Rules and Regulations

European Hyperloop Week 2026

7 December 2025 - Version 6.1

Introduction

Dear Participants,

We are excited to host another edition of the European Hyperloop Week in 2026 and welcome all teams applying for the competition to join us again at the European Hyperloop Center in the Netherlands.

In the past 5 years the four student teams that founded the European Hyperloop Week have done a tremendous job organizing the competition. To further the continuous improvement of the competition and their long-term vision they have brought on-board Lorenzo Benedetti and Marinus van der Meijs who will lead the competition organization in collaboration with the European Hyperloop Center for 2026.

This set of rules and regulations has been carefully created in close collaboration with the previous European Hyperloop Week team and the jury members. This year we are introducing several major changes to the competition that we would like to highlight.

Most notably, changes have been made to the overall competition where teams have to decide whether they would like to compete in the "Design & Demonstrate" division or the "Design-only" division. Within each division teams compete against each other to win awards, among which the most prestigious of them all: the Overall Hyperloop Week Award. With this new set-up, demonstrating teams compete against other demonstrating teams and design-only teams compete against other design-only teams. All information related to this new structure can be found in this rules and regulations document.

This new competition structure allows for a reduction in documentation load for the student teams and jury. In combination with better templates provided throughout the year, this should increase the quality of feedback from the competition staff during the year, giving teams an opportunity to perform optimally.

Little changes have been made to the technical rules and individual categories for which points can be earned. This should allow teams to carry over a lot of knowledge from previous years. However, make sure to read the changelog and the complete document for the things that did change and all details.

Finally, we look forward to what you will bring, present, and demonstrate this year. We wish everyone the best of luck and are ready to answer any questions you might have throughout the year.

Best regards,

The European Hyperloop Week Team

Table of Contents

Changelog

Section	Version	Change
A	6.0	Introduction of section A for administrative rules and regulations, including new competition structure consisting of two divisions and their awards. The showcasing competition is discontinued. The section includes clarifications regarding penalties and protests. The section further outlines submission deadlines and instructions for documents/forms that are required to be submitted throughout the year.
R	6.0	Introduction of section R outlining the rules and regulations for research submissions and their evaluation procedure.
T	6.0	Introduction of section T outlining the rules and regulations for the technical categories and their evaluation procedure.
M.1.8	6.0	Wedge locking washers, if correctly installed have been added as an approved positive-locking method.
M.3.2	6.0	Addition that both switches must trigger simultaneously and further clarification of the emergency brake switches.
M.3.3	6.0	Additional rule that ensures triggering the emergency brake switches results in the Hight Voltage system being deactivated since they are now part of the SDC.
M.3.5	6.0	Clarified what is meant with independent braking system(s).
M.3.6	6.0	Instead of being able to bring the vehicle to a timely standstill with one independent braking system, it is now only required to do this after failure of one independent braking system. This means that prototypes with, for example, 4 independent braking systems can now perform their calculations with 3 braking systems, instead of only 1. It is clarified that this braking performance is also required to be accomplished with the failure of 1 independent braking system and the loss of power/air/fluid supply at the same time. In addition, the theoretical top speed is clarified.
M.3.9	6.0	Rule is updated specifying that the retraction/deactivation of the brake system must be part of the shutdown circuit, but is allowed to be placed in parallel with the HVC actuation, giving a clear way to disengage the brakes without HV activation.
M.3.10	6.0	Rule is slightly simplified. This is now only required for the overall braking system, not each independent brake system.
E.5	6.0	An updated version of the example shutdown circuit is added, it is recommended teams follow this example as much as possible.
E.4.9	6.0	Clarifying that the HVMS is not part of the High Voltage circuit (it should be part of the SDC).
E.5.3	6.0	Addition of emergency brake switches to the list of components in the SDC, this ensures activation of the brakes turns of HV.
E.11.1	6.0	Rotary MSD is now included in the main rule as approved option.
E.11.3	6.0	New rule, dictating an interlock is always required.
C.1.2	6.0	Addition of new state, possible with the new SDC example where HV is off and brakes are retracted/undeployed.
C.1.8	6.0	The rule is extended, where if the brakes are deployed during a demo also the contactors are opened.
C.2.2	6.0	Rule has been generalized.
L	6.0	The rules regarding shipping and logistics have been updated with clear delivery and pick-up windows specified with more clearly defined responsibilities for the teams.

Section	Version	Change
R.1.4 R.1.6	6.1	Limitation of number of authors per research submission to 6.
M.3.1	6.1	For prototypes that operate on a short track at low speeds are not required to have an emergency braking system, the physical stop(s) at the end of the tracks should be sufficient to stop the prototype safely.
M.5.1	6.1	Clarification of coolant, materials not being pumped around to transfer heat can be used. E.g. to store heat (thermal battery).
E.3.4 E.14.41	6.1	Rule is clarified, it must be possible to disconnect at least one measurement. E.g. by disconnecting a wire, a group of wires, or by interrupting the signal using a PCB mounted push button.
E.9.14	6.1	Clarification when soldered connections are allowed.
E.14.7 E.14.8	6.1	Simplification and clarification focused more in the intent of the rule. Teams should be able to remove their battery from the prototype, it should be able to inspect it and when removed from the prototype it must remain rules compliant.
C.1.2	6.1	Correction of maintenance state, only HVCs need to be open, not the complete SDC, as this wouldn't allow the brakes to be undeployed.
I.1.12	6.1	Clarification that parts will be sealed after technical inspection, including the HVBC to prevent modifications without re-inspection.

A Administrative Rules

A.1. Competition Overview

Competition Goals

A.1.1 The competition challenges teams to research, design, build, and demonstrate hyperloop prototypes and technologies to further hyperloop development and educate students.

Competition Information

A.1.2 The competition will be held from 13 July until 19 July 2026 at the European Hyperloop Center in Veendam, Groningen, The Netherlands.

A.1.3 The competition consists of two divisions:

- Design-only Division
- Design & Demonstrate Division

A.1.4 Teams are allowed to compete in only one division.

A.1.5 The competition is divided into several research and technical categories for which points can be earned as described in chapters R and T .

A.1.6 Teams competing in the Design-only Division are not allowed to compete in:

- Levitation and Guidance Demonstration
- Propulsion Demonstration
- Integrated Hyperloop Demonstration

A.1.7 The points that can be earned for each category and division is shown in Table 1.

A.1.8 The team with the most overall points wins the competition.

A.1.9 All prototypes used to compete in the Design & Demonstrate Division must meet the requirements described in chapter M , chapter E , and chapter C .

A.1.10 Teams competing in the Design-only Division are allowed to bring prototypes and/or sub-systems to showcase at the competition as long as they are not powered, do not contain pressurized systems, do not contain permanent magnets, and do not contain a battery.

A.1.11 All prototypes used to compete in the Design & Demonstrate Division must pass technical inspection as described in chapter I .

Table 1: Competition points per category.

	Design-Only	Design & Demonstrate
Research Categories	shared scoring	
Technical Aspects of Hyperloop Systems	100	
Socio-Economic Aspects of Hyperloop Systems	100	
Technical Categories		
Engineering Design	300	300
Levitation and Guidance Demonstration		175
Propulsion Demonstration		175
Integrated Hyperloop Demonstration		150
Total Points	**500**	**1000**

A.2. Eligibility

A.2.1 Registering teams must consist primarily of students.

A.2.2 There are no limitations on technologies used in prototypes as long as they relate to the hyperloop concept and comply with the rules and regulations set out in this document.

A.3. Code of Conduct

Competition Staff Authority

A.3.1 The competition staff reserve the right to interpret or modify the competition rules or schedule at any time and in any manner that is required to ensure a safe and fair competition.

A.3.2 All team members are required to cooperate with, and follow all instructions from the competition staff.

A.3.3 All official announcements, guidelines, and clarifications posted on the website or communicated directly to the teams via e-mail are considered part of the rules and regulations.

A.3.4 Failure of any team member to comply with an instruction or command directed specifically to that team or team member results in 25 penalty points being deducted from the team's overall score. Repeated failure to comply with specific instructions or commands will result in elimination from the competition.

Unsportsmanlike Behavior

A.3.5 Unsportsmanlike behavior by a team or team member results in 25 penalty points being deducted from the team's overall score. Repeated unsportsmanlike behavior will result in elimination of the team from the competition.

Violations of Intent

A.3.6 Violation of the intent of a rule will be considered a violation of the rule itself.

A.3.7 Any parts, devices or software designed with the intent to violate a rule, will be considered as a violation.

Penalties

A.3.8 Rule violations result in at least 10 penalty points being deducted from the team's overall score, unless explicitly defined otherwise.

Protests

A.3.9 A team may protest any rule interpretation, score or staff action which they feel has caused some actual, non-trivial, harm to their team, or has had a substantive effect on their score.

