Rules & Regulations

2025 Edition

by the EHW Technical Committee

Version 1.0 - June 4, 2025

EUROPEAN HYPERLOOP WEEK

Foreword

Dear Participants,

On behalf of the EHW team, we are excited to extend a warm welcome to all the teams applying to join us for the EHW week 2025 in Groningen, Netherlands. We know that many of you are returning competitors, and some of you are joining us for the first time, so we would like to highlight the changes we have made to ensure a fair and engaging competition. Understanding these changes is crucial to your success, and we encourage you to pay close attention to them.

A new awarding system will be introduced in this edition of the European Hyperloop week. We are sure that this will make the competition even more competitive with a fair and transparent judging system. There are three categories that teams can compete in: Demonstration Competition, Showcasing Competition and Research Submission.

In the Demonstration Competition a points system will be introduced where the team with the most points will win the prestigious Overall Award. The focus of this EHW edition is on the demonstration of the systems. Teams that demonstrate a working system will be rewarded.

Another exhibition will be held this year, where the team that most effectively presents the Hyperloop concept through their stand and impresses the jury with their vision and story will be honored with the Showcase Award. This approach gives emerging and smaller teams without a fully functional pod the chance to win and proudly present an award to their university and sponsors.

There is also an efficient change regarding the documents that must be submitted for the demonstration competition. The previous ITD document will be condensed into a more streamlined format. The former Final Demonstration Document will be replaced by a Final Design Document (FDD) and a Safety Document (SFD). Additionally, the SPD and POD will be substituted with videos that teams must create of their pod or track. These changes aim to enable efficient evaluation by the jury while helping teams present crucial information concisely, reducing the time required for extensive documentation.

A final update has been made to Chapter 6.1, Rules & Regulations for Demonstrations, with a strong emphasis on safety. We recognize that this represents a significant change from previous years, but we are confident that it will enhance the overall safety of the competition and optimize the scrutineering process.

For any questions related to R&R, a Q&A session will be held around the end of November.

Best of regards and good luck!

The EHW Technical Team

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1 Introduction

"The European Union must reduce the emissions of the transport sector by 60% by 2050"

"Transport services represent an industry worth 664 billion euros and employ 11 million people on just one continent" – European Commission

Under this premise, four European Hyperloop teams came together to create an event that will drive the development of the Hyperloop in Europe and around the world. It aims to be an event that brings the Hyperloop community together and that focuses on the scientific exchange between all those working on the concept of the Hyperloop. On one hand, the successful transition from the concept of Hyperloop to an actually feasible system calls for all forces to work together towards a common goal, and on the other, it is essential to inspire and convince the public that this form of transport has the potential to shape the future.

The event organizing Committee is comprised of four student teams of the European Hyperloop community, namely:

HYPERLOOP UPV

Universitat Politécnica de Valencia, Spain

DELFT HYPERLOOP

Technische Universiteit Delft, Netherlands

HYPED HYPERLOOP EDINBURGH

The University of Edinburgh, Scotland

swissloop

Eidgenössische Technische Hochschule Zürich, Switzerland

2 General Information

This document outlines all technical aspects of the European Hyperloop Week 2025, also referred to as EHW 2025 or Event.

2.1 Terminology

TG.1 Any model exhibited, presented, or operated at the Event is referred to as a System. The term Subsystem is used if a subordinate reference shall be made clear.

TG.2 Every team applying for the Event is referred to as an Applicant.

TG.3 Every applicant admitted to the Event is referred to as an Exhibitor.

TG.4 Every system that will be demonstrated at the EHW 2025 is referred to as a Demonstrator.

2.2 Eligibility

EG.1 There are no limitations on registering systems, as long as they relate to the Hyperloop concept. This includes:

- Fully integrated vehicles to scale.
- Isolated subsystems
- Infrastructures.
- Test benches.

2.3 Liability & Safety

LS.1 Every exhibitor must sign the European Hyperloop Week 2025 Terms & Conditions of Participation.

LS.2 Every exhibitor takes full responsibility for their systems even though the EHW Committee makes the final decision if a system might be brought to the Event or operated.

LS.3 The EHW will NOT be liable for any damages incurred or incidents that may occur.

LS.4 Every exhibitor who actively operates a system on the site of the Event will be obliged to possess valid liability insurance that covers both personal injury and property damage at any Event venue.

LS.5 The instructions of the EHW Committee and associated personnel must always be followed. Failure to do so might result in the exclusion from the Event.

2.4 Intellectual Property of Submitted Documentations

IP.1 The EHW Committee and all associated partners guarantee to treat the submitted documentation of the applicants confidentially and not disclose or disseminate any information from it.

IP.2 The EHW Committee and all persons involved in the application and evaluation process for the EHW Awards explicitly do not have any rights to the content of the documentation.

IP.3 The documentation submitted remains the intellectual property of the respective applicant.

This intellectual property regime is also set out in the EHW Terms & Conditions.

2.5 Privacy

PR.1 The EHW Committee guarantees to treat the personal data of the applicants confidentially, not to use them for any other purpose than for conducting the Event, and not to pass them on to third parties without their consent.

3 Code of Conduct

Jury Authority

CC.1 The EHW staff and jury reserve the right to interpret or modify the competition rules at any time and in any manner that is required to ensure a safe and fair competition.

CC.2 All team members are required to cooperate with and follow instructions from the jury and EHW staff.

CC.3 All clarifications posted on the website or sent to the teams directly are considered part of the rules.

CC.4 Failure of a team or team member to follow an instruction or command directed specifically to that team or team member will result in a point penalty deducted from the team's overall score.

CC.5 Disrespectful behavior from a member of a team towards other teams, the EHW organization, or jury will result in a direct warning to the respective team. If continued, it will be a reason for disqualification.

Unsportmanlike behavior

CC.6 During the event, unsportsmanlike behavior will result in a point penalty deducted from the team's overall score.

Violations of Intent

CC.7 Any parts, devices, or software fragments designed with the intent to violate a rule, will be considered a violation. Violation of the intent of a rule will be considered a violation of the rule itself.

Protests

CC.8 Protests can be filed against a decision made by the EHW or jury that is contrary to a rule from the most recent version of the Rules and Regulations of the EHW and has an actual, non-trivial, and negative effect on the team.

CC.9 All protests must be filed in writing and should list the rule or regulation that has been violated and in which way or form and presented to the appointed EHW staff member. The team cannot present any new information in the protest. In order to have a protest considered, a team must post a 50-point protest bond which will be forfeited if their protest is rejected.

CC.10 Protests will be handled by the advisory board of the EHW.

CC.11 The decision of the advisory board regarding any protest will be in written form and is final.

Presentations and Expert Talks

CC.12 Every team and every member of the team is responsible for networking and getting involved in activities with the sponsors of the competition. An attitude of rejection to any activity, team, or collaborative organization will be considered unsportsmanlike behavior.

4 Schedule of the EHW 2025

SCDL.1 Based on current planning, the European Hyperloop Week is scheduled for 14th-20st July 2025. The event will last for one week and will be completely dedicated to Hyperloop-related technologies.

SCDL.2 The main constituents of the event will be:

- Demonstrations

  Exhibitors will demonstrate their Hyperloop technology to the public. To do so, an exhibitor must apply for one of the application categories described in Applications (see Section 5).

- Presentations

  Any demonstration will be preceded by a technical presentation made by the demonstrating team. The corresponding jury will be present, and any participant from any team is encouraged to attend too. This serves as a way to share knowledge and do a better evaluation of their posterior demonstration. It is also an intellectual defense, where the team will prove they understand the strengths and risks of their own system.

- Conferences

  Talks, round tables, workshops, and others will be presented by industry and academia experts.

SCDL.3 The above-mentioned constituents will take place simultaneously throughout the week. The week itself will be arranged thematically such that presentations and conferences about similar technologies will be held on the same day.

SCDL.4 The weekdays will provide the opportunity for presentations and conferences. The spotlight during these days should be on the showcase and networking among participants.

SCDL.5 Towards the end of the week, extended infrastructure will be available for team demonstration. The infrastructure provided by the EHW Committee and its technical characteristics can be found in EHW Infrastructure & Associated Requirements (see Section 9).

SCDL.6 The conclusion of the EHW 2025 will be a public exhibition and will be the time when the EHW Competition awards will be presented.

SCDL.7 Exact details on the event schedule will be sent to the participating teams at least 1 month in advance of the competition. Be aware that the presented schedule is only a rough outline and is still subject to change. Furthermore, it will be the EHW Committee who will schedule any activities of the exhibitors, which explicitly includes the system presentations.

5 Applications

- There are three application categories a team can apply to:
  - Demonstration Competition.
  - Showcasing Competition.
  - Research Submission.
- Choose your category. Beforehand each team must apply to one or more of the competition categories, depending if you intend to demonstrate your prototype (Demonstration Competition), show your work in an exhibition (Showcasing), or present the research you did over the year (Research).
- Depending on the chosen category the team needs to hand in certain documents. This will be explained in more detail in the chapters 6, 7 and 8.
- It is possible to compete in all three categories.

5.1 Introduction

As one of the core features of the EHW 2025, the best systems demonstrated will be awarded. This section provides an outline of all the awards that will be handed out during this EHW edition.

- Demonstration Competition
  - Engineering Design Award
  - Demonstration Awards:
    - Levitation and Guidance Demonstration Award
    - Propulsion Demonstration Award
    - Integrated Hyperloop Demonstration Award
  - Engineering Excellence Diploma (up to 3)
  - Overall Award
    - 1st Place
    - 2nd Place
    - 3rd Place
- Research Submission
  - Full-Scale Award - Technical Aspects of Hyperloop Systems
  - Full-Scale Award - Socio-Economic Aspects of Hyperloop Development
- Showcasing Competition
  - Showcase Award
- Sponsor Awards: sponsored by partners of the Event. Applications to any award will automatically be added to the Sponsor Awards. These may be, but are not limited to:

- Community Award
- Outreach Award

The grading of the awards will be done by an impartial jury consisting of people with a technical, industrial, or research background.

5.2 Demonstration Competition

DC.1 In this category, applicants bring Demonstrators to the EHW, which implements features of a hyperloop system. This can be done by building a fully working vehicle that integrates all subsystems, or a specific subsystem by itself, like a levitation test bench, o propulsion motor, cooling system, etc.

DC.1 Teams in this category will be required to write extensive documentation of the complete system throughout the year, expecting an overall very high quality and clear direction of the proposal.

DC.1 More detailed information about the documents that need to be submitted can be found in Section 5.6.1.

DC.1 There are four types of awards in this category:

5.2.1 Overall Award

This year, the Overall Award is divided into several events, each awarding points. Ultimately, the team with the highest total points across the two categories Research Submission and Demonstration Category will receive the Overall Award, ensuring a fair and transparent Winner.

Category/Prizes	Points
Research Submission	
Technical Aspects of Hyperloop Systems	100
Socio-Economic Aspects of Hyperloop Development	100
Demonstration Category	
Engineering Design Award	310
Demonstration Awards	
Levitation & Guidance	170
Propulsion Demonstration	170
Integrated Hyperloop	150
Overall Award	**1000**

Table 1: Breakdown of the point system for the Overall Award.

Any team participating in the Demonstration Competition will automatically be enrolled and eligible for the Research Submission awards and the Demonstration Category awards and therefore also for the Overall Award.

With this award, the EHW wants to highlight the importance of not only the design, manufacturing, and testing of a hyperloop prototype but also the overall awareness of the hyperloop environment and the team's efforts to contribute to and advance it. Therefore, this award will be given to the best overall team taking into account both the demonstration and research categories.

In the following chapters, the different Awards will be explained:

5.2.2 Engineering Design Award

Teams will be judged based on their knowledge and the overall build/design quality of their demonstrator. The scoring will be based on different aspects of the demonstrators, e.g. mechanical, electrical, software, propulsion, etc.

Scoring criteria: The main criteria for the scoring will be the knowledge and engineering quality of the demonstrator. The Final Design Document (FDD) and a Q&A session between the judges and the team will be the main scoring criteria. Judges will concern themselves with the quality of the design decisions made by the team, their ability to explain why these decisions have been made, and their understanding of the technical aspects.

Format: The design judging will happen through "1 on 1 conversation" between industry experts (judges) and the relevant engineers from the teams. For example, there might be 5-8 judges during the judging session for the team, and a maximum allowed team members from the team of 7-10 to explain the design of the demonstrator and answer questions. The format allows for in-depth discussions and questions regarding the demonstrator to truly test the engineering quality of the teams. The judging will take place at the demonstrator, if available, to evaluate the overall design easily ask questions, and explain the implementation. The duration of the judging will be 45 min. The score will be based on an evaluation of both the FDD and this Q&A session.

5.2.3 Demonstration Awards

These awards will be given to teams that excel during the prototype demonstration part of the EHW. A minimum of 120 points on each of the awards will be required in order for a team to be eligible for any of the following demonstration awards.

- Levitation and Guidance Demonstration Award

Criteria: The objective for the levitation and guidance award is for teams to demonstrate these systems and show that their solution: works and is of high performance. The criteria for this award include, among others:

- Whether the systems work (levitation/guidance).
- Stability.

- Energy consumption/efficiency.
- Resistance to disturbances (e.g. external forces, gaps in tracks).
- Lift-to-Weight.
- Reliability.
- Level of redundancy, ability to reject system faults.
- Quality of the data

Format: Teams would get 1 or 2 opportunities to demonstrate their system with the jury present and will be asked to share the data of their sensors in a specific format to allow for analysis by the judges.

