules in APPENDIX A are mandatory for main category and only recommended for second category.

A1. DEFINITIONS

Definition High Voltage (HV) and Low Voltage (LV)
Any circuit with a difference of potential greater than 60 V DC, will form part of the vehicle's High Voltage (HV) system. Below that voltage, it will be considered as part of the Low Voltage (LV) system. The maximum allowed voltage of the HV system will be 140 V DC (batteries full load).

High Voltage System (HVS)
The High Voltage System (HVS) consists of all electrical parts which form part of the engine, controller, battery or any other part connected to them. The HVS must be electrically insulated from the frame or mass of the vehicle. The accumulator or also battery of the HVS system is defined as any cell, battery or Super-capacitor (or all of them), capable of storing electric energy for the electric propulsion system. The HVS will use a control device between the engine and the accumulator, not allowing direct connection between the engine and the accumulator.
It is mandatory to include clearly visible danger warning labels in the enclosures or areas close to the components that work with Alta Voltage (HV), which include the text "HIGH VOLTAGE" like picture below.
A display shall be installed on the instrument panel indicating in voltage between terminals of the HVS system. The WSMC organization may carry out random measurements to check whether the value shown on the display corresponds to the actual value of the HVS.

Low Voltage LV System connected to ground (Ground Low Voltage System GLVS)
The LV grounded system (GLVS) is formed by any circuit or electrical part of the vehicle and therefore is not part of the HVS. The GLVS will be an LV system, ie a voltage less than 60 V DC.

A2. SYSTEMS DISTRIBUTION

Separation of HVS and GLVS
HVS and GLVS systems must be physically separated. There shall be no contact between the HVS and the vehicle frame or any metal part exposed to the outside.
In the case of self-designed, commercially not available HVS elements that certain components belonging to the HVS and GLVS are installed on the same motherboard, they will be placed in clearly differentiated and marked for this purpose on the plate. The separation between both shall be at least 6.4 mm on the surface, 3.2 mm through the air and 2 mm if under cover (these distances may not be respected in the case of opto-couplers whose rated voltage is equal to or greater than the voltage of the HVS).

Positioning the HVS system
All components of the HVS system must be contained within a reinforced structure that guarantees its integrity in case of accident.
The frame of the motorcycle may be considered as a protective structure of the HVS system, assuming that its design and construction protects to the all system in case of an accident

Isolation between HVS and GLVS
The HVS and the GLVS system must be galvanically isolated. In the case of use of a DC/DC converter, it must comply with that specification. Resistance between HVS and GLVS must be at least 50 kΩ. Organizers reserve right to check this at any time.

Insulated and Wiring
All components of the HVS system must be properly insulated and protected against direct contact.
The protection of the HVS system must be ensured in such a way that impossible to reach the HVS conducting parts with a cylindrical probe of 100 mm in length and 6 mm in diameter.

- HVS connections must be encapsulated by insulated components.
- Cables or conductors belonging to the HVS system must be fireproof grade UL-94 V0, FAR25 or equivalent.

A3. BATTERIES

Permissible accumulation systems
Any type of energy storage system shall be permitted as battery, except for batteries of molten salt (thermal batteries) and batteries made out of fuel. Super-capacitors are allowed.
The supplied voltage of the batteries will be of a maximum of 140 V DC with fully charged accumulator for main category. The connection scheme used must be presented to the WMSC organization (cells in series and in parallel).

Battery container
All battery cells and/or super-capacitors that are part of the accumulator, must be installed inside a battery container. The use of several battery containers is permitted.
Each of them must comply with the requirements required for the case of single battery container.

If the battery container is not readily accessible, the WSMC organization may, at any time, require photographs of the layout and assembly of this. It will be mandatory to provide a detailed description of the battery container before assembling.
It will be also mandatory the delivery of photographs of the different phases of the assembly, showing all the components used.

Electrical configuration for accumulator
If the container is made of electrically conductive material, the terminals of the cells or super-capacitors, must be correctly protected and insulated with an electrically insulating material.
If the container is made of electrically conductive material (metals, carbon fiber, etc.), the body of the cells cannot be directly in contact with the inner wall of the crankcase. It must have used an isolated material between them. Prismatic cells with rigid isolated are excluded from this requirement.

- Each container shall include at least one fuse, which rated current is below the cut-off power of the contactor.
- Each container shall include at least one type line contactor normally open, one installed in the positive terminal of the accumulator.
- The contactor can be a mechanical or a semiconductor one, anyway must be safe.
- The closing of the line contactor, and therefore the presence of High Voltage (HV) at the outlet of the accumulator, must be marked through a red light signal located on the dashboard.
- Welding Battery Management System (BMS) drivers to the terminals it is allowed.

Mechanical configuration of the accumulator
Battery containers shall be constructed from a material mechanically resistant and properly anchored to the frame. The battery container may be part of the frame of the motorcycle, provided which complies with the appropriate stiffness and strength conditions.
Battery containers that are not part of the frame should be protected against lateral impacts by the frame of the motorcycle itself.