A.3.10 All protests must be submitted by e-mail by the team captain within the announced protest period. In order to have a protest considered, a team must post a 10 point protest bond which will be forfeited if their protest is rejected.

A.3.11 The decision of the staff regarding any protest will be in a written form and is final.

A.4. Liability

A.4.1 Every team takes full responsibility for their equipment, prototypes and team members.

A.4.2 The competition or competition staff is not liable for any damages, theft or incidents that may occur.

A.4.3 Every team must ensure all team members have appropriate valid private liability insurance and individual health insurance for the competition. The team may provide this for their team members.

A.4.4 All team members must sign a liability waiver which must be submitted with the Team Member Registration Form.

A.5. Rules for Teams and Team Members

Team Registration

A.5.1 Teams that wish to participate in the competition must apply for a slot in the competition by filling in the registration form that can be found on the website before the deadline.

A.5.2 The competition staff will review all applications and decide which teams will be accepted to the competition within 4 weeks after the deadline.

A.5.3 During the registration process, teams must indicate one team captain and two deputies which will be the main contact persons for the competition.

A.5.4 During the registration process, teams must decide to compete in either the Design-only Division or Design & Demonstrate Division. Teams have the option to switch between divisions until the deadline for “Division Designation Change”.

Team Members

A.5.5 Each team member must provide proof of valid private liability insurance and individual health insurance. This must be submitted by the team captain in the Team Member Registration Form.

A.5.6 Only registered team members are allowed to access the competition site (except public days), work on, or operate the team’s prototype(s).

A.5.7 Team members must be at least 18 years of age.

A.6. Documentation & Deadlines

Required Documentation and Forms

A.6.1 Several documents and forms are required to be submitted by the teams in order to score points and compete in the competition. An overview of the documents, forms and corresponding deadlines is provided in Table 2.

A.6.2 Teams may be asked via e-mail to provide additional documents or forms in preparation for the competition.

Submission

A.6.3 All document or form submissions must be submitted once by the team captain or one of the deputies. When multiple submissions are made, only the last one before the deadline is considered.

A.6.4 Teams must submit the required documents before the respective deadline via email: submission@hyperloopweek.com.

A.6.5 Required forms must be submitted digitally before the respective deadline. Required forms are shared with team captains and their deputies via e-mail.

Correction Requests

A.6.6 Competition staff and volunteers may request a correction for a document or form.

A.6.7 The corrected document/form must be submitted within 7 days following the request or 7 days following the deadline (in case the request is made before the deadline).

A.6.8 Corrected documents not received in time will be treated as late submissions.

Late Submission and Failure to Submit

A.6.9 Documents or forms submitted later than the respective deadline will result in 5 penalty points per day being deducted from the team's overall score.

A.6.10 Teams that fail to submit the required documents within 7 days after the deadline may be eliminated from the competition or relevant competition category. E.g. failure to submit the "Safety Document(s)" may result in elimination from the demonstration categories.

Overview of Documents, Forms, and Deadlines

Table 2: Document and form submission deadline overview.

Documents and Forms	Submission Deadline	Remarks
Team Registration Form	14-12-2025 – 23:59	
Division Designation Change Form	15-03-2026 – 23:59	
Safety Document(s)	15-03-2026 – 23:59	Not required for Design-only Division.
Technical Aspects of Hyperloop Systems Abstract	01-05-2026 – 23:59	
Socio-Economic Aspects of Hyperloop Systems Abstract	01-05-2026 – 23:59	
Technical Aspects of Hyperloop Systems Submission	14-06-2026 – 23:59	
Socio-Economic Aspects of Hyperloop Systems Submission	14-06-2026 – 23:59	
Engineering Design Document	31-05-2026 – 23:59	
Team Member Registration Form	07-06-2026 – 23:59	
Prototype Video Form	14-06-2026 – 23:59	Not required for Design-only Division.

A.7. Competition Awards

Shared Awards

A.7.1 All teams competing are eligible to win the following awards:

- Technical Research Award (see R.2)
- Socio-Economic Research Award (see R.3)

Design & Demonstrate Division Awards

A.7.2 Teams competing in the Design & Demonstrate Division are eligible to win the following awards:

- Engineering Design Award (see T.1)
- Levitation and Guidance Demonstration Award (see T.3)
- Propulsion Demonstration Award (see T.4)
- Integrated Hyperloop Demonstration Award (see T.5)
- Overall Hyperloop Week Award (1^{st}, 2^{nd}, or 3^{rd} place) based on total points (max. 1000).

Design-only Division Awards

A.7.3 Teams competing in the Design-only Division are eligible to win the following awards:

- Design-only Engineering Award (see T.1)
- Design-only Hyperloop Week Award based on total points (max. 500).

Special Awards

A.7.4 All teams competing are eligible to win an Emerging Engineering Talent Award which is awarded to teams performing exceptional in a specific area but are unable to win main prizes.

A.7.5 The Emerging Engineering Talent Awards are awarded at the discretion of the competition staff and jury members. A maximum of 3 Emerging Engineering Talent Awards are awarded.

A.7.6 All teams competing are eligible to win thematic Sponsor Awards which are awarded by sponsors of the European Hyperloop Week.

A.7.7 Teams may be required to submit additional documents to be eligible to win specific Sponsor Awards.

A.7.8 All teams competing are eligible to win additional special awards such as (for example):

- Community Award
- Outreach Award

These special awards will be announced at the opening of the European Hyperloop Week or on the website before the start of the competition.

A.8. General Rules

Competition Standards

A.8.1 The official competition website is: https://hyperloopweek.com/.

A.8.2 The competition date/time format is: "DD-MM-YYYY hh:mm".

A.8.3 The competition time zone is Central European Time (CET) or Central European Summer Time (CEST) during daylight savings time in Europe.

A.8.4 The official language of the competition is English, all communication must be in English.

General Prototype Rules

A.8.5 Teams are not allowed to remove their prototype or part thereof from the competition site after the competition has begun. Violations of this rule may result in disqualification from the competition.

A.8.6 The competition and competition staff is not responsible for the use of prototypes outside of the competition.

A.8.7 Teams are not allowed to operate, test, or demonstrate their prototype and (sub-)system until the corresponding stages of technical inspection have been passed (see chapter I).

A.8.8 All prototypes and (sub-)systems must be designed and fabricated in accordance with good engineering practices.

Team Presence

A.8.9 The teams are responsible to be in the right place at the correct time.

A.8.10 If a team is not present and ready to compete at the scheduled time they may be disqualified from the corresponding category.

Safety Equipment

A.8.11 Each team must have at least two foam type fire extinguishers with valid inspection tags, or with an inspection date in in the past year in proximity of the prototype at all times. Powder type fire extinguishers are not allowed. Fire extinguishers must have a rating of at least:

- USA, Canada and Brazil: 10BC or 1A 10BC
- Europe: 34B or 5A 34B
- Australia: 20BE or 1A 10BE

A.8.12 Each team that has a prototype that uses High-Voltage must have the following safety equipment:

- Insulated cable shears.
- Insulated screw drivers and any other tools that are required to connect or disconnect parts in the High-Voltage system including within any High-Voltage batteries.
- Multimeter with protected probe tips rated for 600 V CAT III or better.
- Face shield.
- Two pairs of High-Voltage insulating gloves, not expired or purchased in the past year.
- Two HV insulating blankets of at least 1.0 m2 each.
- Safety glasses with side shields for all team members that might work on High-Voltage system or High-Voltage batteries.

All safety equipment must be rated for at least the maximum voltage used by the team.

A.8.13 Each team must have safety shoes for all team members working with heavy components or lifting thereof rated S3 or better.

Work Safety

A.8.14 All team members must wear appropriate personal protective equipment while performing work.

A.8.15 When lifting heavy (>25 kg) components appropriate equipment shall be used by the team members including safety shoes in accordance with A.8.13.

A.8.16 Team members operating or driving vehicles (such as a car or forklift) must possess the correct license or certificate in accordance with local law and follow all local traffic rules.

A.8.17 Team members must not be under the influence of alcohol (0.0‰), cannabis, or any other recreational drug while on the competition site. Any team member in violation will be removed from the competition. Repeated violations result in disqualification of the whole team.

A.8.18 Alcohol, cannabis, or any other recreational drug is not allowed on the competition site.

A.8.19 When operating the prototype the team must ensure a safe area is created around the prototype. Only team members involved in the work are allowed within the safe area.

A.8.20 All activities on the prototype that do not require the activation of the high-voltage system, require the Manual Service Disconnect to be in OFF position (or removed).

Team Work Area

A.8.21 All teams will be given a “Team Work Area” at the competition site (covered).

A.8.22 The Team Work Area may be used by teams to (not limited to):

- Work on their prototype.
- Display information such as posters, mock-ups, sub-systems, or other information for the purpose of supporting their Engineering Design or Research Submissions.