- Propulsion Demonstration Award

Criteria: The objective for the propulsion award is for teams to demonstrate these systems and show that their solution: works and is of high performance. The criteria for this award include, among others:

- Whether the system works.
- Stability.
- Energy consumption/efficiency.
- Acceleration.
- Top Speed.
- Reliability.
- Level of redundancy, ability to reject system faults.
- Quality of the data

Format: Teams would get 1 or 2 opportunities to demonstrate their system with the jury present and will be asked to share the data of their sensors in a specific format to allow for analysis by the judges.

- Integrated Hyperloop Demonstration Award

Criteria: Every team that performs demonstrations will be judged in this category (even if not applying for a levitation or propulsion demonstration). The objective for this category is to score teams based on the integration of their demonstrator and their performance. This includes the demonstration of other essential technologies for the hyperloop such as power transfer, vacuum compatibility, suspension, lane-switching, software, navigation and control, etc.

Format: During the demonstrations of the teams judges will take notes and use the data requested from the team and observations to score for this award.

5.2.4 Engineering Excellence Diplomas

Criteria: The goal of the engineering excellence award is to award applicants who have performed very well in a specific way but are not able to win any prizes because they are perhaps only competing with a specific sub-system. For example, a team that has a very impressive propulsion system design, but due to issues is unable to demonstrate it; a team that only demonstrates a cooling system but works excellently, etc. The goal is to award excellence outside the main prizes.

Format: The award will be handed out to up to 3 teams at the discretion of the jury.

5.3 Research Submission

RS.1 Research Submission is an application category for EHW 2025 that focuses on the challenges involved in the translation from Hyperloop prototypes to a real-world Hyperloop system. Exhibitors must demonstrate an understanding of the implementation of Hyperloop technologies in society, by presenting research relevant to full-scale Hyperloop development.

RS.2 The final submission should consist of a single PDF document detailing the research the applicant has conducted.

RS.3 If the applicant chooses to present a relevant prototype to this research, then documentation for this prototype needs to be submitted as well. This should be done following the guidelines of a Demonstration or Showcase, depending on the activity the applicant aims to conduct at EHW 2025. The application process for Research Submission is described in Research Submission (see Section 7).

RS.4 The Research Submission should be self-sufficient, meaning that the applicant should not need to present any material (prototypes, pieces of software, videos, etc.) for the submission to be coherent and complete.

RS.5 All details of relevant additional material (e.g., design and functionality of a prototype or piece of software) should be included in the Research Submission itself.

RS.6 For a Research Submission to be eligible for a Full-Scale Award, it must follow the rules as stated in Chapter 7.

RS.7 A team has to publish their submission on an open-access platform before the competition, so any time before the 14th of July. The EHW website, your own platform/website, your university repository, or another open-access platform can be used as a platform to publish open-access submissions.

RS.8 Submissions eligible for the Full-Scale Awards shall fall under the following two categories:

(a) Technical Aspects of Hyperloop Systems:
This category aims to explore technical aspects of the full-scale Hyperloop system, including both the pods and the infrastructure. The development of Hyperloop technology is very much still underway, with many technical questions remaining unanswered. EHW 2025 is an opportunity for student teams to attempt

to answer some of those questions.

Any topic that falls within the category of Technical Aspects of Hyperloop Systems is an acceptable choice for submissions to this award. Full-scale Technical Aspects submissions for technical systems could include your own laboratory research.

Teams are highly encouraged to perform research on one or more of the following topics or come up with their own underexposed area of technical Hyperloop research:

- Safety systems (emergency exits, safe havens, etc.).
- Life support systems.
- Vacuum management (leakage, vacuum pumps, airlocks).
- Thermal management.
- Banking.
- Tube construction (forces, joints, lane-switch).
- Energy management and (inductive) power supply to the vehicle.
- Noise inside the pod, and/or outside the tube.

(b) Socio-Economic Aspects of Hyperloop Development

This category of the Full-Scale Award is meant to explore the aspects of Hyperloop development that have to do with the interaction between (the development of) 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.

Any topic that falls within the category of Socio-Economic Aspects of Hyperloop Development is an acceptable choice for submissions to this award. Full-Scale Socio-Economic Aspects submissions could include your own surveys.

Teams are highly encouraged to perform research on one or more of the following topics or come up with their own underexposed area of socio-economic Hyperloop research:

- Sustainability of construction and operation.
- Accessibility for people with reduced mobility.
- Impact on society (acceptability/societal changes).
- Travel comfort/experience.
- Costs and ticket affordability.
- Security and emergency procedures (eg. risk and harm mitigation vs. zero failure policy).
- Alignment (underground vs. above ground, approach to cities, integration in environment).
- (Safe) operation.

The two categories define broad topics that the research questions of the submissions must fall within. It is strongly recommended to perform in-depth scientific research,

rather than examining all aspects of a category. A submission should contribute to the expansion of knowledge concerning a full-scale Hyperloop. Knowing the Hyperloop system and its current development is therefore key for a good submission. Although a thorough literature review is also essential, do not repeat existing research. Label sources correctly, solely combining existing research does not suffice. The categories have been chosen to be broad to allow applicants the freedom to explore the topics that they find most appealing and relevant.

Applicants may submit up to one application per award category. A repository with a collection of known repositories for Hyperloop research and a curated literature repository for Hyperloop research from EHW, jurors and partners is available at the Hyperloop Paper Repository.

5.4 Showcasing Competition

SC.1 This category emphasizes the clear and effective communication of Hyperloop concepts, technologies, and challenges to both technical and general audiences. Teams entering this category will have the opportunity to present their work in a dedicated exhibition space at the competition site. This provides a platform for emerging teams to showcase their vision for the future of Hyperloop. Exhibitors are expected to demonstrate exceptional skill in delivering Hyperloop-related content in an engaging and informative way. The team with the most compelling design and visionary presentation of their stand and Hyperloop concept will be recognized with an award.

SC.2 Submissions may take various forms including, but not limited to:

- Technical systems that illustrate key Hyperloop principles
- Visual demonstrations of complex engineering concepts
- Research presentations formatted for public engagement
- Interactive displays explaining Hyperloop components or systems

SC.3 The application process requires comprehensive documentation following the guidelines detailed in Showcase Documentation (see Section 8.2).

SC.4 While physical demonstrations and visual aids enhance the submission, the core message and educational value should be effectively conveyed through the required documentation and poster presentations.

SC.5 On a designated day during the EHW, the jury will visit the exhibition, and the team must be present at their stand at the scheduled time to answer the judges' questions.

SC.6 The submission will be evaluated based on:

- Clarity and effectiveness in communicating complex technical concepts
- Innovation in presentation methods
- Relevance to current Hyperloop development challenges
- Potential impact on public understanding of Hyperloop technology

SC.7 Teams are encouraged to focus on areas such as:

- System integration visualization
- Infrastructure and station design representation
- Passenger experience demonstration
- Safety system explanations
- Environmental impact visualization

Submissions eligible for the Showcasing Award should demonstrate excellence in one or more of the following aspects:

(a) Communication of Technical Concepts:

- Clear visualization of complex technical systems
- Effective demonstration of engineering principles
- Interactive presentations of Hyperloop components
- Innovative ways to explain technical challenges
- Physical or visual models that enhance understanding

(b) Educational Impact:

- Accessibility to different audience levels
- Clear presentation of technical information
- Engagement with viewers/audience
- Quality of visual aids and demonstrations
- Effectiveness in explaining complex concepts

5.5 Basics of the Application Process

Concerning the application process the applicant must adhere to the following points.

General

AP.1 Virtual participation is not permitted.

AP.2 The general concept for each application shall be fixed in the first documentation. System adaptations within the year are allowed as long as the core concept remains unchanged.

AP.3 If there is feedback from the EHW Committee, the applicant is obliged to implement/follow that feedback to ensure a successful application.

AP.4 A request to postpone a deadline can be made using the official communication channels. The EHW encourages to never account for extra time, although an exception can be made for a major cause or to ensure the safety of the team during the development process. The proposal review will be private and individual. The EHW reserves the right to deny these proposals without any justification.

Documentation

AP.5 If the demonstration of a certain system requires the active operation of other systems, such systems must be addressed in every documentation.

AP.6 Systems or parts of a system that are not intended for demonstration or showcase as part of an application should not be included in the documentation unless they are important to the functioning of the systems being demonstrated (e.g. a control system). In that case, they should be included concisely.

AP.7 The documentation timeline as presented in Application Timeline (see Section 5.5) must be followed. Failure to do so may result in the exclusion from the EHW 2025.

AP.8 All documentation shall be established as Formulated Engineering Documentation, meaning that they are developed, written documents and consequently are not in presentation or slide format. The EHW Committee may reject applications that are inadequately written.

AP.9 All the represented data (i.e. Figures) must be own-referenced or the external reference must be explicitly stated. All graphs must have legible axis titles and legends (preferably with the same font type and size as the text) and with a common format throughout the document.

AP.10 All documents and deliverables the applicant provides to the EHW should be written in English.

AP.11 The relevant award/s for each application must be defined in the first documentation.

5.6 Application Timeline

Please note that each date mentioned below which is not specified in detail, will be announced at a later date.

5.6.1 Application Timeline for the Demonstration Competition

The application process for the Demonstration Competition consists of several stages. The deadlines for the whole season can be found in the Table 1. You can find more information about the individual documents that have to be submitted in chapter Application Process for Demonstrations.

Due Date	Action	Who
13th December 2024 23:59 CET	Submission of Intent to Demonstrate	Applicant
January 2025	Applicant receives - Feedback session with the jury. - Notification if successfully qualified, changed to subsystem demonstration or rejected.	EHW Committee
29th February 2025 23:59 CET	Submission of Safety Document	Applicant
March 2025	Applicant receives: - Feedback session with the jury. - Notification if successfully passed or failed.	EHW Committee
19th April 2025 23:59 CET	Submission of Final Design Document	Applicant
13th June 2025 23:59 CET	Submission of Video Demonstration	Applicant
Late June 2025	Submission of Posters	Applicant
Before EHW 2025	Further information concerning the event week will be provided to the exhibitor	EHW Committee
14-20 July 2025	European Hyperloop Week	

Table 2: Application timeline for Complete System

5.6.2 Application Timeline for Research Submission

The application process for Research Submission consists of two stages. The applicant will receive the final acceptance or rejection of their application after the first stage. The second stage of the application process consists of submitting the work of the research itself.

If the applicant chooses to present a prototype along with their Research Submission, then the application process for Showcase or Demonstration needs to be followed separately for the prototype. The deadlines presented in Table 2 must be met to be considered for Full-Scale Awards and Sponsor Awards.

Due Date	Action	Who
13th December 2024 23:59 CET	Submission of Intent to Submit Research	Applicant
January 2025	Applicant receives - Feedback session with the jury. - Notification if qualified or rejected	EHW Committee
22nd June 2025 23:59 CET	Submission of Final Research Submission	Applicant
25th June 2025 23:59 CET	Submission of Posters and Complementary Material	Applicant
25th June 2025 23:59 CET	Submission of Video Presentation	Applicant
13th July 2025 23:59 CET	Publish research papers online	Applicant
Before EHW 2025	Further information concerning the event week will be provided to the exhibitor	EHW Committee
14-20 July 2025	European Hyperloop Week	

Table 3: Application timeline for Research Submission

6 Demonstrations Application

Every applicant shall read the following subchapters carefully and check if they can meet the requirements, with special emphasis on all the safety precautions. If the applicant fails to fulfill one point for a certain system, then the system will not be permitted for a demonstration.

6.1 Rules & Regulations for Demonstrations

These guidelines apply regardless of a full system or an isolated subsystem demonstration.

General Technical Requirements

General

G.1 All rules and regulations shall apply regardless of the type of demonstration (full-system or sub-system demonstration).

G.2 Teams are not allowed to operate, test, or demonstrate their (sub-)system until the corresponding stages of technical inspection have been passed. (See section T – Technical Inspection for details.)

G.3 Teams are not allowed to operate, test, or demonstrate their (sub-)system without completion of all relevant Technical Documentation (see section 6.2).

G.4 All (sub-)systems must be designed and fabricated in accordance with good engineering practices.

Rule Questions

G.5 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.

G.6 Rule questions must be submitted with as much information and all relevant context such that a good response can be formulated by the organization.

G.7 Rule questions can be submitted via e-mail to:

technical@hyperloopweek.com
subject: Rules & Regulations Query

Definitions

G.8 Technical Documentation – For the purpose of demonstrating compliance with the rules and regulations the technical documentation includes all rule questions submitted by the team, the safety document (SFD), and all other correspondence with the competition organization.

G.9 Custom track – Any track other than the European Hyperloop Center Infrastructure.

G.10 Fire-Retardant material – a material meeting one of the following standards:

- UL94 V-0 for the minimum used material thickness.
- FAR 25.853(a)(1)(i).
- FAR 25.853(a)(1)(i).

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

Safety Equipment

G.11 Each team must have at least two foam type fire extinguishers with valid inspection tags, or with an inspection date in the past year.

G.12 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

G.13 Each team that has a (sub-)system 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.

G.14 Each team must have safety shoes for all team members working with heavy components or lifting thereof rated S3 or better.

Mechanical System Requirements

General Mechanical Requirements

M.1 All mechanical system requirements apply to the vehicles, custom tracks, and other prototypes of the teams.

M.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.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.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.5 All threaded critical fasteners must be at least 4 mm metric grade 8.8 (OEM parts 3 mm metric grade 8.8).

M.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.7 All critical fasteners must be secured from unintentional loosening using positive locking mechanisms.

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.
- Tab washers.

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

M.8 A minimum of two full threads must project from any lock nut.