- Cells shall be properly protected to any relative displacement (horizontal and vertical) inside the container.
- Only communication holes between the inside and the outside of the container for the passage of the conductor cables correctly isolated and for cooling and ventilation.
- The ventilation openings may not occupy a complete side of the container.
- The ventilation openings must include some type of filter element, to prevent the possible entry of dust, particles and liquids into the container.
- If a container is completely sealed in shall include an exhaust valve to prevent the concentration of gases reach a critical pressure.
- It is allowed the use or adaptation of commercial containers or crankcase, provided that they comply with the characteristics imposed in the present rules.

Battery Management System (BMS)
It is mandatory to install a battery management system (BMS).The BMS should read the voltage of each cell to keep the cells inside of the voltage limits indicated by the manufacturer.

The BMS system should read the temperature of the cells at their most warm through a compatible temperature sensor. It will be mandatory read the temperature of at least 4 cells installed, with at least two at the areas which are expected to be higher temperatures.
In the case of the use of a passive balancing or cells equaling (optional), resistors shall be capable of dissipating the energy corresponding to the rolling, in such a way that during the rolling process never exceed the temperature indicated by the manufacturer of the resistance (or BMS) and does not affect battery cells or near printed circuits.
In order to improve the roll speed, it is allowed the activation of the cooling of the battery container during the swinging or rolling.
The BMS system must deactivate the traction of the vehicle in case of the voltage of one of the cells is discharged to the critical minimum voltage or exceed the maximum critical temperature of the cell, according to the indicated by the manufacturer. This mandatory deactivation must be punctual with the opening of the battery accumulator contactor.
It is allowed to decrease the electrical power delivered to the engine until it is equal to zero at the cell's critical voltage point or the maximum temperature of the cell.
The BMS system must also deactivate the recharging system when exceed the maximum levels of voltage or cell temperature.

A4. ENGINE

Engine controller
It is understood by engine controller, or engine drive, as the device hardware that controls the speed and torque of an electric engine. The controller is part of the HVS and can integrate a part of the GLVS.

- The use of any type of commercial controller is allowed.
- The controller's own development is allowed, or the adaptation of any commercial device.
- The hardware components shall be compatible with the voltage values and work intensity.
- The controller must comply with all requirements that may affect him on those rules.

A5. OPERATIONS

Preload circuit
It is mandatory to install a pre-charge circuit before closing the contactor of the accumulator. The minimum level of pre-load must reach 90% of the actual voltage of the accumulator, and / or 10 V of maximum voltage difference between terminals. When the disconnection circuit is open also must open the preload circuit.

HVS Activation Notice
A red light will be installed, which will stay on when the HVS is activated, ie when the accumulator contactor is closed.

HVS Disconnect Circuit
The disconnect circuit manages the closing and opening of the line contactor.
The disconnection circuit shall consist of at least:

- A General Traction System Switch (Tractive System Master Switch - TSMS).
- An Emergency Switch.
- The disconnection system managed by the BMS.

The disconnection circuit shall comply with one of the following:

- Disconnection circuit with contactor directly controlled by the disconnection circuit.
- Disconnection circuit with contactor directly controlled by the controller.

In the event that the coil of the contactors of the battery accumulator is controlled directly by the engine controller (or by another device), then the disconnection circuit shall ensure the shutdown of the controller (or the corresponding device) and therefore the shutdown of the contactor coil, ensuring its opening.
Once the disconnection circuit (open contactor) is opened by the actuation of any of the devices provided (TSMS, Emergency Switch, BMS or IMD) the system will be in the "not ready to drive" state, and will necessary that the pilot reactivate it manually and voluntarily (e.g. restarting the controller), before the shutdown circuit closes again.

Disconnection from the GLVS system
To ensure independent power on and off of the GLVS system, a Low Voltage System General Switch must be installed (GLVMS).

Deactivating the DC / DC converter
In the case of using a DC / DC converter as an LV power source, complete disconnection of the inverter must be guaranteed in order to avoid self-consumption.

HV Fuses
The circuit on the HV side shall be protected by at least one fuse, the conditions indicated above.
The rated current of the fuse will be below the calculated short circuit, and by the above the maximum service current.
If multiple cell banks are placed in parallel, each of these must be protected with its separate fuse.
The fuse or fuses must be installed inside the container or crankcase of batteries.

Chargers
All types of chargers with a nominal power of less than or equal to nominal 2 kW (maximum 8 nominal amps in configuration one-phase network side).
Serial or parallel configurations of different shippers provided that the total sum of the unit powers of the loaders does not exceed the power indicated above
The loader must have its corresponding ground conductor properly connected to the charger housing.
The use of chargers with parameters above those given above must be approved by the organizer.

Network connection
The mains connection may be single-phase (230 VAC, 50 Hz) or (400 VAC, 50 Hz). The connection of the ground conductor to the socket is mandatory.

Connection to the bike
The connection between the charger and the motorcycle must comply with security minimum conditions.