A.8.23 All work that can reasonably be executed at the Team Work Area must be executed at the Team Work Area.

A.8.24 Teams bringing a custom track will be given a “Custom Track Area” (not covered).

A.8.25 The Team Work Area and Custom Track Area must be kept clean and tidy at all times.

A.8.26 The Team Work Area and Custom Track Area are not allowed to be visually shielded from spectators and/or competition staff/volunteers unless required to protect against weather.

Rule Questions

A.8.27 In case teams have questions regarding the rules they can submit a rule question to the competition organization. Teams can submit rule questions for the following reasons:

- Asking clarification regarding a specific requirement.
- Asking confirmation that a certain implementation of the requirement is approved and within the rules and regulations.
- Asking for help implementing the requirements for their specific situation.
- Any other questions related to the rules and regulations.

The competition organization and technical team will do their best to respond to rule questions in a timely manner.

A.8.28 Rule questions must be submitted with as much information and all relevant context such that a good response can be formulated by the organization.

A.8.29 Rule questions must be submitted via e-mail to: question@hyperloopweek.com and include “Rule Question” in the subject line.

R Research Categories

R.1. General Research Submission Rules

Category Objective and Criteria

R.1.1 The objective of the research submissions is to challenge teams to research aspects of hyperloop beyond the demonstrations at the competition. This includes socio-economic aspects and technical aspects of real-world hyperloop implementation.

R.1.2 The teams participating in the research category will be judged based on the following criteria (not limited to):

- Relevance of the research topic for hyperloop development.
- The overall quality and novelty of the research performed.
- Alignment and completeness of literature review with hyperloop ecosystem and overall existing research for the specific topic.
- The methodology used to perform the research.
- The usefulness of the conclusions and results of the research.
- Responses to questions during the Q&A session and the team members' knowledge about the research topic.
- The quality of the supporting materials such as posters, scale-models, and mock-ups shown at the competition.

Submission Requirements

R.1.3 Prior to submitting a full research report, teams must submit a research abstract that requires approval from the judging team. The approval will be based on quality and novelty of the abstract and topic.

R.1.4 The research abstract must contain the following information:

- Title of the research topic and research category
- Team name
- Authors of the research up to 6 (1-2 corresponding authors with email address)
- Abstract of the research (max 300 words)
- Main literature sources

R.1.5 The research abstract must be a single file in PDF format and must be a single (1) page. It can be continuously handed in until the deadline.
If the research abstract is handed in before 22 December 2025, the team will be eligible for a feedback session which will take place in January, February, or March.

R.1.6 The research report must at least contain the following information:

- Title page with: title of the research; authors up to 6 (1-2 corresponding authors with email address); team name; university name; research category; and date
- Abstract
- Introduction
- Literature Review
- Methodology
- Results and Findings
- Discussion
- Conclusion
- References
- Appendixes if any

R.1.7 The research report must be a single file in PDF format and must contain 25 pages or less (including appendices, title page, references and etc...).

R.1.8 The research submitted must be the teams' own work. Previous literature may be used, as long as the applicant adheres to scientific standards. Plagiarism or excessive use of LLM models such as ChatGPT will result in disqualification of the research submission.

R.1.9 Failure to submit a research abstract or research report for a research category will result in elimination from that category in accordance with A.6.10.

R.1.10 Prior to the competition the Research Jury will review and approve the research reports to be eligible for the competition.

R.1.11 Havard style references are recommended [Surname et al.; 2025].

Research Category Procedure

R.1.12 The research category will be judged by a group of volunteers (Research Jury) based on the research report and the discussion in Q&A format during the competition.

R.1.13 During the competition all teams that submitted an approved research report will be assigned a timeslot per research category to present their research at their Work Area in a Q&A format to the Research Jury. A detailed schedule will be announced shortly before the competition.

R.1.14 At least one author of the research submission must be present during the Q&A session.

R.1.15 Teams must bring at least a poster but are allowed to bring additional materials such as scale-models, mock-ups, and supporting documents to explain, strengthen, and visualize their research and results.

R.1.16 During the research judging (Q&A format) the Research Jury will ask questions to the team members regarding the research they've performed.

R.1.17 After completion of the Q&A sessions, the Research Jury will determine the finalists per research category that will get the opportunity to present their research in a public presentation which the Research Jury will include in the final scoring for the award and will use to determine the winner.

A detailed schedule and the number of available presentation slots will be announced during the competition.

Research Publication

R.1.18 After the competition the European Hyperloop Week may publish the submitted research reports.

R.2. Technical Aspects of Hyperloop Systems

R.2.1 All rules and regulations listed in R.1 apply to the submission of the Technical Aspects of Hyperloop Systems category.

Category Objectives

R.2.2 This category aims to explore technical aspects of the hyperloop system, including both the vehicles and the infrastructure. The development of hyperloop technology is very much still underway, with many technical questions remaining unanswered. This category is an opportunity for teams to attempt to answer some of those questions by performing research.

Research Topics

R.2.3 Teams are free to choose their research topic. Examples of suitable topics include:

- Safety systems
- Life support systems
- Vacuum management
- Thermal management
- Infrastructure construction
- Energy management (infra and vehicle)
- Aerodynamic performance
- Design or optimization of sub-systems for full-scale implementation

R.3. Socio-Economic Aspects of Hyperloop Systems

R.3.1 All rules and regulations listed in R.1 apply to the submission of the Socio-Economic Aspects of Hyperloop Systems category.

Category Objectives

R.3.2 This category aims to explore the aspects of hyperloop development that have to do with the interaction between hyperloop technology and society. With the technology advancing rapidly, questions arise regarding the non-technical aspects of the implementation, both of social and economic nature. This category is an opportunity for teams to attempt to answer some of those questions by performing research.

Research Topics

R.3.3 Teams are free to choose their research topic. Examples of suitable topics include:

- Sustainability and environmental aspects
- Accessibility
- Impact on society
- Travel comfort and experience
- Business model, costs and economic aspects
- Security
- Concepts of operation
- Hyperloop route design

T Technical Categories

T.1. Engineering Design

Category Objective and Criteria

T.1.1 The objective of the Engineering Design category is to evaluate the team's engineering process, knowledge, and effort that went into the design of a hyperloop prototype for demonstration at the competition.

T.1.2 The teams participating in the Engineering Design category will be judged based on (not limited to):

- The quality of the engineering efforts
- Knowledge and understanding of the team regarding the design (process)
- Responses to questions during the Q&A session
- Design trade-offs and decision making
- If the design concepts are adequate and appropriate for the application

Submission Requirements

T.1.3 Teams participating in the Engineering Design category must submit an Engineering Design Document.

T.1.4 The Engineering Design Document must (at least) include the following information:

- Title page with: team name; university name; and date.
- Overview of the team's design objectives.
- Brief description of the overall prototype including image showing the prototype.
- Any information to explain or highlight design features, concepts, methods, and objectives.
- Any information to express the value and performance of the prototype.

T.1.5 The Engineering Design Document must be a single file in PDF format and must contain 10 pages or less (including appendices, title page, and etc...).

T.1.6 Failure to submit an Engineering Design Document will result in elimination from the Engineering Design category in accordance with A.6.10.

Engineering Design Procedure

T.1.7 The Engineering Design category will be judged by a group of volunteers (Technical Jury) based on the Engineering Design Document (approx. 10% of scoring) and the discussion in Q&A format during the competition (approx. 90% of scoring).

T.1.8 During the competition all teams that submitted an Engineering Design Document will be assigned a 30 minute timeslot to present their engineering design at their Work Area or Custom Track Area in a Q&A format to the Technical Jury.

T.1.9 Teams are allowed to bring additional materials such as spare parts, their prototype, posters, scale-models, mock-ups, and supporting documents to explain, strengthen, and visualize their engineering design.

T.1.10 During the Engineering Design judging (Q&A format) the Technical Jury will ask questions to the team members regarding the engineering design they've performed.

T.1.11 After completion of the Q&A sessions, the Technical Jury will determine the top 2-3 teams (finalists) that will get the opportunity to present their prototype design in a 20 minute public presentation which the Technical Jury will use to determine the winner and final scoring for the Engineering Design Award.

T.2. General Demonstration Requirements

Eligibility to Demonstrate

T.2.1 Only teams that have passed all technical inspections are allowed to demonstrate at the competition.

T.2.2 Prior to the competition, teams that wish to demonstrate at the competition are required to submit a Prototype Video, showing the technical state of their prototype.

T.2.3 Teams are allowed to demonstrate their prototype at their Work Area, Custom Track Area or in an infrastructure provided by the competition.

T.2.4 Teams demonstrating their prototype in an infrastructure provided by the competition might need to comply with additional requirements that will be shared in separate documentation and may require additional checks during technical inspection.

Demonstration Procedure

T.2.5 Teams that have completed all technical inspections will be given a timeslot in which they can perform demonstrations at the competition where the Technical Jury will observe, ask questions, and score the teams on the performance of the prototype.