M.9 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.10 Any rotational system (e.g. wheels, magnetic disks) shall be properly balanced.

Magnetic Systems

M.11 Teams shall implement adequate handling and storage procedures for permanent magnets.

M.12 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.13 Warning signs in accordance with ISO 7010-W006 are placed on (sub-)systems that utilize permanent magnets to indicate a magnetic field is present.

Braking System

M.14 If the prototype of the team has a propulsion system, the prototype is required to have an emergency braking system.

M.15 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 track/vehicle that each under all operating conditions trigger the emergency braking system actuation (the "emergency brake switch") when the prototype reaches the location of the switch (for example a switch on the right side of the vehicle and one on the left, both normally closed, wired in series with the emergency braking system actuation signal, see Appendix A (2) for example circuitry). The emergency brake switch must be actuated without programmable logic.

M.16 The emergency braking system must consist of at least two independent braking system mechanisms / brakes. They can be fed from the same power or air/fluid source but should otherwise be independent.

M.17 Each independent emergency braking system 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.15) with a 10% safety margin.

M.18 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.19 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.20 The emergency braking system is only allowed to be undeployed / retracted when the Shutdown Circuit (SDC) signal is high and should automatically deploy by hardware if the SDC is opened. See Appendix A (2) for example circuitry.

M.21 The braking force applied by each independent braking system must be designed such that the net braking force is zero in all directions except opposite the direction of travel.

Compressed Gas Systems and High-Pressure Fluids

M.22 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.23 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.24 Gas cylinders/tanks and their pressure regulators must be of appropriate manufacture, certified and labeled as such.

M.25 Any part of a compressed gas or fluid system must be properly shielded from heat sources.

Cooling Systems

M.26 Cooling systems must only use plain water or air as the coolant.

M.27 Any cooling or lubrication system must be sealed from leakage.

M.28 Any cooling or lubrication system using a vent must have properly sized catch-cans to collect excess cooling fluid or lubrication material.

Custom Tracks

M.29 The requirements in this section (custom tracks) do not apply to teams that demonstrate in the European Hyperloop Center Infrastructure.

M.30 The maximum length of a custom track is 50 meters.

M.31 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.32 The track shall be able to withstand strong weather conditions (wind, rain, etc.).

M.33 The custom track is not allowed to move during a run, due to forces exerted on it. This should be possible without anchoring it (anchoring is likely not possible at the competition site).

M.34 The custom track must be able to be operational between 0 – 40 °Celsius.

M.35 A safety perimeter must be defined around the track and shielded with fences.

M.36 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.37 Any custom track that can create a low-pressure environment must include a method to quickly repressurize the custom track.

Electrical System Requirements

General Electrical System Requirements

E.1 All electrical system requirements apply to the vehicles, custom tracks, and other prototypes of the teams.

E.2 The Low Voltage System (LVS) is defined as every electrical part that is not part of the High-Voltage System.

E.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.4 High Voltage is defined as any voltage above the maximum allowed voltage in the Low Voltage Systems.

E.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.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.7 High Voltage System Enclosures are defined as any housing or enclosure that contains part of the High Voltage System.

E.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.9 Only electric motors are allowed.

E.10 Any electric motor (if used for propulsion) must be connected to the battery through a motor controller.

E.11 Any electromagnet must be connected to the battery through a converter.

E.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.

Low Voltage System

E.13 All Low Voltage System parts must be adequately insulated.

E.14 All Low Voltage System wiring must not use orange wiring or conduit.

E.15 The Low Voltage System must be grounded to the main structure of the vehicle, or main structure of the infrastructure.

Low Voltage Batteries

E.16 Low voltage batteries are all batteries that are connected to a Low Voltage System.

E.17 Any low voltage battery must be securely attached to the prototype and have a rigid and sturdy casing.

E.18 Any low voltage battery must have adequately sized overcurrent protection (fuse), not more than 100 mm from ungrounded terminals.

E.19 Battery packs based on lithium chemistry other than lithium iron phosphate (LiFePO4):

- Must have a Fire-Retardant casing, see G.10.
- 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.125), 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 individually disconnect one temperature sensor, and one cell voltage measurement wire during technical inspection if any wire is used.

To clarify: LiFePO4 batteries do not require a BMS.

Measuring Points and Master Switches

E.20 Each prototype utilizing High Voltage must have two High-Voltage Measuring Points (HVMPs).

E.21 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.22 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.23 All HVMPs must use 4mm shrouded banana jacks rated for 600 V CAT III or better.

E.24 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.25 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.26 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.27 Each LVMS must be marked "LV" and have its ON and OFF positions marked appropriately.

E.28 Each prototype utilizing a High-Voltage must have a High-Voltage Master Switch (HVMS) that is part of the Shutdown Circuit (SDC).

E.29 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.30 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.31 All master switches and measuring points should be located close to each other in a convenient position on the prototypes.

Shutdown Circuit

E.32 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.33 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.34 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
- IMD, for High-Voltage prototypes
- High Voltage BMS, for High-Voltage prototypes

E.35 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.36 The shutdown buttons, the master switches, and all interlocks must not act through any power stage.

E.37 The High Voltage Master Switch (HVMS) must be the last switch before HVCs except for the pre-charge circuitry.

E.38 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.39 If the SDC is opened by the HV BMS or IMD, it must be latched open by a non-programmable logic that can only be manually reset with a button on the prototype or by turning the prototype completely off.

E.40 Closing the SDC by any part defined in E.34 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.

Appendix A (2) shows an example schematic of the required SDC.

Shutdown Buttons

E.41 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.42 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.43 All shutdown buttons must have a minimum diameter of 40 mm, must be red, and must be of normally closed type.

Grounding

E.44 High Voltage System Enclosures, see E.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.45 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.46 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.

Overcurrent Protection

E.47 All electric systems must have appropriate overcurrent protection.

E.48 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.49 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.50 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.51 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.52 The overcurrent protection must be designed for the expected surrounding temperature range but at least for 0 °C to 85 °C.

High Voltage System Insulation, Wiring and Conduit

E.53 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.54 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.55 The temperature rating for High Voltage wiring, connections, and insulation must be appropriate for the expected surrounding temperatures but at least 85 °C.

E.56 It must be possible to clearly assign and prove the wire gauge, temperature rating, and insulation voltage to each used High Voltage wire.

E.57 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.58 High Voltage wiring must be located out of the way of possible snagging or damage.

E.59 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.60 Any shielded High Voltage cable must have the shield grounded.

E.61 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.62 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.63 All High Voltage connections must not include compressible material such as plastic in the stack-up or as a fastener.

E.64 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.7, that are suitable for high temperatures. Off-the-shelf components, e.g. converters, might be allowed without a positive locking feature if connections are completed as recommended by the manufacturers' datasheet and no positive locking is possible.

E.65 Teams must be prepared to demonstrate positive locking. For inaccessible connections, appropriate photographs must be available.

E.66 Soldered connections in the High Voltage high current path, are only allowed if all of the following are true:

- connections on PCBs
- connections within motors or magnetic systems
- the connected devices are not cells or wires
- the devices are additionally mechanically secured against loosening

High Voltage System and Low Voltage System Separation

E.67 Two electric circuits are defined as galvanically isolated if all of the following conditions are true:

- The resistance between both circuits is $\geq$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.68 The entire High Voltage System and Low Voltage System must be galvanically isolated.

E.69 All connections from a High Voltage System component to external devices, such as laptops must include galvanic isolation.

E.70 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.71 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.72 Components and cables capable of movement must be positively restrained to maintain spacing.

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

Table 4: Clearance and Creepage Distance

E.73 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 the table 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.

E.74 Teams must be prepared to demonstrate spacing on team-built equipment. For inaccessible circuitry, fully assembled spare boards or pictures must be available.

Manual Service Disconnect (MSD)

E.75 It must be possible to disconnect at least one pole of any High Voltage Battery by quickly removing an unobstructed and directly accessible element, fuse, or connector. 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 the MSD without removing any panels. Remote actuation of the MSD through a long handle, rope, or wire is not allowed.

E.76 Anyone should be able to remove the MSD without the use of tools within 10 seconds while the prototype is on or in the track.

E.77 Rotary type MSD switches are allowed if they feature an interlock

E.78 The MSD must be clearly marked with "MSD".

Discharge Circuit

E.79 If a discharge circuit is required to meet E.38, 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.38 may be exceeded. Full discharging functionality must be given after a reasonable time with a deactivated discharge circuit.

E.80 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.81 Fusing of the discharge main current path is prohibited.

High Voltage System Active Light

E.82 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.83 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.84 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.85 The mentioned voltage detection must be performed inside the respective High Voltage Enclosure.

E.86 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.87 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.88 The HVAL must be placed on the prototype in a way that is clearly visible from any position around the prototype.

E.89 The entire illuminated surface of the HVAL must be clearly visible in various light conditions including in direct sunlight.

E.90 The HVAL and all needed circuitries must be hard-wired electronics. Software control is not allowed.

High Voltage Batteries / Energy Storage

E.91 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.92 The following energy storage methods are not allowed:

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

E.93 All cells that store the High Voltage Energy must be enclosed in HVBCs.

E.94 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.95 Spare cells must be stored in an electrically insulated container made of fire-retardant material.

E.96 Spare High Voltage Batteries and spare cells must be presented at technical inspection.

E.97 It must be possible to open the HVBC for technical inspection.

E.98 Each HVBC must be removable from the prototype while still remaining rules compliant without the need to install extra components. A dummy connector or similar may be used to restore the system's isolation.

E.99 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.100 Every HVBC must contain at least one fuse and at least two HVCs.

E.101 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.102 The HVCs must be mechanical relays of a "normally open" type.

E.103 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.104 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.105 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.106 Every wire used in a HVBC, regardless of whether it is part of the Low Voltage System or High Voltage System, must follow E.54, E.55, and E.56.

E.107 All HVBCs must lie within and be rigidly attached to the primary structure of the prototype. HVBCs must be protected from impacts.

E.108 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.109 The design of the HVBC and its contents, calculations and/or tests must be documented in the respective Technical Documentation.

E.110 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. Alternative materials are allowed with proof of equivalency in Technical Documentation.

E.111 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 Technical Documentation.

E.112 High Voltage Battery segments must be separated by internal vertical walls which extend from the bottom upwards until the lid / top.

E.113 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.114 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.115 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.116 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.117 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.118 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.119 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.120 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.121 Every HVBC which is completely sealed must also have a pressure relief valve to prevent high pressure in the HVBC.

E.122 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.123 Every HVBC must contain its full BMS including its own and BMS exclusive SDC power stage.

E.124 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.125 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.126 The maximum cell temperature is 60 °C or the limit stated in the cell data sheet, whichever is lower.

E.127 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.128 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.129 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.130 It must be possible to individually disconnect the current sensor, one temperature sensor, and one cell voltage measurement wire during technical inspection if any wire is used.

E.131 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.

Pre-Charge Circuit

E.132 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.133 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.134 The pre-charge circuit must use a mechanical, normally open relay. All pre-charge current must pass through this relay.

E.135 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.

Insulation Monitoring Device

E.136 Every prototype not connected through a power outlet must have an Insulation Monitoring Device (IMD) installed in the High Voltage system.

E.137 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 officials 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.138 The response value of the IMD must be set to $\geq$500 Ω/V, related to the maximum voltage. The response value must not be changed after electrical inspection.

E.139 The IMD must be connected on the prototype side of the HVCs.

E.140 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.141 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.39.

E.142 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.

Chargers

E.143 Only chargers presented at technical inspection are allowed. All connections of the chargers must be insulated and covered. No open connections are allowed.

E.144 While charging, the HVBC must be connected to protective earth.

E.145 High Voltage charging leads must be orange.

E.146 When charging, the High Voltage Battery BMS must be active and must be able to open the SDC.

E.147 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 te charger.

E.148 All chargers must be of overall good build quality.

Control System Requirements

General Control System Requirements

C.1 All control system requirements apply to the vehicles, custom tracks, and other prototypes of the teams

C.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.
- (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.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.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.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.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.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.8 The control system must prevent actuation of the propulsion system if the emergency brakes are deployed.

Communications

C.9 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.10 The teams are not allowed to use the frequencies shown in Figure 1 below for their communication system.

Technical Inspection

T.1 All technical inspection rules apply to the vehicles, custom tracks, and other prototypes of the teams (all called "prototype").

T.2 Each individual prototype (custom track, vehicle, etc....) must pass the following technical inspections:

- Mechanical Inspection
- Electrical Inspection
- Control System Inspection

T.3 Teams are not allowed to dynamically test their prototype before all inspections have been passed.

T.4 Teams are not allowed to engage the High Voltage System of the prototype without the supervision of the scrutineer before having passed the Electrical Inspection.

T.5 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.