- The load connector on the motorcycle must have a manual or automatic closing.
- The conductors of the recharging connector present on the motorcycle shall be inaccessible when the connector is closed.
- The load connector on the motorcycle must meet a degree of IP- 65 when closed.
- The load connector shall be located in a protected area of the motorcycle before possible drops, contacts or projections.

Recharge operation
The process of recharging the accumulators must be carried out safely.
During the recharging operation of the motorcycle during all event, mandatory presence of at least one member of the team at all times that knows the detail of the recharge maneuver.
The member of the team responsible for the reloading operation must be prepared to face any type of performance during recharging (manual disconnection, deactivation, etc.) to isolate the vehicle from the network before any eventuality.
A fire extinguisher suitable for extinguishing electric fire (agent CO2 extinguisher or similar) shall be provided during the recharge maneuver.
The BMS system shall have a device for controlling recharge process.

A6. WIRING

General Isolation
All cables and connectors shall be covered with material insulation, except for direct ground connections.
Areas, elements and systems with a high electrical risk should be correctly protected against possible contacts and manipulations. We recommend the installation of rigid insulated casings for greater protection.

Dimensioning
All wires and connectors must be dimensioned correctly based on the requested current levels.

Moisture protection
Ensure that the components of the propulsion system are properly highly protected against moisture. An IP65 degree of protection.

Wiring
The length of the cables should be the correct one, so it is forbidden to length of excess cable.
The passage of the electrical installation should be avoided, as far as possible, for possible hot spots.

APPENDIX B. THE EXEMPLARY ELECTRIC SCHEME

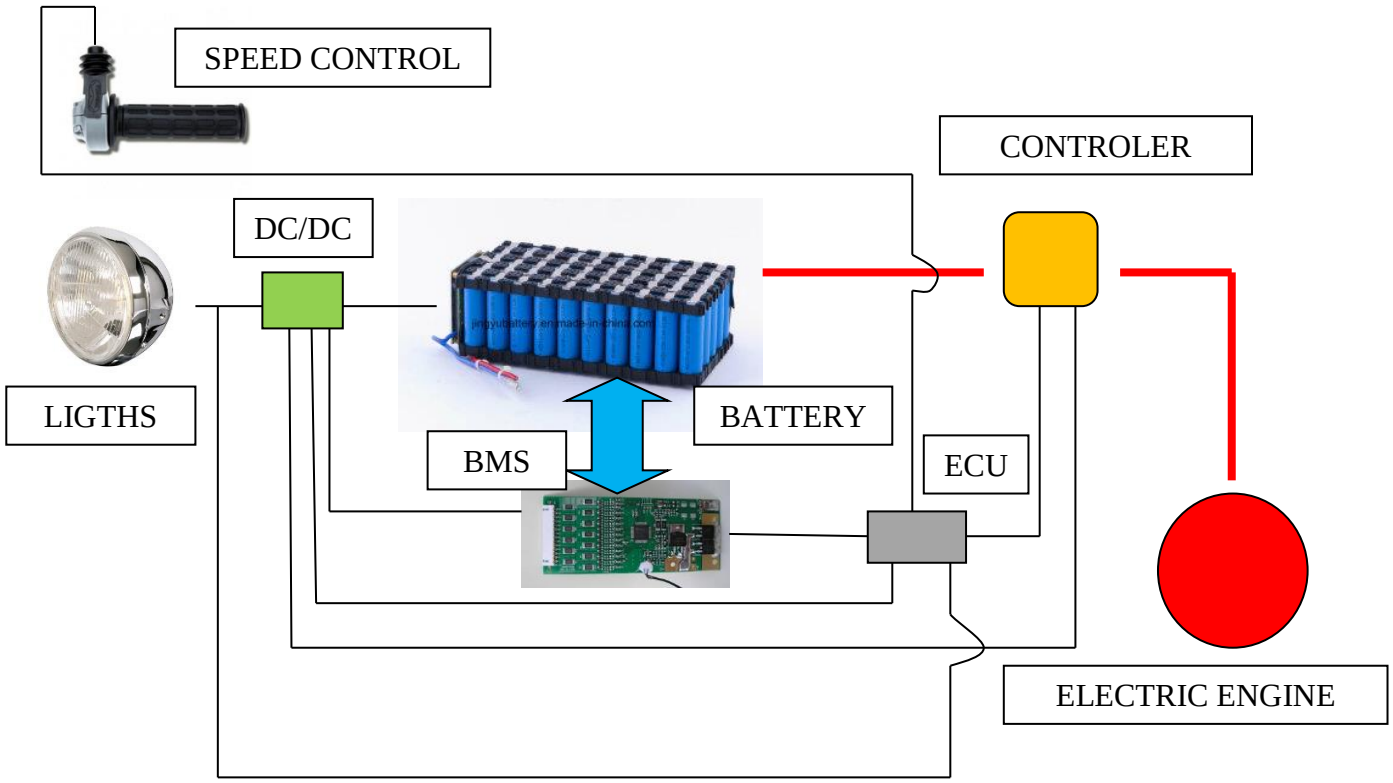

Figure 1. Small scheme for a typical electric light motorbike