T.2.6 During the demonstration timeslot all demonstration categories will be judged simultaneously.

T.2.7 If the Technical Jury suspects that the prototype is no longer rules compliant or any of the data / results are changed or tampered with, they may request additional inspections in line with I.1.13.

T.3. Levitation and Guidance Demonstration

Demonstration Objective and Criteria

T.3.1 The objective of the Levitation and Guidance Demonstration category is to demonstrate the functionality and performance of the levitation and guidance system(s) of the prototype.

T.3.2 The teams will be judged by the Technical Jury based on (but not limited to):

- Functionality of the system.
- Perceived reliability.
- Stability of the system (incl. resistance to disturbances) and ability of the team to support this with data.
- Safety features.
- Performance of the systems (e.g. energy consumption).
- Quality of the data

T.4. Propulsion Demonstration

Demonstration Objective and Criteria

T.4.1 The objective of the Propulsion Demonstration category is to demonstrate the functionality and performance of the propulsion and braking system(s) of the prototype.

T.4.2 The teams will be judged by the Technical Jury based on (but not limited to):

- Functionality of the system.
- Perceived reliability.
- Stability of the system and ability of the team to support this with data.
- Safety features.
- Performance of the systems (e.g. energy consumption, acceleration, and speed).
- Quality of the data

T.5. Integrated Hyperloop Demonstration

Demonstration Objective and Criteria

T.5.1 The objective of the Integrated Hyperloop Demonstration category is to evaluate the functionality and performance of the overall prototype and integrated operation of levitation, guidance, and propulsion as well as demonstrating the functionality of supporting sub-systems such as safety systems, suspension, vacuum compatibility, energy storage/transfer, thermal management, software, and etc…

T.5.2 The teams will be judged by the Technical Jury based on (but not limited to):

- Functionality of the overall integrated prototype.
- Perceived reliability.
- Stability of the system and ability of the team to support this with data.
- Performance of the systems (e.g. energy consumption).
- Interaction between sub-systems.
- Quality of the data

M Mechanical System Requirements

M.1. General Mechanical Requirements

M.1.1 All mechanical system requirements apply to the vehicles, custom tracks, and other prototypes of the teams.

M.1.2 Critical (sub-)systems are defined as guiding systems (lateral & vertical), propulsion systems, (emergency) braking systems, all batteries / energy storage systems, load carrying structures, suspension systems, and high-voltage systems.

M.1.3 All structural parts between or utilized in the critical (sub-)systems must be designed with a safety factor higher than 2 under the worst-case load case.

M.1.4 Critical fasteners are defined as bolts, nuts, and other fasteners utilized in the critical (sub-)systems or utilized to connect critical (sub-)systems together.

M.1.5 All threaded critical fasteners must be at least 4 mm metric grade 8.8 (OEM parts 3 mm metric grade 8.8).

M.1.6 All threaded critical fasteners must be of the type hexagon bolts (ISO 4017, ISO 4014 or an equivalent standard.) or socket head cap screws (ISO 4762, DIN 7984, ISO 7379 or an equivalent standard) including their fine-pitch thread versions.

M.1.7 All critical fasteners must be secured from unintentional loosening using positive locking mechanisms.

M.1.8 The following methods are accepted as positive locking mechanisms:

- Correctly installed safety wiring.
- Cotter pins.
- Nylon lock nuts (ISO 7040, ISO 10512, EN 1663 or an equivalent standard) for locations where no temperature rating above 80 ◦C is required.
- Prevailing torque lock nuts (DIN 980, ISO 7042 or an equivalent standard, and jet nuts or K-nuts).
- Locking plates or tab washers, if correctly installed.
- Wedge-locking washers, if correctly installed.

Any locking mechanism based on pre-tensioning, or an adhesive is not considered a positive locking mechanism.

M.1.9 A minimum of two full threads must project from any lock nut.

M.1.10 Snap or retaining rings according to DIN 471, DIN 472, or equivalent standard are allowed in OEM applications or for securing bearings or shafts and similar components given that they do not bear any loads under normal operating conditions. The groove must be in pristine condition and manufactured according to the standard of the snap or retaining ring.

M.1.11 Any rotational system (e.g. wheels, magnetic disks) shall be properly balanced.

M.1.12 Fire-Retardant material is defined as a material meeting one of the following standards:

- UL94 V-0 for the minimum used material thickness.
- FAR 25.853(a)(1)(i).
- For foams only: UL94 HF-1 and UL94 VTM-0.

Equivalent standards are only accepted, if the team shows equivalence and this is approved before the event.

M.2. Magnetic Systems

M.2.1 Teams shall implement adequate handling and storage procedures for permanent magnets.

M.2.2 Any mounted or stored permanent magnets shall be covered by a high-quality cover or storage container that ensures that:

- The magnetic flux density does not exceed 1 mT anywhere on the surface of the cover or storage container.
- The magnetic flux density does not exceed 0.5 mT at a distance of 1 meter or more from the cover or storage container.

M.2.3 Warning signs in accordance with ISO 7010-W006 are placed on (sub-)systems that utilize permanent magnets to indicate a magnetic field is present.

M.3. Braking Systems

M.3.1 If the prototype of the team has a propulsion system, the prototype is required to have an emergency braking system. If the track used by the team is shorter than 10 meter and the theoretical maximum velocity of the prototype is less than 1 m/s, no emergency braking system is required.

M.3.2 To ensure the emergency braking system is actuated at a safe distance from the end of the track, two (physical) switches should be implemented on the prototype (the “emergency brake switches”) that each under all operating conditions simultaneously trigger when the prototype reaches a specified location of the track (see M.3.6 for determination of this location).

For example an arm limit switch on the right side of the vehicle and one on the left, both normally closed, see Figure 1 for example circuitry.

M.3.3 The emergency brake switches must be wired in series with the shutdown circuit (SDC).

M.3.4 The emergency brake switches must be actuated without programmable logic.

M.3.5 The emergency braking system must consist of at least two independent braking systems. They can be fed from the same power or air/fluid source but should otherwise be independent. For example, one braking system on the left of the prototype, and one on the right. The braking systems are considered independent if failure of any component on one system does not affect the ability of the other braking system.

M.3.6 The emergency braking system, after losing one (1) independent braking system and its power/air/fluid supply, must be able to bring the prototype to a full stop from its theoretical top speed before the end of the track after triggering the emergency brake switch (see M.3.2) with a 10% safety margin. The theoretical top speed is defined as the speed the prototype can reach if it would keep accelerating until triggering the emergency brake switches.

M.3.7 The emergency braking system must be fully deployed without any voltage/power or air/fluid pressure present on the prototype and without the use of software.

M.3.8 The emergency braking system, when deactivated / retracted must automatically fully deploy in case of power loss or loss of air/fluid pressure without the use of software.

M.3.9 The emergency braking system retraction/deactivation relays and logic are only allowed to be placed in parallel with the pre-charge circuitry, HVCs, HVMS, and HVC logic but should otherwise be in series with the rest of the SDC. See Figure 1 for example circuitry.

M.3.10 The braking force applied by the braking system must be designed such that the net braking force is zero in all directions except opposite the direction of travel.

M.4. Compressed Gas Systems and High-Pressure Fluids

M.4.1 All compressed gas systems must not exceed 50 bar. Gas cylinders/tanks may exceed 50 bar if a pressure regulator is directly mounted onto them, limiting the output pressure to 50 bar or less.

M.4.2 All parts of a compressed gas or fluid system must be rated for the maximum operating pressure. Components designed or manufactured by the teams themselves require a minimum safety factor of 2.

M.4.3 Gas cylinders/tanks and their pressure regulators must be of appropriate manufacture, certified and labeled as such.

M.4.4 Any part of a compressed gas or fluid system must be properly shielded from heat sources.

M.5. Cooling Systems

M.5.1 Cooling systems must only use plain water or air as the coolant. Coolant is defined as the fluid/gas that is being pumped around and transfers heat between locations.

M.5.2 Any cooling or lubrication system must be sealed from leakage.

M.5.3 Any cooling or lubrication system using a vent must have properly sized catch-cans to collect excess cooling fluid or lubrication material.

M.6. Custom Tracks

M.6.1 The requirements in this section (custom tracks) do not apply to teams that demonstrate in the infrastructure provided by the competition.

M.6.2 The maximum length of a custom track is 50 meters.

M.6.3 The custom track must be fitted with a physical stop at the end of the track that is able to prevent the vehicle/prototype from exiting the custom track if it impacts the stop at maximum speed.

M.6.4 The track shall be able to withstand strong weather conditions (wind, rain, etc.).

M.6.5 The custom track is not allowed to move during a run, due to forces exerted on it. This should be possible without anchoring it.

M.6.6 The custom track must be able to be operational between 0 – 40 degrees Celsius.