Number	Frequencies	Power	Bandwidth	Duty cycle	Remarks
B	6765 - 6795 kHz	42 dBµA/m at 10 m			
C	13,553 - 13,567 MHz	42 dBµA/m at 10 m			
D	26,957 - 27,283 MHz	10 mW e.r.p.,which is 42 dBµA/m at 10 m			
D1	26,990 - 27,000 MHz	100 mW e.r.p.	≤ 10 kHz	< 0.1%	
	27,040 - 27,050 MHz				
	27,090 - 27,100 MHz				
	27.140 - 27,150 MHz				
E	40,660 - 40,700 MHz	10 mW e.r.p.			Cannot be used for video
F1	169,4000 - 169,4750 MHz	500 mW e.r.p.	≤ 50 kHz	< 1%	
F2	169,4000 - 169,4875 MHz	10 mW e.r.p.		< 0.1%	
F3	169,4875 - 169,5875 MHz	10 mW e.r.p.		< 0.001%	
F4	169,5875 - 169,8125 MHz	10 mW e.r.p.		< 0.1%	
G	433,050 - 434,790 MHz	10 mW e.r.p.		< 10%	
G1	433,050 - 434,790 MHz	1mW e.r.p.			For bandwidth higher than 250 kHz the maximum power density is -13 dBm/10 kHz
G2	434,040 - 434,790 MHz	10mW e.r.p.	25 kHz		
H1	863,000 - 865,000 MHz	25mW e.r.p.		< 0.1%	
H2	865,000 - 868,600 MHz	25mW e.r.p.		< 1%	
H3	868,700 - 869,200 MHz	25mW e.r.p.		< 0.1%	
H4	869,400 - 869,650 MHz	500 mW e.r.p.		< 10%	
H5	869,400 - 869,650 MHz	25mW e.r.p.		< 0.1%	
H6	869,700 - 870,000 MHz	S mW e.r.p.			
H7	869,700 - 870,000 MHz	25mW e.r.p.		< 1%	
I	2400 - 2483,5 MHz	10 mW e.i.r.p.			
J	5725 - 5875 MHz	25 mW e.i.r.p.			
K	24,00 - 24,25 GHz	100 mW e.i.r.p.			
L	57 - 64 GHz	100 mW e.i.r.p.			Maximum transmitter power output of 10 dBm and a maximum e.i.r.p. spectrum power density of 13 dBm/MHz
M	61,0 - 61,5 GHz	100 mW e.i r.p.			
N	122 - 123 GHz	100 mW e.i r.p.			
O	244 - 246 GHz	100 mW e.i r.p.			

Figure 1: Available frequencies with power, bandwidth, and duty cycle for communication in the Netherlands (source: https://wetten.overheid.nl/BWBR0036378/2016-12-28).

T.6 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.

T.7 Prototypes presented for technical inspection must be in "ready to demonstrate" condition.

T.8 Teams should bring all relevant datasheets, rule questions, photos, spare parts, and equipment to prove compliance with the rules and regulations.

T.9 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.

T.10 Scrutineers will mark or seal various different approved parts. Removal of or damage to the seals will void the inspection approval.

T.11 After passing technical inspection, scrutineers may perform additional inspections (e.g. after a demonstration) to ensure prototypes still comply with the rules and regulations.

T.12 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.

Appendix A - Example SDC Vehicle

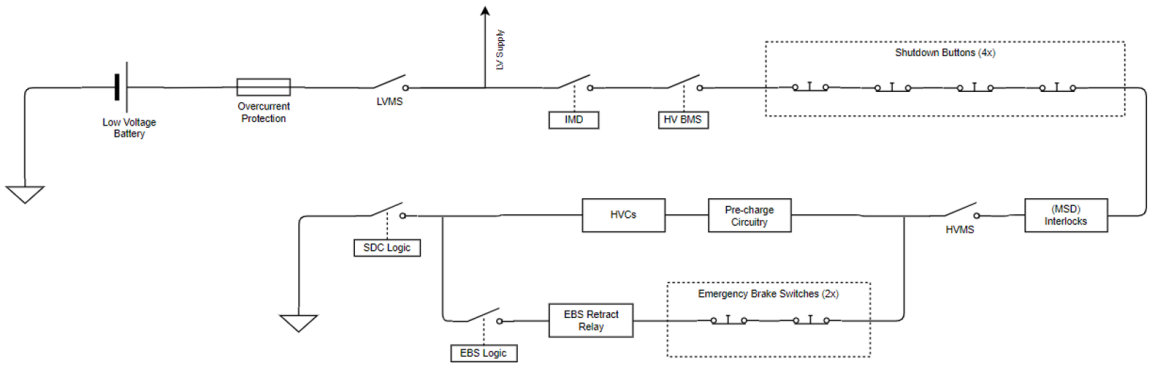

Figure 2: Example of the Shutdown Circuit.

6.2 Application Process for Demonstrations

In order to get the approval for a Demonstration at the Event, the applicants shall demonstrate their understanding of subsystems with the following documents to be submitted in PDF format by the indicated deadlines. Failure to do so might result in the exclusion of the Event. For ease of submission, a template for each of the submission documents will be released well prior to the submission deadline. These templates contain information on what each section should contain. For details on the submission itself refer to Applications (see Section 5).

6.2.1 Intent to Demonstrate (ITD)

This document is used as a first application for the Event. It shall provide an overview of the current status and upcoming steps of the respective system. Most importantly, the applicant must explain how the respective system will be tested prior to the Event. The applicant is reminded to complete Application Process (see Section 5.5) at this documentation stage.

ITD.1 Due: 13th December 2024, 23:59 CET via this form.

ITD.2 Document format: Formulated Engineering Documentation (see AP.11). Preferably using bullet points, tables, and descriptive images.

ITD.3 Document scope: Maximum of 3 pages per subsystem, excluding citations, index, or a cover page.

Minimum content

General

ITD.4 Description of the applicant and list of updated team members.

ITD.5 Details on the development environment and the research objectives.

ITD.6 Determination of one representative who will be in correspondence with the EHW Committee.

ITD.7 The category which this application is registered for. In the case of subsystems, specify which one will be demonstrated.

System

ITD.8 Technical description of the system to be demonstrated:

- Desired functionality. Do not explain basic physics or commonly used subsystem functionalities unless required by the jury in a feedback document. For example: No need to explain the basics EMS (electromagnetic suspension) works, as every year teams use this concept.
- Constraints (mass, dimensional, and budget).
- Initial concepts and Free Body Diagrams.

ITD.9 Size, components, appearance of the system (CADs, if available at this stage).

ITD.10 Integration of the system into a subordinate structure/system (if applicable).

ITD.11 Key elements and features of the system.

Safety

ITD.12 Precautions are taken in order to comply with the Rules & Requirements for Demonstration.

ITD.13 What are the key elements of the system? Which features incorporate the highest safety risks?

ITD.14 How will the subsystems that pose the highest safety risks tested prior to the Event?

6.2.2 Safety Document (SFD)

With this document, the applicants shall give further exact details of the system they want to demonstrate at the Event. It is intended as technical documentation and the applicant shall demonstrate that the corresponding system is designed and engineered safely and that he is able to test and operate the system safely.

SFD.1 Due: 29th February 2025, 23:59 CET via this form.

SFD.2 Document format: A Safety Document Template will be provided at a later stage. The applicant must fill in the blanks for the systems that apply to their demonstrator.

SFD.3 Document scope: Focus on the compliance of the team with the Rules & Regulations. For this, teams will be asked to provide proof their design fulfills the safety standards set in the R&R. This may include uploading, among others, schematics, calculations, or datasheets.

SFD.4 Documents that do not follow this template will not be reviewed, and will require an immediate correction upon the team is notified.

SFD.5 Addendums: Applicants have until 22nd March 2025, 23:59 CET, to send in an addendum to their SFD. Only minor, inevitable changes related to force majeure limitations will be accepted. Said limitations must be explicitly stated in the addendum.

Expected content

Safety

SFD.6 Technical description of the system to ensure compliance with the Rules & Requirements for Demonstration (see Section 6.1). Datasheets, electrical diagrams, high-pressure system schematics, calculations, etc, will be asked.

SFD.7 Preliminary risk assessment for Demonstration, including transport and lifting procedures.

SFD.8 Detailed FMEA and description of risk mitigation measures.

SFD.9 Summary of all energy storage types and components present in system(s).

SFD.10 Requirements for Transport, Storage, and Lifting as defined in Section 9.3, especially TS.4.

SFD.11 Transport and Lift Plan of the system

SFD.12 Procedures for safe storage of systems including potential energy.

Testing

SFD.13 Description of manufacturing methods of high safety risk components.

SFD.14 Outline of testing methods of high safety risk components.

6.2.3 Final Design Documentation (FDD)

With this document, the applicants shall describe in detail the system they want to demonstrate at the Event. It is intended as a document that will be taken into account while judging the team for the Engineering Design Award. This document will be used by the jurors in the grading and will likely base their 1-on-1 questions on this document as a starting point. Therefore, it is important that the team describes their system as best as they can. A template will be provided at a later stage.

FDD.1 Due: 19th April 2025, 23:59 CET via this form.

FDD.2 Document format: Formulated Engineering Documentation (see AP.11).

FDD.3 Document scope: Maximum of 100 pages in total excluding citations, index, or a cover page. The team is free to spend more or fewer pages on each subsystem, however, it is recommended to use around 10-15 pages maximum for each subsystem.

FDD.4 Larger documents will not be reviewed, and will require an immediate correction upon the team is notified.

Minimum content

General

FDD.5 Description of the applicant and updated list of team members.

FDD.6 Details on the development environment and the research objectives.

FDD.7 Definition of budget, funding, and method of manufacturing (in-house, outsourced, or combination) for each subsystem.

System

FDD.8 Detailed explanation of desired functionality. Do not explain basic physics or commonly used subsystem functionalities unless required by the jury in a feedback document. For example: No need to explain the basics EMS (electromagnetic suspension) works, as every year teams use this concept.

FDD.9 Description of design process taken.

FDD.10 Free Body Diagrams to define load cases for simulations.

FDD.11 Evidence of simulations validating the theory, and detailed analysis of results.

FDD.12 Detailed description of the dimensioning process.

FDD.13 Description of the manufacturing processes.

FDD.14 Size, components, appearance of the system.

FDD.15 Evidence of CAD models; Technical drawings of the complete system may be used to illustrate dimensions, but they should not be included for individual components of the system.

FDD.16 Integration of the system into a subordinate structure/system (if applicable).

FDD.17 Detailed plan of the demonstration, specifying the needed equipment and infrastructure (either own infrastructure or provided by EHW Committee).

FDD.18 Parts list (including dimensions and mass), in tabular format. Please identify which parts are made in-house or outsourced from an external supplier.

FDD.19 Images or CAD renders of the demonstration setup including all parts of the system that will be brought to the Event.

FDD.20 If the applicant intends to use their own infrastructure (e.g. test bench), its safety must be proven as well.

Testing

FDD.21 Outline of manufacturing and testing procedures to be included in the Safety Procedures Documentation.

6.2.4 Video of Demonstration (VOD)

This document will include a link to the videos along with a one-page explanation of their content. The videos and accompanying document provide detailed demonstrations of tests that showcase the intended functionality during EHW 2025, as well as the thorough testing conducted on systems identified as high safety risks.

The tests must contain results, measurements, and data in order to prove that it has been performed. Additionally, it is required to hand in video recordings of the tests in order to prove that the tests were conducted properly. The performance of the system will not be assessed with these videos. This document is intended to prove that the team is far enough into the testing phase so that they will be able to demonstrate their technology at the EHW and to prove proper testing of specific systems. The team may improve the performance of the Demonstrator up until the Demonstration Day.

Any deliberate manipulation or wrong presentation of testing results, testing methods, or equivalent will lead to the immediate ban from the Event.

VOD.1 Due: 13th June 2025, 23:59 CET via this form.

VOD.2 Document scope: The document must include a video of the functionality of the intended systems to be demonstrated at the EHW 2025 and one page of explanation what is shown. The performance of the system will not be evaluated during this submission. The intent is to ensure that the Applicant is far enough into the testing phase so that they will be able to perform a demonstration at the EHW. The performance of specific systems can be improved up until the Demonstration Day. In addition, if safety risks are identified by the EHW Committee during the revision of any of the previously handed-in documents, the Applicant may be requested to upload additional videos.

Minimum content

VOD.3 Written report of every completed test for the respective systems, which include, for each test:

- Aim/objectives of the test (hypothesis).
- Test description (methodology).
- Information about used testing infrastructure and setup (components, material, dimensions, instrumentation, etc.).
- Risk assessment.
- Detailed testing protocols (including entrance and exit criteria for each step in the protocol).
- Testing setpoints/conditions (e.g. load cases, pressure, voltage, speed, etc.).
- Expected results.
- Measurement data.
- Processed results (graphs, diagrams). All the representation of results must be own-referenced or the external reference must be explicitly stated. All graphs must have legible axis and legend titles (preferably with the same font as the text) and with a common format throughout the document.
- Conclusion.

VOD.4 Video of performed tests submitted in the following format:

- Static camera position.
- Clear vision of performed test.
- At least 1080p resolution.
- Uploaded to an online streaming service (e.g. YouTube) and a link provided within the VOD report.
- The date of the video upload onto the streaming service must precede the submission deadline of the VOD.

6.2.5 Summary Pages

This document shall be delivered prior to the EHW. It will be used for publication on the EHW Website and Social Media. This will promote knowledge sharing, and serve as a baseline for new teams joining the competition. It can be adapted from the ITD, polishing it with the requested feedback and adapting it to not include any confidential information.

SPG.1 Due: 10th July 2025, 23:59 CET.

SPG.2 Document format: Formulated Engineering Documentation (see AP.11). Tables from the ITD can be replaced with figures and renders of the system.

SPG.3 Document scope: Maximum of 3 pages per subsystem, excluding citations, index or a cover page.

6.2.6 Technical Presentations

Presentations serve as a way for the jury to directly interact with the team proposal, as an intellectual defense that proves the team understands their proposal and as an information exchange between teams and other assistants to the competition.

DP.1 Due: Competition week.

DP.2 Document format: Graphical slides.

DP.3 Document scope: 30' of presentation for the complete system presentation. 15' for the subsystem presentations. This time is exclusive for the presentation and more time will be given for questions.

6.2.7 Scrutineering

The safety of the teams, jury, and audience is crucial. Therefore, the prototypes of the teams will be thoroughly checked before they are cleared for demonstrations with a round of scrutineering before the event. Specific details on the logistics of how to apply for the Scrutineering stages once at the EHW location will be provided 1 month before the competition.

Testing of the system inside the EHW precinct will not be allowed before the corresponding scrutineering is passed.

During the scrutineering, prototypes will be inspected by the technical jury. The technical jury will assess the manufacturing and assembly of the prototype and will check safety-related aspects. In addition to that, the resemblance of the pod with the documentation previously supplied to the EHW (FDD and SFD) will be checked.

The scrutineering will happen before or during the EHW 2025. Detailed logistical information will be given in further versions of this R&R document. Team members will need to be present during the scrutineering. The pod or demonstrator has to be present during the scrutineering to be eligible for demonstration.

General

SCRT.1 The scrutineering is divided into the following stages:

- Mechanical check
- Magnets inspection

- Battery and Low-Voltage inspection
- Software and Sensors inspection
- Power Electronics inspection
- Demonstration test

SCRT.2 Each demonstrating system applying to the demonstration Category must pass all parts of technical inspection. Failure to do so will result in the team not demonstrating its system.

SCRT.3 Each demonstrating system applying to a subsystem award must pass all parts of the technical inspection that apply to them (decided by the jury). Failure to do so will result in the team not demonstrating its system.

SCRT.4 The jury reserves the right to disqualify a team or apply up to a 10-point penalty if significant changes are made to the system concerning the FDD or VOD.

SCRT.5 A scrutineering sheet containing points that will be inspected will be provided to the teams prior to the competition.

SCRT.6 Teams are responsible for confirming their system and that the required equipment satisfies the Rules and Regulations before presenting it for scrutineering.

SCRT.7 Safety non-critical rule violations that do not provide a benefit to the team and that cannot be changed at the event location may result in a point deduction.

SCRT.8 Safety non-critical rule violations that provide a benefit to the team and cannot be changed at the event location may result in a point deduction.

SCRT.9 Once the system is approved for demonstration, any damage to the system that requires repair(s) will void the scrutineering. After completion of the repair(s), the system must be re-submitted for scrutineering approval.

SCRT.10 Scrutineering officers reserve the right to prohibit the use of a part that could pose a safety risk.

Scrutineering approval

SCRT.11 During the mechanical inspection, the team will be handed a sticker containing all required scrutineering stages. This sticker must be placed in a visible spot on the system or test setup.

SCRT.12 The jury and EHW technical team will decide which scrutineering stages must be performed by each team. The team will be informed well before the competition.

SCRT.13 To pass any scrutineering stage:

- The jury must physically review in detail the involved parts of the system
- The procedure must be approved.
- The procedure must be performed live in front of the jury.
- The team should be able to answer all questions posed by the jury members.

SCRT.14 The jury may not approve a stage and ask the team to change certain aspects of the system. In this case, the team must perform that scrutineering stage again to gain approval.

SCRT.15 To be able to perform the demonstration test, the team must have successfully passed all scrutineering stages. This means no partial stages.

Post-event scrutineering

SCRT.16 The jury reserves the right to perform another scrutineering at any point during the week to check for compliance with the rules.

SCRT.17 After any demonstration, the system must comply with the rules.

SCRT.18 If the inspected team presents violations of the rules, the jury reserves the right to apply a penalty deduction on each of the awards the team is applying for.

SCRT.19 After the demonstration test has been performed, the team is not allowed to make any changes to the system that will alter the performance of the system unless strictly stated via written notice by the jury. This includes software updates.

SCRT.20 If any changes are made to a part of the vehicle (either hardware or software) that has already been scrutineered, the applicant must pass this stage(s) again.

SCRT.21 If unauthorized changes are made, the jury reserves the right to:

- Disqualify the team if the changes result in a safety hazard.

7 Research Submission Application

As stated in Research Submission (see Section 5.3), the Research Submission consists of a self-sufficient document fully detailing the work of research the applicant has completed.

7.1 Rules & Requirements for Research Submission

For the Research Submission to go ahead at EHW 2025, the applicant must abide by the following rules:

RSA.1 The research presented is the applicant's own work. Previous literature can be used, as long as the applicant adheres to scientific standards. All contributions to the research by collaboration and information exchange with third parties should be clearly indicated.

RSA.2 The Research Submission presents novel information. The applicant is responsible for revising the novelty of the research. Previous edition reports can be found here (EHW 2024b). In case the research addresses a previously investigated topic, the applicant must clearly indicate what new aspects of the topic are addressed or to what extent the topic is approached in a new way, resulting in new information or insights.

RSA.3 The Research Submission itself may consist of a single PDF document per topic. If the applicant would like to present supplementary material related to their Research Submission, such as an experimental set-up, then they need to follow the application process for Demonstration (see Section 6) or Showcasing (see Section 8) as required by their intended activities. The supplementary material will not contribute to the evaluation of the Research Submission or Full-Scale Presentation.

7.2 Application Process for Research Submission

In order to be allowed to submit and present research at EHW 2025, the applicants shall document their work in the Intent to Submit Research (ITSR) and Final Research Submission (FRS) in PDF format by the indicated deadlines. Failure to do so will result in an unsuccessful application. For details on the submission itself refer to the announcements on the social media of European Hyperloop week and webpage.

7.2.1 Intent to Submit Research (ITSR)

This document is used as the first application for the EHW 2025. It shall contain information on the topic of research the applicant aims to submit, the scope of the work, and a brief overview of the methodology used.

ITSR.1 Due: 13th December 2024, 23:59 CET via this form.

ITSR.2 Document format: Extended abstract, use of tables and descriptive images recommended.

ITSR.3 Every ITSR makes use of the following ITSR document (EHW 2024a) filled in, or the team may use their own document with similar layout and headers.

ITSR.4 Document scope: Sketch the outline of your research; maximum of 5 pages per Research Submission, excluding the cover page, and optional index and citations.

Minimum content

General

ITSR.5 Description of the applicant, including the development environment and an up-to-date list of team members working on the submission.

ITSR.6 Designation of one representative who will be in correspondence with the EHW Committee.

ITSR.7 The Full-Scale Award for which this application is registered.

Research

ITSR.8 Title of the research project.

ITSR.9 Motivation of the research project and research objectives.

ITSR.10 Scope of the research.

ITSR.11 Overview of the methodology followed (or to be followed) in conducting the research.

ITSR.12 Outline of content that will be presented in the FRS.

ITSR.13 If applicable, description of supplementary material the applicant would like to present and whether this material will be demonstrated or showcased based on the definitions of the Rules and Regulations. In the case of demonstration, a separate ITD is required following the Rules and Regulations stated in Demonstration (see Section 6).

7.2.2 Final Research Submission (FRS)

This document should contain all details of the research conducted by the applicant that is to be presented at EHW 2025. Content-wise, it should follow the guidelines described in this section and be self-sufficient without requiring additional material. The appendix may provide supplementary information which is relevant, but not necessary to understand the submission.

The EHW Committee reserves the right to reject an application if the FRS does not meet expectations or if it differs greatly from the ITSR.

FRS.1 Due: 22nd June 2025, 23:59 CEST.

FRS.2 Document format: Research paper. The submission should be a single PDF file no longer than 20.000 words (roughly 40 A4 pages), not counting the reference list and appendices.

FRS.3 Addendums: No addendums will be accepted for the FRS. Submissions should be in their final form at this stage.

FRS.4 Layout of the report must be clear and structured. It is highly recommended to use this structure. You may use you own structure, however it is obligated to include on the title page: The title, authors names, team name, word count (exclusively relevant report content), and the award applying for.

FRS.5 All information not created by the author must be cited properly with traceable and reliable sources.

7.2.3 Posters and Complementary Material

All successful applicants must bring a printed poster to the EHW that meets the minimum content and format requirements. Each Research Submission must have its own dedicated poster. Teams are responsible for bringing the poster, a stand, and any additional materials they wish to display. The stand must be suitable for showcasing both the poster and any complementary items.

At the EHW, there will be a designated conference area where each research submission of a team will have its own stand. Due to space limitations, teams will not be able to give presentations as in previous editions. Instead, the jury will circulate between stands, engage directly with teams, and evaluate the defense of their research. The jury will prepare a set of questions in advance and assess each team's responses at the conference stand.

The jury's impression during this process, combined with the quality of the Final Research Submission (FRS), will determine which three teams per submission category will be invited to deliver a full oral presentation. The remaining teams will present a shorter 5 minute presentation instead.

RSP.1 Due date: 25th June 2025, 23:59 CEST.

RSP.2 Poster content: The poster should summarize and reflect the Final Research Submission (FRS).

RSP.3 Submission requirements:

- List of items brought, including their dimensions
- Minimum poster size: A2
- Maximum stand width: 200 cm
- Maximum stand depth: 200 cm

7.2.4 Full-Scale Presentations

Teams must record and submit a video presentation prior to the competition. These recordings, alongside the research submissions and the teams' defense at the EHW conference, will be used by the jury to determine which three teams from each research category will deliver a full presentation at the EHW. The remaining teams will give a shortened version of their presentation during the event.

For teams delivering shortened presentations, we highly recommend preparing a concise and impactful pitch.

It is essential that the video presentation is of high quality, with clear audio. Graphical slides must be used throughout, and both the presenters and the slides must be clearly visible in the recording.

FSP.1 Video submission due: 25th June 2025

FSP.2 How to submit: Upload your video to a platform such as your team's website, YouTube, or Google Drive. Ensure that the link is accessible and easily shareable with EHW organizers and the jury.

FSP.3 Full presentation: 15 minutes of content

FSP.4 Shortened presentation: 5 minutes of content

8 Showcasing

The Showcase category provides teams an opportunity to compete by presenting innovative work that advances understanding of Hyperloop technology and its challenges. Teams can participate in the Showcase competition through three distinct approaches:
Showcases can be:

- Independent presentations of new Hyperloop concepts, technologies, or research
- Complementary material to demonstrated systems (such as an aeroshell design).
- Visual or interactive supplements to research presentations (like a scale model of a Hyperloop station accompanying research on station design).

Teams participating in the Showcase category will present their work at dedicated stands with accompanying posters. These presentations will be evaluated as part of the Showcase competition. The Showcase Award will recognize excellence in communicating Hyperloop concepts and advancing understanding of its technological challenges.

8.1 Rules & Requirements for Showcase

In order to receive the permission for a showcase at the EHW 2025, the applicant must follow the following rules:

SHW.1 In principle, each participating team has space for 3x1 meters to showcase systems, research, and posters. In case a team is in doubt about something they intend to bring to the EHW, they are strongly advised to contact the technical team.

SHW.2 The showcased work is powerless.

SHW.3 No kind of potential, kinetic, chemical, or electromagnetic energy stored in, on, within, or around the showcased work (thus especially no batteries within the system). This includes that no kind of the mentioned energy storage is allowed on the site of the EHW 2025.

SHW.4 Any further low-power devices or appliances that are not part of the system and only intended for visual display or presentation purposes (i.e., LEDs, lights, monitors) must also be mentioned and highlighted in the Showcase application and can be powered on-site if approved by the EHW Committee.

SHW.5 The magnetic flux density cannot exceed 1 mT anywhere on the surface of the cover or storage box of any permanent magnet.

SHW.6 The exhibitor needs to sign the EHW Terms & Conditions. Therefore, they take full responsibility for any damage, incident, or accident caused to or by an exhibitor's showcased material.

SHW.7 The requirements for Transport, Storage, and Lifting as specified in Section 9.4 must be followed.

8.2 Showcase Documentation (SD)

In order to get approval for a Showcase at the EHW 2025, the applicants shall document the respective system by submitting the required documents in PDF form by the indicated deadline. Failure to do so will result in an unsuccessful application. For details on the submission itself refer to section 10.

SHWD.1 Due: 17th June 2025, 23:59 CET via this form.

SHWD.2 Document format: Formulated Engineering Documentation (see AP.12) or extended research abstract.

Minimum content

General

SHWD.3 Team name

SHWD.4 Point of contact and email

SHWD.5 Description of the applicant and updated list of team members, advisors, and industry partners.

SHWD.6 Details on the development environment and the research objectives related to the showcased material.

SHWD.7 If applicable, the award application to which the showcased material is related.

System (if applicable)

SHWD.8 Detailed explanation of theory and principle physics of desired functionality.

SHWD.9 Description of design process taken.

SHWD.10 Free Body Diagrams to define load cases for simulations (if applicable).

SHWD.11 Evidence of simulations validating the theory, and detailed analysis of results (if applicable).

SHWD.12 Dimensions, mass, and components of the system.

SHWD.13 Appearance of the system, either by clear images or CAD models. Technical drawings of the complete system may be used to illustrate dimensions, but they should not be included for individual components of the system.

SHWD.14 Integration of the system into a subordinate structure/system (if applicable).

SHWD.15 Detailed plan of the showcase, specifying the needed equipment (expected to be provided by the EHW and brought by the team).

SHWD.16 Images, or CAD renders, of the showcase setup including all parts of the system that will be brought to the EHW 2025.

SHWD.17 Any low-power devices or appliances that the applicant wishes to use for visual display or presentation purposes (i.e., LEDs, lights, monitors).

Research (if applicable)

SHWD.18 Title of the research project.

SHWD.19 Motivation of the research project and research objectives.

SHWD.20 Scope of the research.

SHWD.21 Overview of the methodology followed (or to be followed) in conducting the research.

SHWD.22 Outline of content that will be presented in the showcased research.