M.6.7 A safety perimeter must be defined around the track and shielded with fences.

M.6.8 If a tent is placed over the track, a path must be always kept clear to ensure that all people are able to get out of the tent safely in case of an emergency. Exiting the tent must be possible from at least two sides.

M.6.9 Any custom track that can create a low-pressure environment must include a method to quickly repressurize the custom track.

E Electrical System Requirements

E.1. General Electrical System Requirements

E.1.1 All electrical system requirements apply to the vehicles, custom tracks, and other prototypes of the teams.

E.1.2 The Low Voltage System (LVS) is defined as every electrical part that is not part of the High-Voltage System.

E.1.3 The maximum allowed voltage that may occur between any two electrical connections in the Low Voltage System is 60 VDC or 50 V AC RMS.

E.1.4 High Voltage is defined as any voltage above the maximum allowed voltage in the Low Voltage Systems.

E.1.5 The maximum allowed peak voltage is 600 VDC. Batteries capable of reaching higher voltages than 600 VDC are allowed if they are limited to 600 VDC using the BMS.

E.1.6 The High Voltage System is defined as every part that is electrically connected to any motor, electromagnet, or battery unless the maximum voltage used by these systems is below the maximum allowed voltage for Low Voltage Systems.

E.1.7 High Voltage System Enclosures are defined as any housing or enclosure that contains part of the High Voltage System.

E.1.8 All High Voltage System Enclosures must be labeled with reasonably sized stickers according to ISO-7010-W012 and contain the text “High Voltage”.

E.1.9 Only electric motors are allowed.

E.1.10 Any electric motor (if used for propulsion) must be connected to the battery through a motor controller.

E.1.11 Any electromagnet must be connected to the battery through a converter.

E.1.12 Any battery made of pouch type cells is not allowed to be operated in a low-pressure environment. Any enclosure used to provide a pressurized environment for a pouch type cell battery must have its pressure monitored.

E.2. Low Voltage System

E.2.1 All Low Voltage System parts must be adequately insulated.

E.2.2 All Low Voltage System wiring must not use orange wiring or conduit.

E.2.3 The Low Voltage System must be grounded to the main structure of the vehicle, or main structure of the infrastructure.

E.3. Low Voltage Batteries

E.3.1 Low voltage batteries are all batteries that are connected to a Low Voltage System.

E.3.2 Any low voltage battery must be securely attached to the prototype and have a rigid and sturdy casing.

E.3.3 Any low voltage battery must have adequately sized overcurrent protection (fuse), not more than 100 mm from ungrounded terminals.

E.3.4 Battery packs based on lithium chemistry other than lithium iron phosphate (LiFePO4):

- Must have a Fire-Retardant casing, see M.1.12.
- Must include overcurrent protection that trips at or below the maximum specified discharge current of the cells.
- Must include overtemperature protection of at least 25% of the cells, meeting (E.14.36), that trips when any cell leaves the allowed temperature range according to the manufacturer's datasheet, but not more than 60 ∘C, for more than 1 s and disconnects the battery.
- Must include voltage protection of all cells that trips when any cell leaves the allowed voltage range according to the manufacturer's datasheet for more than 500 ms and disconnects the battery.
- It must be possible to display all cell voltages and measured temperatures, e.g. by connecting a laptop.
- It must be possible to disconnect at least one temperature sensor, and one cell voltage measurement during technical inspection.

To clarify: LiFePO4 batteries do not require a BMS.

E.4. Measuring Points and Master Switches

E.4.1 Each prototype utilizing High Voltage must have two High-Voltage Measuring Points (HVMPs).

E.4.2 The HVMPs should be directly connected to the intermediate circuit capacitors even if the Manual Service Disconnect (MSD) has been disconnected or the High-Voltage battery is disconnected.

E.4.3 One HVMP should be connected to the High-Voltage positive side and marked "HV+" and one HVMP should be connected to the High-Voltage negative side and marked "HV-".

E.4.4 All HVMPs must use 4mm shrouded banana jacks rated for 600 V CAT III or better.

E.4.5 Each HVMP must be secured with a current limiting resistor. Fusing the HVMPs is prohibited. The resistor's power rating must be chosen such that they can continuously carry the current if both HVMPs are short-circuited. The current limiting resistor must be chosen as follows:

- Max Voltage <200 V DC: 5 kΩ;
- 200 V DC < Max Voltage < 400 V DC: 10 kΩ;
- Max Voltage > 400 V DC: 15 kΩ.

E.4.6 Next to the HVMPs a Low Voltage System Ground measuring point must be installed. A 4mm black shrouded banana jack must be connected to the Low-Voltage System Ground and must be marked "GND".

E.4.7 Each Low-Voltage System must have their own Low-Voltage System Master Switch (LVMS) that must completely disable power to the Low-Voltage System.

E.4.8 Each LVMS must be marked "LV" and have its ON and OFF positions marked appropriately.

E.4.9 Each prototype utilizing a High-Voltage must have a High-Voltage Master Switch (HVMS) that is part of the Shutdown Circuit (SDC). The switch itself is not be part of the High-Voltage circuit.

E.4.10 Each HVMS must be marked with "HV" and a symbol according to ISO-7020-W012 and have its ON and OFF positions marked appropriately.

E.4.11 All master switches must be a mechanical switch of the rotary type and must be direct acting, i.e. they must not act through a relay or logic.

E.4.12 All master switches and measuring points should be located close to each other in a convenient position on the prototypes.

E.5. Shutdown Circuit

E.5.1 Any prototype utilizing a High Voltage Energy Storage system must incorporate a Shutdown Circuit (SDC) that directly carries the power driving the High Voltage Contactors (HVCs) and pre-charge circuitry (e.g. relays). If the guiding (lateral / vertical) and/or propulsion system is not fed by the High Voltage System, they must also be shut off by the SDC powering their respective relays.

E.5.2 Any prototype utilizing only a Low Voltage System must incorporate a Shutdown Circuit (SDC) that powers relays for any guiding (lateral / vertical) and/or propulsion system.

E.5.3 The following switches and components are required to be placed in series in the SDC and placed on the high-side connection of the HVC and pre-charge circuitry:

- Low Voltage Master Switch (LVMS)
- High Voltage Master Switch (HVMS), for High-Voltage prototypes
- 4x Shutdown Buttons
- 2x Emergency Brake Switches, for prototypes with propulsion system
- IMD, for High-Voltage prototypes
- High Voltage BMS, for High-Voltage prototypes

E.5.4 Every system that is required to or can open the SDC must have its own, non-programmable, power stage to achieve this. The respective power stages must be designed to be able to carry the SDC current, e.g. HVC inrush currents, and such that a failure cannot result in electric power being fed back into the electric SDC.

E.5.5 The shutdown buttons, emergency brake switches, master switches, and interlocks must not act through any power stage.

E.5.6 The High Voltage Master Switch (HVMS) must be the last switch before HVCs except for the pre-charge circuitry.

E.5.7 For High Voltage Systems, if the SDC is opened the High Voltage System must be shut off by opening all HVCs and all pre-charge relays and the voltage in the High Voltage System must drop to below 60 V DC and 50 V AC RMS in less than 10 seconds. All High Voltage Battery current flow must stop immediately. The action of opening the HVCs may be delayed by <250 ms to signal the action to motor controllers / converters to reduce the current before the HVCs are opened.

E.5.8 If the SDC is opened by the HV BMS or IMD, it must be latched open by non-programmable logic that can only be manually reset with a button or by turning the prototype completely off.

E.5.9 Closing the SDC by any part defined in E.5.3 must not (re-)activate the High Voltage System. Additional action must be required such as monitoring by software such that unpressing any shutdown button or switching the HVMS does not immediately (re-)engage the High Voltage System again.

Figure 1 shows an example schematic of the required SDC.

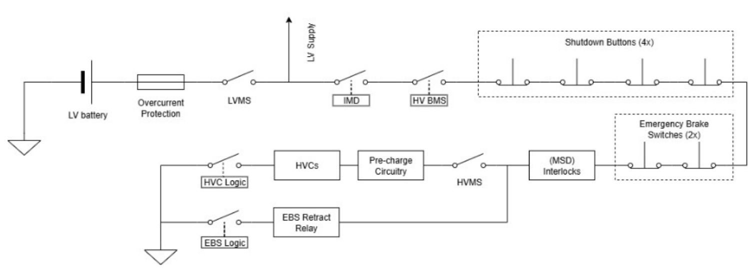

Figure 1: Example Shutdown Circuit.

E.6. Shutdown Buttons

E.6.1 For vehicles a system of four (4) shutdown buttons must be installed featuring a shutdown button on the front, left, right, and rear of the vehicle. At least one shutdown button must be easily accessible while the vehicle is on the track.

E.6.2 For custom tracks featuring a Low Voltage or High Voltage system, a system of at least one (1) shutdown button must be installed on the custom track (e.g. booster sub-system) such that it is easily reachable.

E.6.3 All shutdown buttons must have a minimum diameter of 40 mm, must be red, and must be of normally closed type.

E.7. Grounding

E.7.1 High Voltage System Enclosures, see E.1.7, must consist of either

- a grounded solid layer made of at least 0.5 mm thick electrically conductive material, aluminum or better, or
- be fully made out of electrically insulating materials having an isolation resistance of at least 2 MΩ, measured with a voltage of 500 V. The High Voltage System Enclosure must be rigid and must prevent possible mechanical penetrations. Protruding electrically conductive parts, such as fasteners or connectors, must be grounded.

E.7.2 An electrically conductive part is grounded if its resistance to Low Voltage System ground is below 100 mΩ, measured with a current of 1 A.

E.7.3 Parts of the prototype which are or may become electrically conductive within 100 mm of any High Voltage component must have a resistance below 100 Ω to Low Voltage ground.

E.8. Overcurrent Protection

E.8.1 All electric systems must have appropriate overcurrent protection.

E.8.2 The continuous current rating of the overcurrent protection must not be greater than the continuous current rating of any electric component, for example, wire, busbar, or other conductors that it protects. I.e. if multiple pins of a connector are used to carry currents in parallel, each pin must be appropriately protected.

E.8.3 All used fuses must have an interrupt current rating that is higher than the theoretical short circuit current of the system that it protects.

E.8.4 All overcurrent protection devices must be rated for the highest voltage in the systems they protect. All devices used must be rated for DC.

E.8.5 All overcurrent protection devices that are part of the High Voltage System must not rely on programmable logic. The overcurrent protection function of motor controllers / converters for the motor outputs may rely on programmable logic.

E.8.6 The overcurrent protection must be designed for the expected surrounding temperature range but at least for 0 ∘C to 85 ∘C.

E.9. High Voltage System Insulation, Wiring, and Conduit

E.9.1 All live parts of the High Voltage System must be protected from being touched. This must include team members working on or inside the prototype. This is tested with a 100 mm long, 6 mm diameter insulated test probe when the High Voltage System Enclosures are in place.

E.9.2 Insulation material that is rated for the maximum voltage must be used. Using only insulating tape or rubber-like paint for insulation is prohibited.

E.9.3 The temperature rating for High Voltage wiring, connections, and insulation must be appropriate for the expected surrounding temperatures but at least 85 ∘C.

E.9.4 It must be possible to clearly assign and prove the wire gauge, temperature rating, and insulation voltage to each used High Voltage wire.

E.9.5 All High Voltage wiring must be completed to professional standards with appropriately sized conductors and terminals and with adequate strain relief and protection from loosening due to vibration.

E.9.6 High Voltage wiring must be located out of the way of possible snagging or damage.

E.9.7 All High Voltage wiring that runs outside of High Voltage Enclosures must:

- Be enclosed in separate orange non-conductive conduit or use an orange shielded cable. The wiring (with conduit) must be securely anchored to the prototype, but not to the wire, at least at each end.
- Be securely anchored at least at each end so that it can withstand a force of 200 N without straining the cable end crimp or damaging the enclosure.

E.9.8 Any shielded High Voltage cable must have the shield grounded.

E.9.9 Every High Voltage connector outside High Voltage Enclosures that do not require a tool to open (e.g. the MSD) must include a pilot contact/interlock line which is part of the SDC. High Voltage Enclosures only used to avoid interlocks are prohibited.

E.9.10 All High Voltage connections must be designed so that they use intentional current paths through conductors such as copper or aluminum and must not rely on steel bolts to be the primary conductor.

E.9.11 All High Voltage connections must not include compressible material such as plastic in the stack-up or as a fastener.

E.9.12 All electric connections, including bolts, nuts, and other fasteners, in the high current path, of the High Voltage System must be secured from unintentional loosening. Fasteners must use positive locking mechanisms, see M.1.8, that are suitable for high temperatures. Off-the-shelf components, e.g. converters, will be allowed without a positive locking feature if connections are completed as recommended by the manufacturers' datasheet and no positive locking is possible.

E.9.13 Teams must be prepared to demonstrate positive locking. For inaccessible connections, appropriate photographs must be available.

E.9.14 Soldered connections in the High Voltage high current path, are only allowed if the components are additionally mechanically secured against loosening and if:

- The soldered connections are on PCBs
- The soldered connections are within motors or magnetic systems
- The connected devices are not cells or wires

E.10. High Voltage System and Low Voltage System Separation

E.10.1 Two electric circuits are defined as galvanically isolated if all of the following conditions are true:

- The resistance between both circuits is ≥500 Ω/V, related to the maximum voltage of the prototype, at a test voltage of maximum voltage or 250 V, whichever is higher.
- The isolation test voltage RMS, AC for 1 min, between both circuits is higher than three times the maximum voltage or 750 V, whichever is higher.
- The working voltage of the isolation barrier, if specified in the datasheet, is higher than the maximum voltage.

Capacitors that bridge galvanic isolation must be class-Y capacitors.

E.10.2 The entire High Voltage System and Low Voltage System must be galvanically isolated.

E.10.3 All connections from a High Voltage System component to external devices, such as laptops must include galvanic isolation.

E.10.4 The High Voltage System and Low Voltage System circuits must be physically segregated such that they are not running through the same conduit or connector, except for interlock circuit connections.

E.10.5 Where both the High Voltage System and the Low Voltage System are present within a High Voltage System Enclosure, they must be separated by barriers made of insulating materials or maintain 20 mm spacing through air, or over a surface.

E.10.6 Components and cables capable of movement must be positively restrained to maintain spacing.

E.10.7 If the High Voltage System and the Low Voltage System are on the same PCB, they must be on separate well-defined areas of the board, meeting the spacing requirements in Figure 2 below, each area clearly marked with “HV” or “LV”. The outline of the area required for spacing must be marked. Groves and cut-outs must have a minimum width of 1.5 mm to influence the creepage path. “Conformal coating” refers to a coating insulator on a PCB. Solder resist is not a coating. Both creepage and clearance requirements must be met.

Voltage	Clearance Distance	Creepage Distance	
		General	conformal coating
0 V DC to 50 V DC	1.0 mm	4 mm	1.0 mm
50 V DC to 150 V DC	1.0 mm	5 mm	1.0 mm
150 V DC to 300 V DC	1.5 mm	10 mm	2.0 mm
300 V DC to 600 V DC	3.0 mm	20 mm	4.0 mm

Figure 2: Spacing requirements.

E.10.8 Teams must be prepared to demonstrate spacing on team-built equipment. For inaccessible circuitry, fully assembled spare boards or pictures must be available.

E.11. Manual Service Disconnect (MSD)

E.11.1 It must be possible to disconnect at least one pole of any High Voltage Battery by quickly removing or switching an unobstructed and directly accessible element, fuse, (rotary) switch, or connector (MSD). If multiple batteries are used in series one MSD is allowed to be used if all current goes through the MSD. It must be possible to remove/switch the MSD without removing any panels. Remote actuation of the MSD through a long handle, rope, or wire is not allowed.

E.11.2 Anyone should be able to remove or actuate the MSD without the use of tools within 10 seconds while the prototype is on or in the track.

E.11.3 The MSD must feature an interlock.

E.11.4 The MSD must be clearly marked with “MSD”.

E.12. Discharge Circuit

E.12.1 If a discharge circuit is required to meet E.5.7, it must be designed to handle the maximum voltage permanently. After three subsequent discharges within 30 s in total, the discharge time specified in E.5.7 may be exceeded. Full discharging functionality must be given after a reasonable time with a deactivated discharge circuit.

E.12.2 The discharge circuit must be wired in a way that it is always active whenever the SDC is open. Furthermore, the discharge circuit must be fail-safe such that it still discharges the intermediate circuit capacitors if the MSD has been removed or the High Voltage Battery is disconnected.

E.12.3 Fusing of the discharge main current path is prohibited.

E.13. High Voltage System Active Light

E.13.1 Every prototype must include a High Voltage System Active Light (HVAL) that must indicate the High Voltage status. The HVAL must not perform any other functions. A HVAL with multiple LEDs in one housing is allowed.

E.13.2 The HVAL itself must have a red light, flashing continuously with a frequency between 2 Hz and 5 Hz and a duty cycle of 50 %, active if and only if the Low Voltage System is active and the voltage across any DC-link capacitor exceeds:

- 60 VDC or 50 V AC RMS
- Half the nominal High Voltage

whichever is lower.

E.13.3 The HVAL itself must have a green light, continuously on, active if and only if the Low Voltage System is active and all the following conditions are true:

- All High Voltage Contactors (HVCs) are opened.
- The pre-charge relay is opened.
- The voltage at the prototype side of the HVCs inside the High Voltage Battery does not exceed 60 VDC or 50 V AC RMS.