8.3 Showcasing Posters (SP)

All successful applicants must bring a poster to the EHW with minimum content and format requirements. One poster shall be made per Demonstrated System or Research Submission. More information and the poster template will be provided by the EHW Committee closer to the event dates. All exhibitors must follow the minimum content requirements outlined below.

SP.1 Due: 17th June 2025, 23:59 CEST.

SP.2 Minimum required content: In case the poster regards research, it should summarise and reflect information included in the FRS. In case the poster regards a technical system (proposal), it should summarise and reflect information included in the FDD or present the information that is in line with the requirements for FDD documentation.

Required format

SP.3 Minimum size A2

SP.4 PDF, SVG, AI, or EPS format.

SP.5 300 dpi (dots per inch) or fully vectorized.

SP.6 CMYK color mode.

SP.7 Bleed and registration marks for correct guillotining must be included in the final delivery.

9 EHW Infrastructure & Associated Requirements

This section contains information regarding the Infrastructure used at the European Hyperloop Week 2025. Section 9.1 provides information on the track provided by the European Hyperloop Center that will be available at the competition site, Section 9.2 describes the possibilities of showing the performance of a demonstrator under vacuum conditions, Section 9.3 contains requirements regarding bringing and setting up custom tracks for demonstration, and Section 9.4 provides general requirements on Transport, Storage, and Lifting of materials during the EHW.

9.1 EHC Test track

With the next edition of the European Hyperloop Week being held at the European Hyperloop Center (Groningen, Netherlands) several new opportunities exist for teams to demonstrate their ability to develop hyperloop technology in their facilities. The applicants will be allowed to demonstrate their systems, such as propulsion, levitation, or emergency breaking inside the EHC Tube. In order to be allowed to do so, the demonstrator must fulfill the rules set out in this R&R document.

This section intends to provide the information relevant for the technical compliance of any hyperloop testing vehicle with the facility on a mechanical front. The information in this section is organized in the following manner

- Overview of the Infrastructure
- Detailed design of each track type
- Definition of vehicle / keep-out zones
- Track-to-track transitions
- Maximum allowed (impact) loads per track

9.1.1 Infrastructure Overview

Each pipe contains attachments that support four sets of tracks, whose positioning is specified in Figures 1, 2, and 3. From top to bottom:

- Blue, "Levitation Tracks": a set of plain rectangular tracks, made of electrical steel (M470-50A) and measuring roughly 1 meter per segment.
- Red, "Propulsion Tracks": a set of tracks, each consisting of a row of magnetically separated, electrical steel blocks, which each measure 17 cm in length. A layer of HMPE sits against either side of these rows of blocks.
- Green, "Guidance Tracks": another set of plain rectangular tracks, made of electrical steel and measuring roughly 1 meter per segment.
- Orange, "Safety Tracks": set of tracks consisting of a weldment of two plates and a hollow section, all made of stainless steel 304L (1.4307). Additionally, a 25 mm thick layer of HMPE sits on the top face of this sandwich.
- Purple, "Switch Floor": only present inside the switch pipes.

- "LIM Track": Currently now shown, but is considered to be added in the top center in between the two blue levitation tracks.

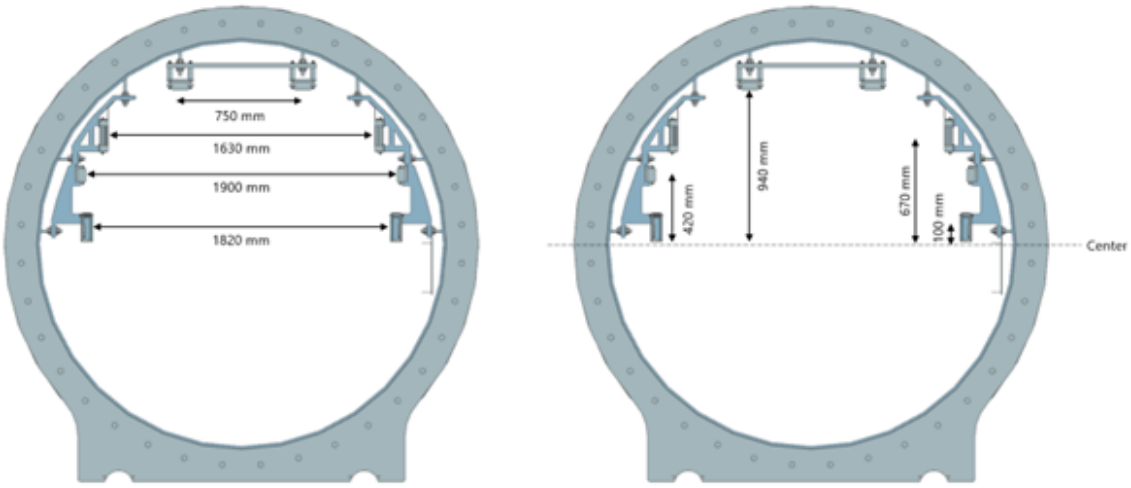

Figure 3: Track position with respect to each other and center

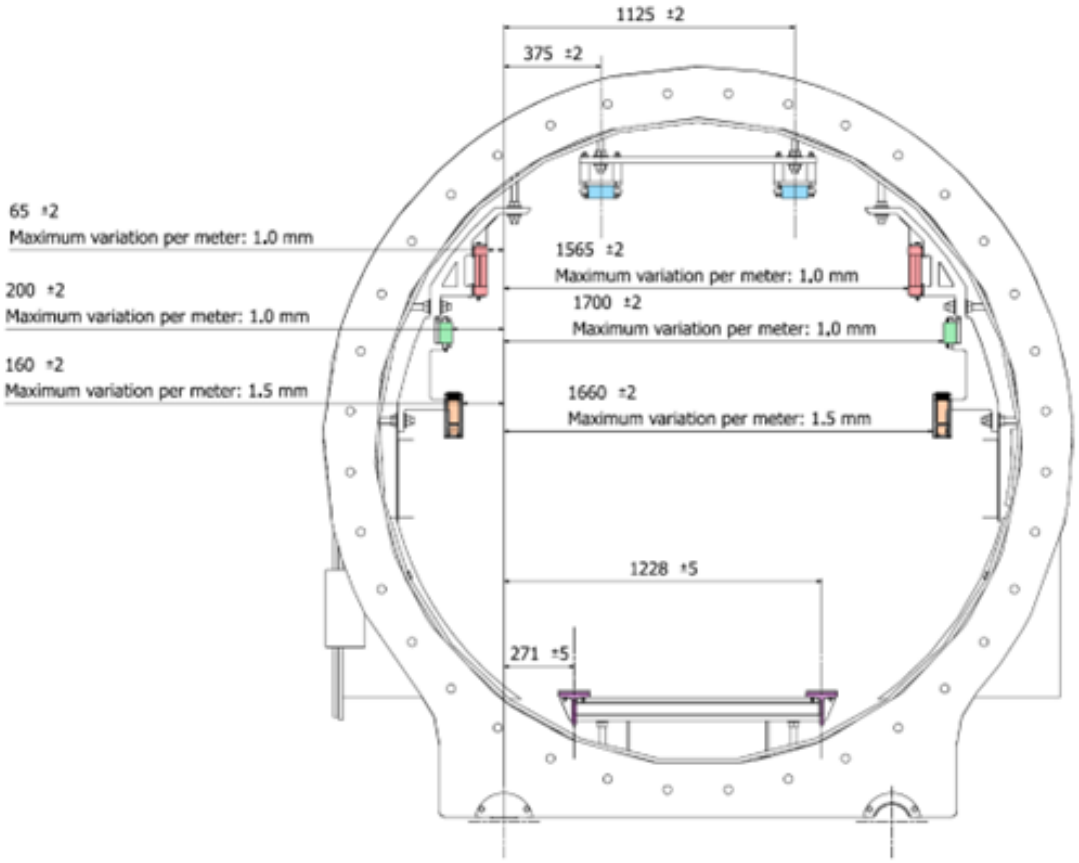

Figure 4: Lateral positioning of tracks within a pipe cross section

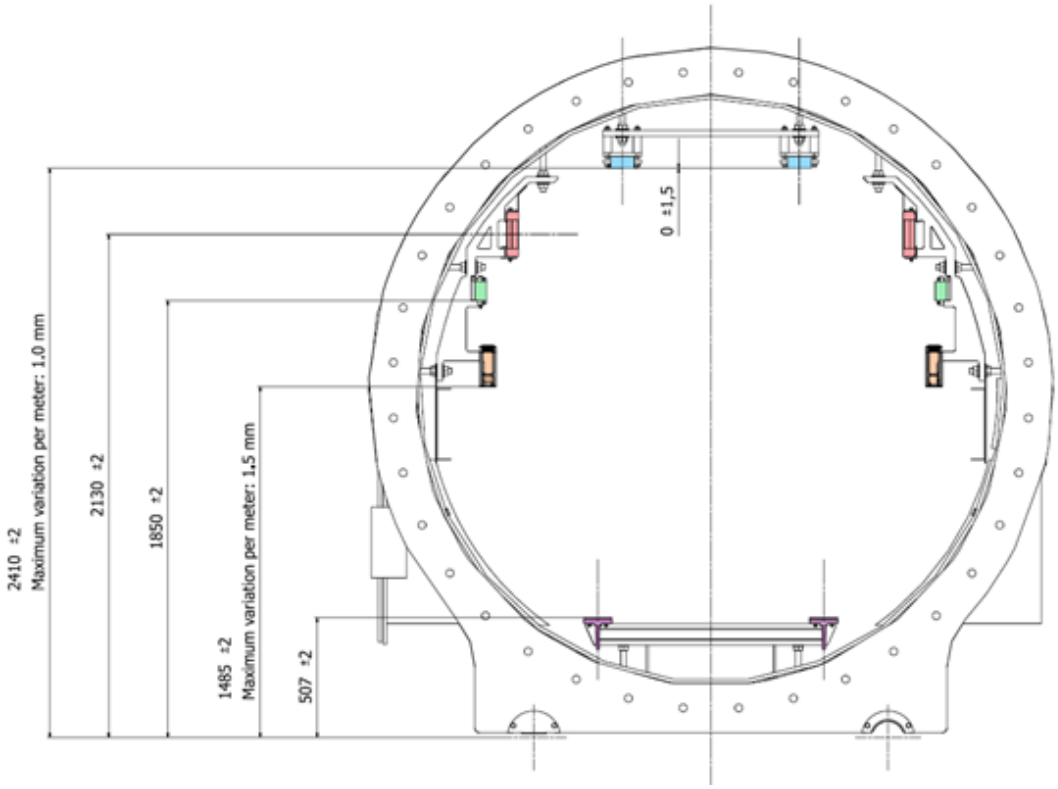

Figure 5: Vertical positioning of tracks within a pipe cross section

9.1.2 Detailed Track Design

This section provides more information per track set about dimensions and the used materials.

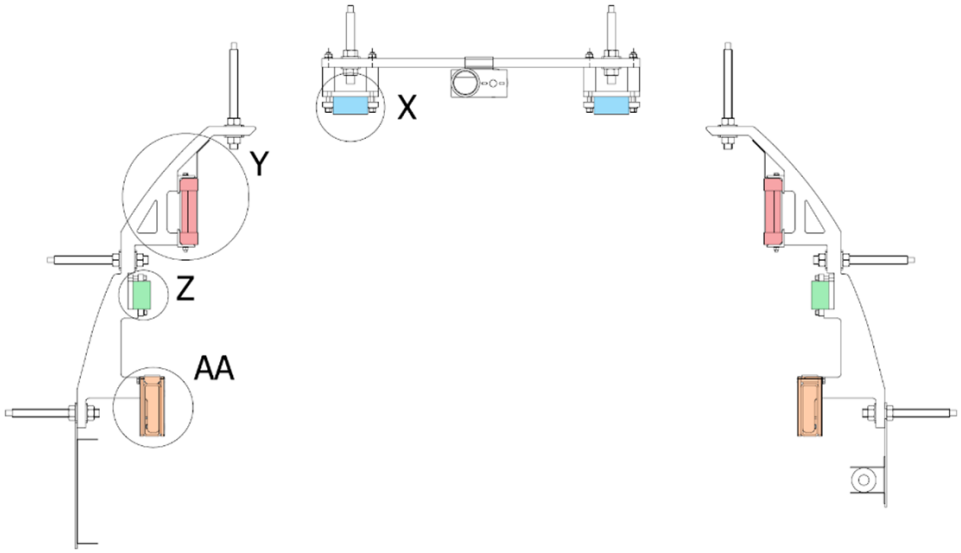

Figure 6: Overview of the track closeups to be discussed in this section

Blue Track – Levitation Track Figure 7 provides a closeup of the blue track. Features include:

- Track segment length: 1 meter.
- Topology & materials: rectangular track made of M470-50A, laminated as indicated in purple.
- Points of possible contact (orange): needs to be avoided by design, as these tracks are prone to delamination. However, an on-board feature does need to be present in case contact is possible to mitigate circumstances in the unlikely event of contact between the vehicle and this track. Requirements for such features include:
  - The material hardness shall be no greater than 121 HB / 70 HRB
  - A shallow chamfer shall be present on the on-board feature in the directions of travel, with the chamfer angle being no greater than 20 degrees.
  - The on-board feature shall have a surface roughness of no greater than 3.2 μm Ra.
  - The material shall prevent forming any permanent bond with the track because of sustained contact.
  - Abrasion of the on-board material shall not lead to any significant fire or respiratory hazard

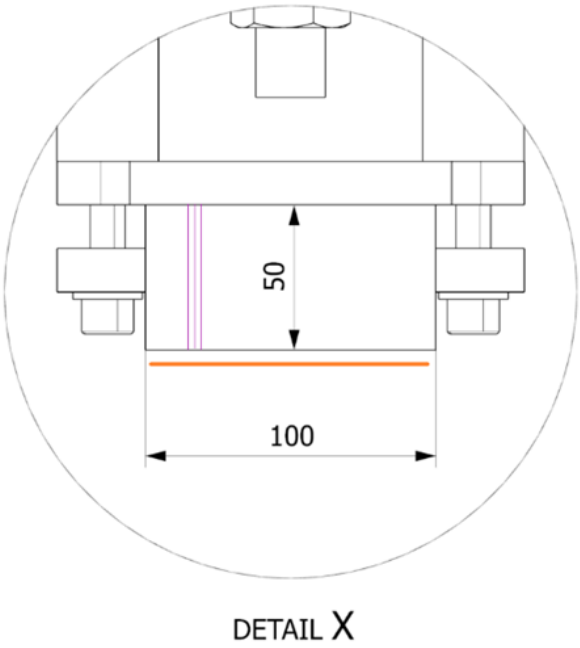

Figure 7: Closeup of the blue levitation track.