E.13.4 The mentioned voltage detection must be performed inside the respective High Voltage Enclosure.

E.13.5 The states mentioned of the relays (opened/closed) are the actual mechanical states. The mechanical state can differ from the intentional state, i.e. if a relay is stuck. Any circuitry detecting the mechanical state must be galvanically isolated.

E.13.6 The voltage detection circuit of the red light and the relay state and voltage detection circuit of the green light must be independent. Any plausibility check between both lights is not allowed. A HVAL state with both lights simultaneously active might occur and must not be prevented.

E.13.7 The HVAL must be placed on the prototype in a way that is clearly visible from any position around the prototype.

E.13.8 The entire illuminated surface of the HVAL must be clearly visible in various light conditions including in direct sunlight.

E.13.9 The HVAL and all needed circuitries must be hard-wired electronics. Software control is not allowed.

E.14. High Voltage Batteries / Energy Storage

E.14.1 The following definitions apply:

- Cell: a battery cell or a super-capacitor.
- Cell Energy: the maximum cell voltage times the nominal capacity of the used cell.
- High Voltage Battery: all cells that store the electric energy to be used by the High Voltage system as a whole.
- High Voltage Battery Container (HVBC): the container itself, which contains the High Voltage Battery.
- High Voltage Battery Segments: sub-divisions of the High Voltage Battery.

E.14.2 The following energy storage methods are not allowed:

- Molten salt
- Fuel cells
- Non-electric energy storage, e.g. fuels.

E.14.3 All cells that store the High Voltage Energy must be enclosed in HVBCs.

E.14.4 Each High Voltage Battery Segment must not exceed a maximum static voltage of 120 VDC, a maximum energy of 6 MJ, and a maximum mass of 12 kg.

E.14.5 Spare cells must be stored in an electrically insulated container made of fire-retardant material.

E.14.6 Spare High Voltage Batteries and spare cells must be presented at technical inspection.

E.14.7 It must be possible to access and open the HVBC for technical inspection.

E.14.8 Each HVBC must be able to be removed from the prototype. When the battery is removed from the prototype it must still remain rules compliant.

E.14.9 If the HVBC is made from an electrically conductive material, the inside insulation barrier must be adequately protected against penetration from conductive parts inside the battery.

E.14.10 Every HVBC must contain at least one fuse and at least two HVCs.

E.14.11 The HVCs must open both poles of the High Voltage Battery. If the HVCs are open, no High Voltage voltage may be present outside of the HVBC and the prototype side of the HVCs must be galvanically isolated from the High Voltage Battery side.

E.14.12 The HVCs must be mechanical relays of a “normally open” type.

E.14.13 LVS must not be included in the HVBC except where inherently required. Exceptions include the HVCs, HV DC/DC converters, the BMS, the Insulation Monitoring Device (IMD), the HVAL’s green light circuitry, and cooling fans.

E.14.14 Maintenance plugs must allow electrical separation of all High Voltage Battery Segments. The separation must affect both poles of all segments including the first and last segment.

Maintenance plugs must:

- Not require tools to separate the segments.
- Be non-conductive on surfaces that do not provide any electric connection.
- Be designed in a way, that it is physically impossible to electrically connect them in any way other than the design intent configuration.
- Be protected against accidental reconnection.
- Be designed such that it is clearly visible whether the connection is open or closed. Electrically controlled switches must not be used.

E.14.15 Each High Voltage Battery Segment must be electrically insulated by the use of suitable rigid and fire retardant material, on top of the segment to prevent arc flashes caused by intersegment contact or by parts/tools accidentally falling into the HVBC during maintenance.

E.14.16 Every wire used in a HVBC, regardless of whether it is part of the Low Voltage System or High Voltage System, must follow E.9.2, E.9.3, and E.9.4.

E.14.17 All HVBCs must lie within and be rigidly attached to the primary structure of the prototype. HVBCs must be protected from impacts.

E.14.18 All HVBC materials as well as all structural parts must be fire retardant. All calculations must be conducted for an ambient temperature of 60 ∘C except for metallic materials and continuous fiber-reinforced laminates.

E.14.19 The design of the HVBC and its contents, calculations and/or tests must be documented in the Safety Document.

E.14.20 HVBCs must be constructed of steel or aluminum. The internal and external walls, covers, and lids must be at least 1 mm thick if made from steel or 2.5 mm if made from aluminum.

E.14.21 Alternative materials are allowed with proof of equivalency in the Safety Document.

E.14.22 Composite HVBCs must satisfy the following additional requirements:

- Each attachment point requires steel backing plates with a minimum thickness of 2 mm. Alternate materials may be used for backing plates if equivalency is approved.
- The calculations and physical test results must be included in the Safety Document.

E.14.23 High Voltage Battery segments must be separated by internal vertical walls which extend from the bottom upwards until the lid / top.

E.14.24 The HVBC itself, the mounting of the HVBC to the chassis, and the mounting of each cell to the HVBC must be designed to withstand the maximum accelerations expected by the teams, including during emergency braking and when hitting the end of the track. HVBCs made of alternative materials may need further reinforcement to comply with this rule.

E.14.25 Pouch cells must be fixed using one or both of the large surfaces only. Each used surface must be fixed on at least 80 %. Tabs of pouch cells must not carry mechanical loads and must not press into the pouch.

E.14.26 All fasteners used within or to mount the HVBC are considered critical fasteners. Fasteners within the HVBC used for non-structural parts, e.g. PCBs, do not have to follow the rules for critical fasteners.

E.14.27 The HVCs and the main fuse, must be separated with an electrically insulated and fire retardant material, from the High Voltage Battery. Air is not considered to be a suitable insulation material in this case.

E.14.28 The mounting of the HVBC requires a minimum of 2 attachment points. Any brackets used to mount the HVBC must be made of steel 1.6 mm thick or aluminum 4 mm thick and must have gussets to carry bending loads.

E.14.29 Holes, both internal and external, in the HVBC, are only allowed for the wiring harness, ventilation, cooling, or fasteners. The HVBC must still be compliant with all other rules, especially the ones concerning its structural requirements. The total cutout area must be below 25 % of the area of the respective single wall.

E.14.30 A sticker according to “ISO 7010-W012” (triangle with a black lightning bolt on a yellow background) with the triangle side length of at least 100 mm and the text “Always Energized” must be applied on every HVBC. The sticker must also contain the text “High Voltage”.

E.14.31 Any High Voltage Battery that may vent explosive gas must have a ventilation system to prevent the vented gas from reaching an explosive concentration.

E.14.32 Every HVBC which is completely sealed must also have a pressure relief valve to prevent high pressure in the HVBC.

E.14.33 Each High Voltage Battery must be monitored by a BMS whenever the Low Voltage System is active, or the High Voltage Battery is connected to a charger.

E.14.34 Every HVBC must contain its full BMS including its own and BMS exclusive SDC power stage.

E.14.35 The High Voltage BMS must continuously measure:

- all cell voltages
- the High Voltage current
- for lithium-based cells: the temperature of at least 25 % of the cells equally distributed within the HVBC

E.14.36 Cell temperature must be measured at the negative terminal of the respective cell. The sensor used must be in direct contact with the electrically exposed negative terminal or less than 10 mm along the high current path, away from the terminal in direct contact with the respective busbar. It is acceptable to monitor multiple cells with one sensor if this requirement is met for all cells sensed by the sensor.

E.14.37 The maximum cell temperature is 60 ◦C or the limit stated in the cell data sheet, whichever is lower.

E.14.38 The BMS must open the SDC, if a critical voltage, temperature, or current value according to the cell manufacturer's datasheet or these rules persistently occurs for more than:

- 500 ms for voltage and current values
- 1 s for temperature values

The accuracy, noise, and sample rate of the measurement must be taken into account.

E.14.39 BMS cell voltage measurement inputs, temperature measurement inputs, and supply voltage of decentralized BMS slaves may be rated below the maximum High Voltage System voltage.

E.14.40 A red indicator light on the prototype that is easily visible from multiple sides, even in bright sunlight and clearly marked with the lettering "HV BMS" must light up if and only if the High Voltage BMS opens the SDC. It must stay illuminated until the error state has been manually reset.

E.14.41 It must be possible to disconnect the current sensor, at least one temperature sensor, and at least one cell voltage measurement during technical inspection.

E.14.42 The BMS must be able to read and display all measured values according in a single overview e.g. by connecting a laptop to the BMS at any place and any time.

E.15. Pre-Charge Circuit

E.15.1 A circuit that ensures that the voltage at the side of the HVCs is pre-charged to at least 95 % of the actual High Voltage Battery voltage before closing the second HVC must be implemented.

E.15.2 A check should be implemented on the prototype that if 95 % of the High Voltage Battery voltage is not reached within 2 times the expected duration the SDC is opened.