Blue Track – Levitation Track Figure 8 provides an isometric view of a red track segment, which is comprised of various components that are shown in a closeup in Figure 7. Features include:

- Track segment length: 4 meter.
- Topology & materials:
  - Magnetically separated track blocks made of M470-50A, whose individual dimensions are presented in Figures 8 and 9. The blocks are placed at a 200 mm pitch, as shown in Figure 10.
  - A 35 mm wide layer of HMPE that sits on either side of the track blocks and protrudes 1 mm from the surrounding components.
  - The track is accompanied by a 2 mm thick flange up top made of stainless steel 304L. Barcode stickers and encoder lines are present on the blue surface across the entire track, which can be used for position measurements at reduced and high speeds.
  - The collective is supported by two stainless steel L-brackets which are located behind the layers of HMPE.
- Points of possible contact (green): contact is permitted exclusively with the layers of HMPE. Direct contact with the electrical steel track blocks needs to be prevented by design. Requirements for any vehicle features that may come in contact with the HMPE include:
  - A shallow chamfer shall be present on the on-board feature in the directions of travel, with the chamfer angle
  - The on-board feature shall have a surface roughness of no greater than 3.2 μm Ra.
  - The temperature at the contact patch shall never exceed 80 degrees Celsius, given a temperature of 30 degrees Celsius as initial condition.

– Abrasion of an on-board material shall not lead to any significant fire or respiratory hazards.

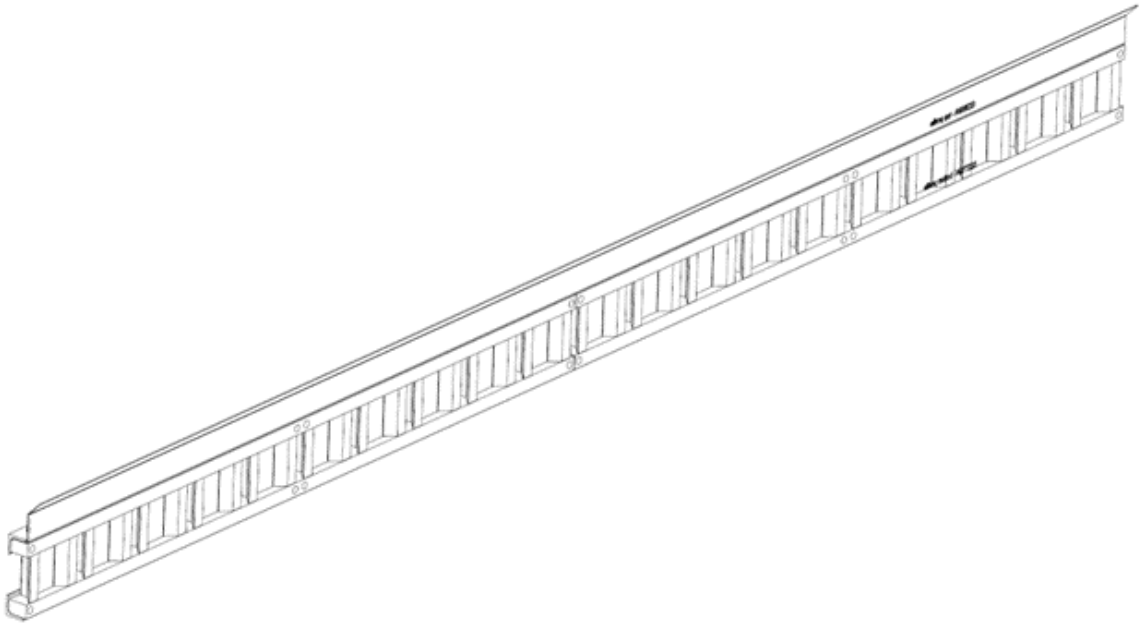

Figure 8: Isometric view of a red track segment

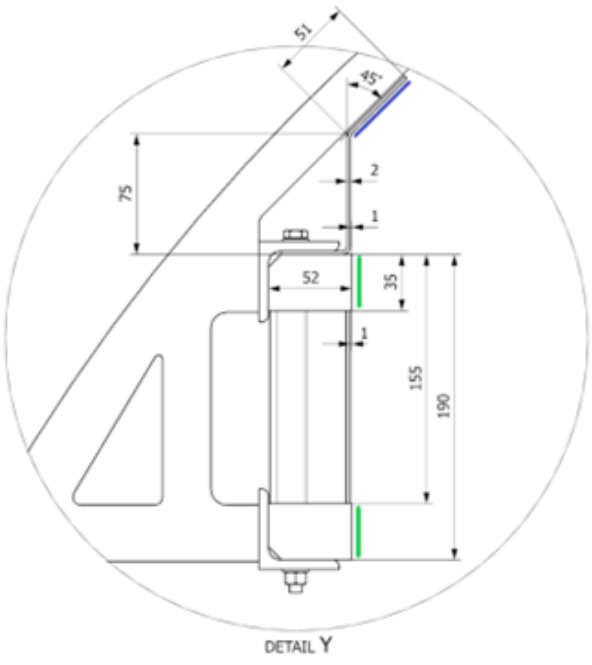

Figure 9: Closeup of the red track

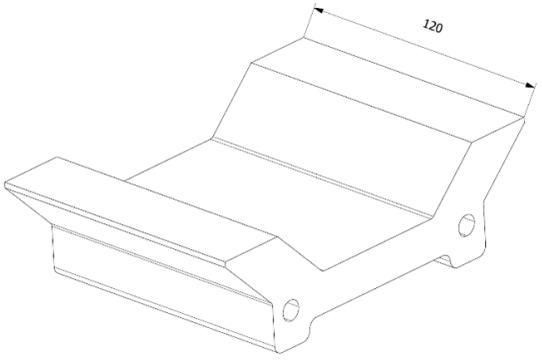

Figure 10: Isometric view of a track block

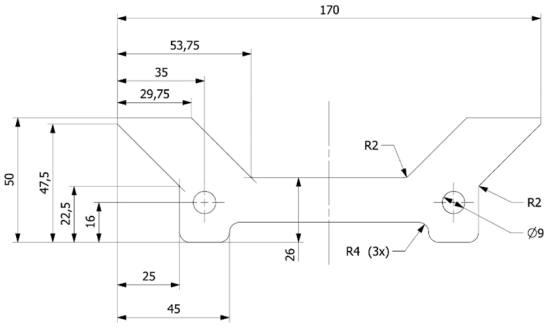

Figure 11: Dimensioning of a single layer in the track block laminate

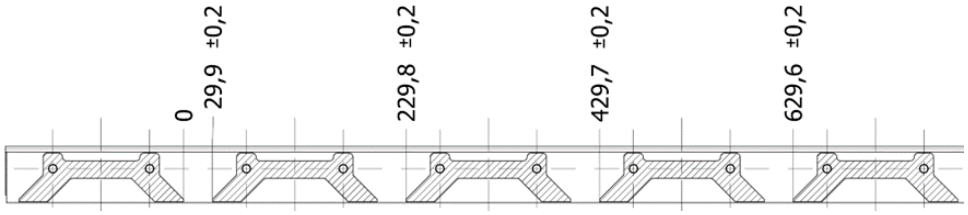

Figure 12: Cross section of the layout of electrical steel track blocks along the red track

Green Track - Guidance Track Figure 13 provides a closeup of the green track, which is analogous to the blue track. Features include:

- Track segment length: 1 meter.
- Topology & materials: rectangular track made of M470-50A, laminated as indicated in purple.
- Points of possible contact (orange): needs to be avoided by design, as these tracks are prone to delamination. However, an on-board feature does need to be present in case contact is possible to mitigate circumstances in the unlikely event of contact between the vehicle and this track. Requirements for such features include:
  - The material hardness shall be no greater than 121 HB / 70 HRB.
  - A shallow chamfer shall be present on the on-board feature in the directions of travel, with the chamfer angle being no greater than 20 degrees.
  - The material shall prevent forming any permanent bond with the track as a result of sustained contact
  - Abrasion of the on-board material shall not lead to any significant fire or respiratory hazard.

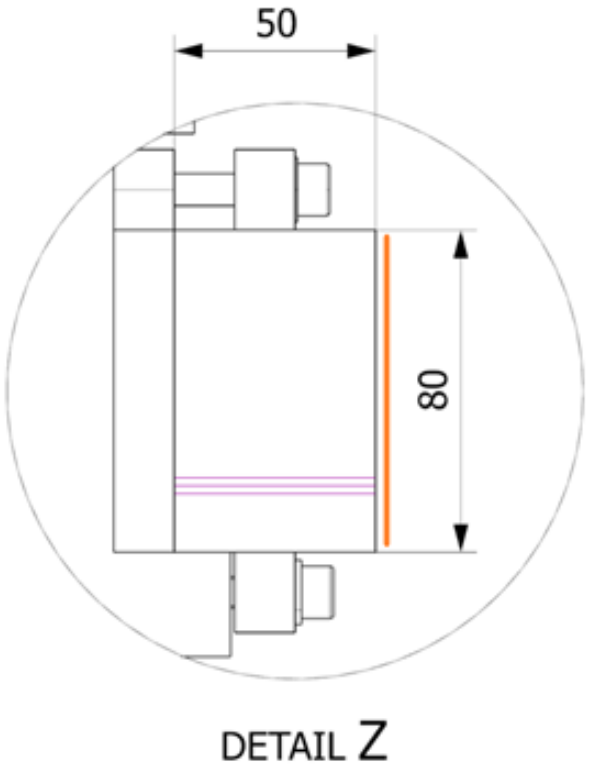

Figure 13: Closeup of the green track

Orange Track - Safety Track Figure 14 provides a closeup of the orange track. Features include:

- Track segment length: 3.5 meter.
- Topology & materials:
  - Gray: steel track attachment.
  - Orange: hollow section made of SS 304L.
  - Blue: plates made of SS 304L.
  - Green: 45 mm wide layer of HMPE that protrudes 5 mm from the stainless-steel plates.
- Points of possible contact (green):
  - On the top face, contact is permitted exclusively with the HMPE. For this contact area, requirements are identical to those stated for the red track, namely:
    - A shallow chamfer shall be present on the on-board feature in the directions of travel, with the chamfer angle being no greater than 20 degrees.
    - The on-board feature shall have a surface roughness of no greater than 3.2 μm Ra.
    - The temperature at the contact patch shall never exceed 80 degrees Celsius, given a temperature of 30 degrees Celsius as initial condition.
    - Abrasion of an on-board material shall not lead to any significant fire or respiratory hazards.
  - On the remaining faces, contact is permitted with the stainless-steel components with a few remarks:
    - On the bottom face momentary contact is permitted, however continuous contact is not.

- Anywhere outside the switch section, contact with the outboard face is permitted but not preferable. The next section on vehicle/ keep-out zones will clarify how far up the outboard face contact is permitted.

– Requirements for vehicle features that contact the stainless-steel track components include:

- The material hardness shall be no greater than 170 HB / 87 HRB.
- A shallow chamfer shall be present on the on-board feature in the directions of travel, with the chamfer angle being no greater than 20 degrees.
- The material shall prevent forming any permanent bond with the track because of sustained contact (galling of particular relevance here).
- Abrasion of the on-board material shall not lead to any significant fire or respiratory hazard.