E.15.3 The pre-charge circuit must use a mechanical, normally open relay. All pre-charge current must pass through this relay.

E.15.4 The pre-charge circuit must be placed inside the High Voltage Battery Container or in the case of multiple batteries inside a designated junction box.

E.16. Insulation Monitoring Device

E.16.1 Every prototype not connected through a power outlet must have an Insulation Monitoring Device (IMD) installed in the High Voltage system.

E.16.2 The IMD must be a Bender A-ISOMETER® iso-F1 IR155-3203, -3204, -4203, or -4204, or a Bender ISOMETER® iso165C-1, iso175, or equivalent IMD. Equivalency may be approved by the competition staff based on the following criteria: robustness to vibration, operating temperature range, IP rating, availability of a direct output, a self-test facility, and must not be powered by the system that is monitored.

E.16.3 The response value of the IMD must be set to ≥500 Ω/V, related to the maximum voltage. The response value must not be changed after electrical inspection.

E.16.4 The IMD must be connected on the prototype side of the HVCs.

E.16.5 One IMD ground measurement line must be connected to the grounded High Voltage Battery Container or the respective grounded High Voltage Enclosure of the IMD. The other chassis ground measurement line must be connected to the low voltage ground. Each connection must use a separate conductor, rated for at least maximum High Voltage voltage. An open circuit in any of these ground measurement connections must result in an opened SDC.

E.16.6 In case of an insulation failure or an IMD failure, the IMD must open the SDC. This must be done without the influence of any programmable logic and must be latched open, see E.5.8.

E.16.7 A red indicator light on the prototype that is easily visible from multiple sides, even in bright sunlight and clearly marked with the lettering "IMD" must light up if and only if the IMD opens the SDC. It must stay illuminated until the error state has been manually reset.

E.17. Chargers

E.17.1 Only chargers presented at technical inspection are allowed. All connections of the chargers must be insulated and covered. No open connections are allowed.

E.17.2 While charging, the HVBC must be connected to protective earth.

E.17.3 High Voltage charging leads must be orange.

E.17.4 When charging, the High Voltage Battery BMS must be active and must be able to open the SDC.

E.17.5 When charging, an IMD must be active and must be able to open the SDC. The second ground measurement line must be connected to the casing of the charger.

E.17.6 All chargers must be of overall good build quality.

C Control System Requirements

C.1. General Control System Requirements

C.1.1 All control system requirements apply to the vehicles, custom tracks, and other prototypes of the teams.

C.1.2 Teams must implement a state machine for the control system of their prototype that at least includes the following states with the following conditions:

- Idle state:
  - The SDC is open.
  - The emergency brakes are deployed.
- Maintenance state:
  - The HVCs and pre-charge relay(s) are open.
  - The emergency brakes are retracted / not deployed.
- (HV) Active state:
  - The SDC is closed.
  - The emergency brakes are deployed.
- Demo state:
  - The SDC is closed.
  - The emergency brakes are retracted / not deployed.
- Emergency State:
  - The SDC is open.
  - The emergency brakes are deployed.

C.1.3 The following data / signals are considered system critical signals:

- All commands and data received from motor controllers or converters.
- All commands and data received from the batteries.
- All commands and data received from the emergency braking system

C.1.4 For each system critical signal, a check should be implemented that if it goes out of acceptable value bounds the system automatically transitions to Emergency State and opens the SDC. This check should be performed by the prototype itself.

C.1.5 The control interface or GUI of the prototype must have an emergency button that requires one click or one keystroke. When pressed the vehicle needs to transition to the Emergency State within 200 ms.

C.1.6 The control interface or GUI needs to display the following prototype statuses (updated at least every 1 s):

- HVAL Green Light Status
- HVAL Red Light Status
- IMD Status
- High Voltage BMS Status
- Emergency Braking System Status

C.1.7 The control interface of GUI needs to display the following values (update at least every 500 ms):

- For every BMS (High-Voltage and Low-Voltage):
  - Pack Voltage
  - Maximum cell voltage
  - Minimum cell voltage
  - Maximum cell temperature
  - Minimum cell temperature
  - Pack current
- DC-link voltage (for High Voltage Systems)

C.1.8 When the emergency braking system is deployed while the prototype is in the Demo state, the control system must open the SDC and deactivate the propulsion system.

C.2. Communications

C.2.1 Teams should implement, for each communication system a heartbeat signal that upon loss of communication for more than 100 ms transitions the infrastructure and vehicle into Emergency State and opens the SDCs.

C.2.2 All wireless communication devices must fulfill the local legislative specifications (e.g., power limitation for radar systems, allowed communication frequency bands and power, etc.) in the country of the competition.

I Technical Inspection

I.1.1 All technical inspection rules apply to the vehicles, custom tracks, and other prototypes of the teams (all called “prototype”).

I.1.2 A prototype is only allowed to enter into technical inspection after a Safety Document has been submitted, completed, and approved prior to the competition by the scrutineers.

I.1.3 The Safety Documents will be evaluated by the scrutineers prior to the competition in the order they have been received.

I.1.4 Each individual prototype (custom track, vehicle, etc.…) must pass the following technical inspections:

- Mechanical Inspection
- Electrical Inspection
- Control System Inspection

I.1.5 Teams are not allowed to dynamically test their prototype before all inspections have been passed.

I.1.6 Teams are not allowed to engage the High Voltage System of the prototype without the supervision of scrutineer before having passed Electrical Inspection.

I.1.7 A list with inspection points for each category will be shared prior to the European Hyperloop Week. The scrutineers may inspect other points not mentioned on the technical inspection sheet to ensure compliance with the rules and overall safety.

I.1.8 Teams are responsible for confirming that their prototype and the required equipment satisfies the requirements and restrictions of the rules before presenting it for technical inspection.

I.1.9 Prototypes presented for technical inspection must be in “ready to demonstrate” condition.

I.1.10 Teams should bring all relevant datasheets, rule questions, photos, spare parts, and equipment to prove compliance with the rules and regulations.

I.1.11 All items on the inspection sheet must be clearly visible for the scrutineers without using instruments such as endoscopes or mirrors. Visible access may be provided by removing panels or by providing removable access panels.

I.1.12 Scrutineers will mark or seal various different approved parts such as the HVBC. Removal of or damage to the seals will void the inspection approval.

I.1.13 After passing technical inspection, scrutineers may perform additional inspections (e.g. after a demonstration) to ensure prototypes still comply with the rules and regulations.

I.1.14 Any prototype that is found to not comply with the rules and regulations after their demonstration during a post-demonstration inspection will result in disqualification from all demonstration categories.

I.1.15 Any repairs or major modifications to the prototype may result in a void of the inspection approval. Teams are recommended to discuss major changes / repairs with the scrutineers prior to continuing testing / demonstration to prevent disqualification.

L Logistics & Shipping Rules

L.1. Shipping Address

L.1.1 Teams that wish to ship their prototype and/or custom track to the competition must use the following address:

[Name of Team / University]
c/o European Hyperloop Center
Spoorhavenweg 17
9645 LZ Veendam
The Netherlands

phone [team captain phone number]
email [team captain email address]

L.1.2 All responsibilities including paperwork, documentation, costs, and/or forms required for inbound/outbound shipping or customs clearance must be completed and supplied by the team. The paperwork and costs are the sole responsibility of the team.

Do not use the European Hyperloop Week or European Hyperloop Center as contact or contracting party for inbound/outbound shipping, this is the responsibility of the team.

L.1.3 All shipment handling, such as sending/crating/loading and receiving/uncrating/unloading is the sole responsibility of the team.

L.2. Incoming Shipments

L.2.1 The rules and regulations regarding incoming shipments applies to all incoming shipments, no matter the size.

L.2.2 The earliest possible delivery date is Monday 6 July 2026 09:00.

L.2.3 The latest possible delivery date is Sunday 12 July 2026 17:00.

L.2.4 Inspecting shipments, reporting and documenting damage to the shipment is the sole responsibility of the receiving team.

L.2.5 All shipping containers must have the team's name permanently and clearly marked.

L.2.6 Incoming shipments may be stored outside and should be weatherproof.

L.3. Outgoing Shipments

L.3.1 The earliest possible pick-up date is Sunday 19 July 2026 09:00.

L.3.2 The latest possible pick-up date is Friday 24 July 2026 17:00.

L.3.3 It is each team's responsibility to schedule the pick-up of the outgoing shipments and prepare the shipments and all the paperwork required for the shipments.

L.3.4 All shipping and customs forms must be filled out by the team.

L.3.5 All shipments must be packed and the crates properly sealed and labelled before the Award Ceremony on Sunday. Failure to prepare the shipment before the Award Ceremony will result in penalty points.

L.3.6 If your shipment is not removed from the competition site by the date and time specified in L.3.2 you will be charged at least €250 per day for storage and handling. After 14 days your shipment may be destroyed at the team's expense.