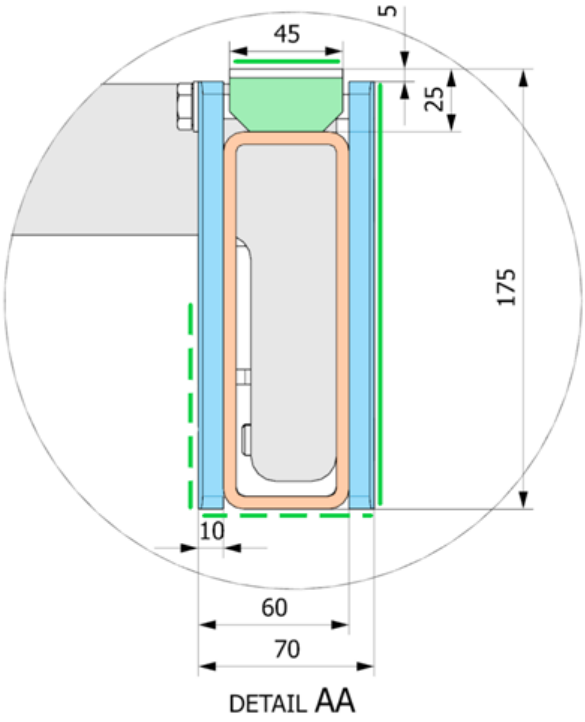

Figure 14: Closeup of the orange track

9.1.3 Vehicle Keep Out Zones (Preliminary)

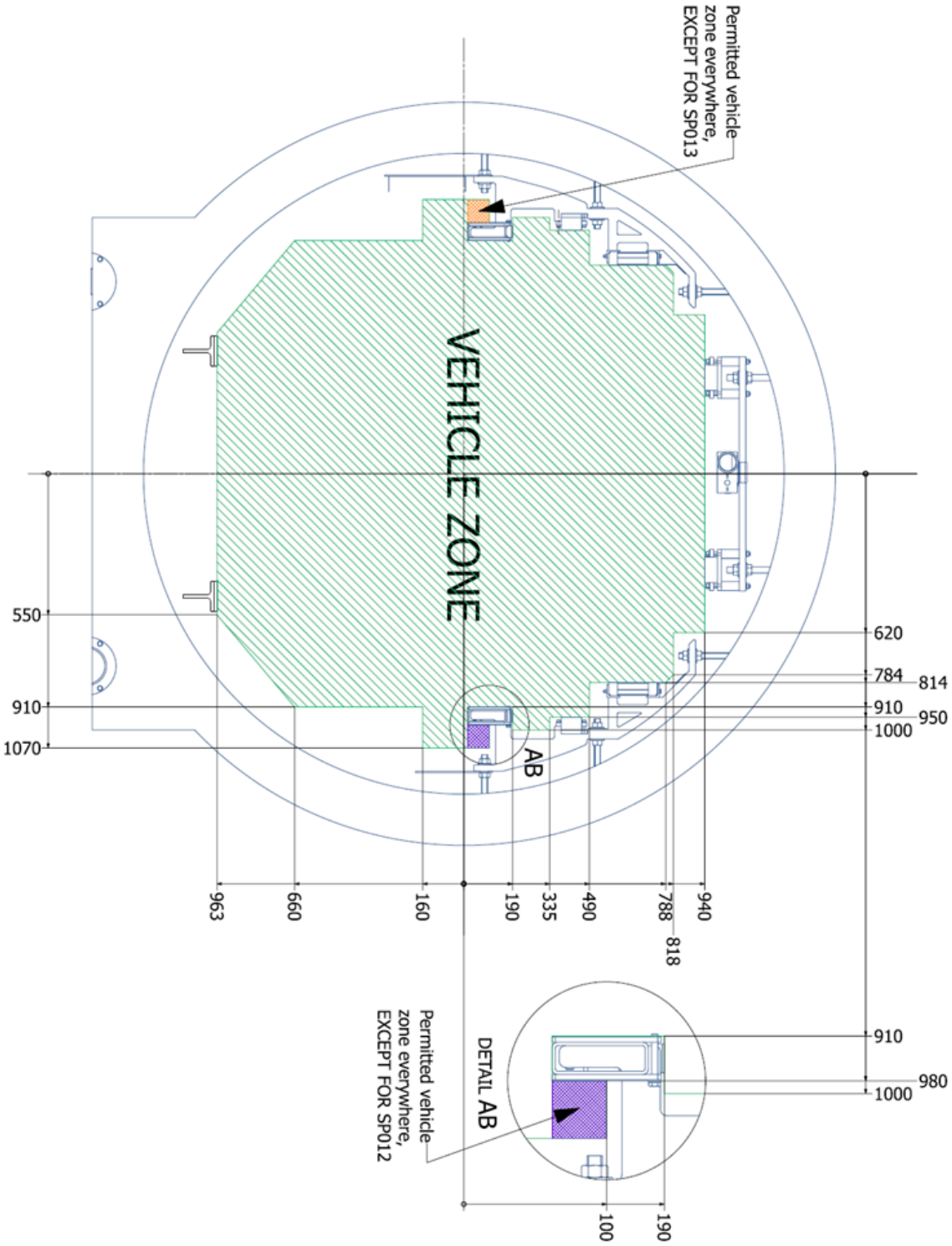

Figure 15: Indication of the zone in which the vehicle is allowed to operate. Any area outside this zone is off-limits for vehicles.

9.1.4 Track-to-track transitions

This section contains information about absolute misalignments, angular misalignments, chamfer definitions and the size of transition gaps between tracks for which the vehicle's design needs to account.

Blue, red and green tracks Features include:

- Absolute (step) misalignment: 1.0 mm
- Angular misalignment: 0.02 degrees
- Transition gap in the direction of travel: 0 - 84 mm
- Chamfers on track ends: not present

Orange Track Features include:

- Absolute (step) misalignment: 1.0 mm
- Angular misalignment: 0.02 degrees
- Top & bottom face:
  - Transition gap in the direction of travel: 0 - 84 mm
  - Chamfer on track ends: 1.5 mm x 10 degrees
- Inboard face:
  - Transition gap in the direction of travel: also 0 - 84 mm, but the track geometry allows for continuous support, given that the vehicle-side support is sufficiently wide (see Figure 16)
  - Chamfer on track ends: 1.5 mm x 20 degrees
- Outboard face:
  - Transition gap in the direction of travel: also 0 - 84 mm, but the track geometry allows for continuous support, given that the vehicle-side support is sufficiently wide (akin to Figure 16)
  - Chamfer on track ends: not present

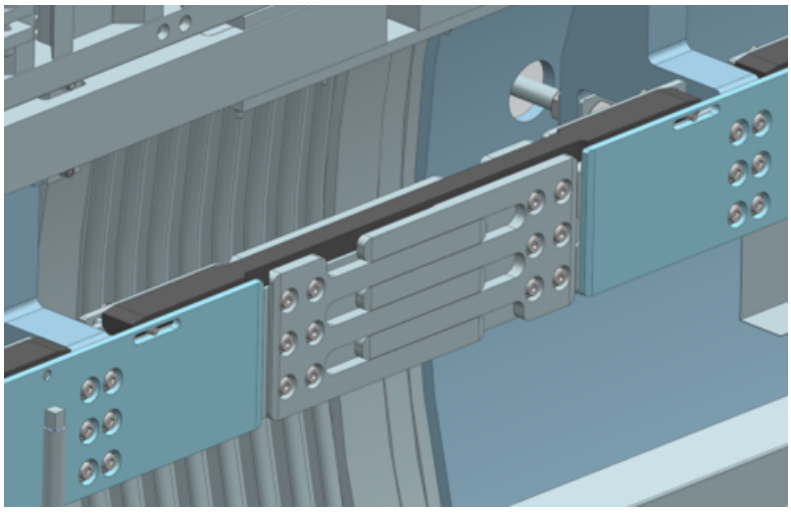

Figure 16: Track transition of orange safety track.

9.1.5 Maximum allowed (impact) loads per track

Figure 15 provides a legend for the maximum allowed impact loads which are presented in Table 1. Some important remarks:

- A vehicle may impact a track on several locations at once. In that case, a point load as high as the value presented in Table 1 may be reached on each point of contact, as long as said contact points are spatially separated by at least 1000 mm.
- The Y and Z forces as presented in Table 1 should not be combined for impact load calculations involving simultaneous impact in two directions.
- For impact calculations the tracks may be simplified to springs with the stiffnesses provided in Table 5.

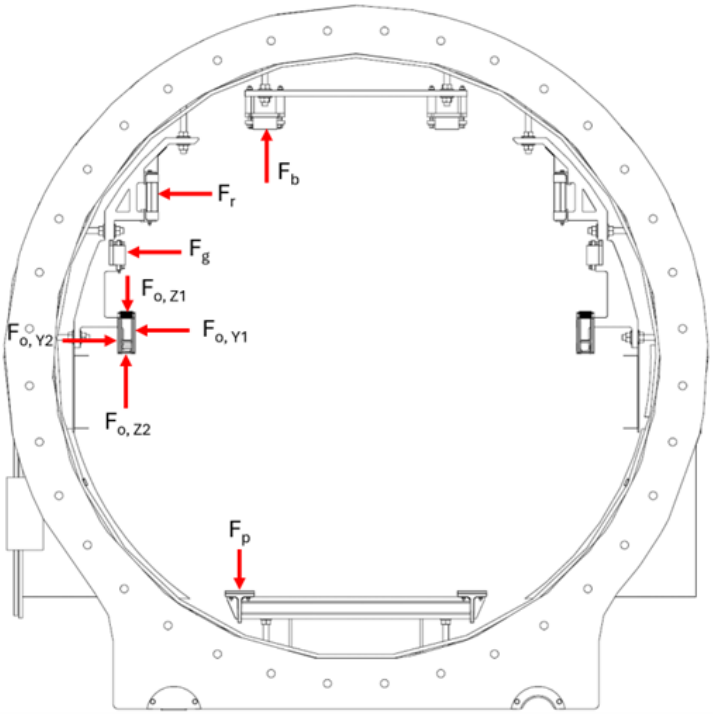

Figure 17: Pipe cross-section with impact load force vectors

Load	Maximum Load [kN]	Effective track stiffness in impact direction [N/m]
F_b	N.A. (18.3)	$6.6 * 10^7$
F_r	24.8	$5.3 * 10^8$
F_g	N.A. (20.8)	$8.3 * 10^8$
$F_{o,y1}$	18.9	$6.9 * 10^8$
$F_{o,y2}$	18.9	$6.9 * 10^8$
$F_{o,z1}$	21.3	$2.5 * 10^8$
$F_{o,z2}$	14.5	$2.5 * 10^8$
F_p	35.2	$7.1 * 10^6$

Table 5: Maximum allowed impact loads for each track

9.2 Vacuum Tube

For this year's event, it remains uncertain whether a vacuum test can be conducted at the EHW location. Although the EHC tube will be accessible at that time, the feasibility of demonstrating a vehicle under vacuum conditions will depend on logistical factors, including the number of applicants. Teams interested in performing vacuum tests will be required to include an additional page in the ITD, detailing their intended vacuum test objectives.

9.3 Custom Test Tracks

For custom tracks, a space will be provided.

CTT.1 All teams who would want to bring their own Custom Test Track to demonstrate must provide a detailed assembly and disassembly plan in the FDD. This must include a timeline, requested equipment, days and times when a forklift will be required as well as the number of people that will be working on the Custom Test Track simultaneously.

CTT.2 Participants have one and a half weeks before the EHW event to assemble their own track. The tracks must be disassembled within three days of the end of the event.

CTT.3 All custom tracks and assembly plans must be approved by EHW.

CTT.4 Multiple tracks will be considered a single unit and must be documented accordingly. Their total length and width is obtained from the sum of the various tracks in addition to the safety distance between them. This length must not be superior to the maximum established length and width for a single track.

CTT.5 For more specific information, feel free to contact the EHW committees to adjust for your specific case.

9.3.1 Technical Requirements for Custom Tracks

CTT. 1 The flatness of the custom track location cannot be guaranteed, meaning a leveling system must exist. A topological survey will be provided at a later date with specifics.

CTT. 2 All teams bringing custom tracks must provide detailed Health and Safety documentation for assembly, demonstration of the pod, and disassembly of the track. Separate H and S documentation must be provided for demonstration and assembly/disassembly (e.g. 2 RA documents).

9.3.2 Logistical Requirements for Custom Tracks

LRC. 1 All components of the custom tracks (including equipment and control station) should fit within the allotted space (as requested on the application form).

LRC. 2 Custom tracks shall arrive in as few deliveries as practical.

LRC. 3 Demonstrations on custom tracks should be visible to the public directly or via a live stream.

LRC. 4 All deliveries must arrive in sturdy containers that can be lifted by a forklift (maximum weight 2.5 Tonnes - symmetrical load). Other lifting mechanisms provided by the teams can be used, but must first be approved by EHW.

LRC. 5 Demonstrations should be visible to the public at all times. For tube-like infrastructures or other non-visible infrastructures, a live stream system must be implemented.

LRC. 6 The document outlines the scope of what will be provided, extras or favors can be asked for however the EHW has no obligation to provide them.

LRC. 7 EHW does not provide cover for custom tracks.

9.4 Transport, Storage and Lifting Requirements

TSL. 1 Each demonstrator needs a method to move around either by hand or on a transport cart.

TSL. 2 Any transport cart must be tested prior to EHW with its maximum payload.

TSL. 3 Each demonstrator shall provide the possibility of being lifted either by hand or with a forklift/small crane.

TSL. 4 The exhibitor must prove that the lifting points of the demonstrator are dimensioned to its mass. This proof shall be included in the FDD.

TSL. 5 If a demonstrator is hand-lifted, the allowable weight for each person is limited to 23 kg.

TSL. 6 A demonstrator must have as many lifting points as required to ensure the previous requirement to be allowed to be hand-lifted.

TSL. 7 If a demonstrator needs a forklift, please contact the EHW organization.

TSL. 8 Unstable demonstrators must have a straight base for the demonstrator handling.

TSL. 9 There is limited storage space during the EHW, so please specify the amount of storage the participant needs.

TSL. 10 If the needed storage space is exceptionally large (not limited to only a pod and scalability stand), the space is to be discussed by the EHW. If not enough space is available, the Participant may be responsible for their storage.

TSL. 11 Each Participant must provide a wooden box(es) in which they store their materials. The dimensions must be specified in the FDD.

TSL. 12 Transport boxes weighing over 150 kg should be designed to be lifted by a forklift or easily rolled by hand using wheels capable of handling smaller obstacles.

TSL. 13 For external events, the EHW organization should provide cargo trucks in which each demonstrator must go inside its pertinent box. If the Participant brings an exceptionally large amount of equipment, please discuss it with the EHW organization.

TSL. 14 The exhibitor shall contact the EHW Committee if they intend to ship their demonstrator themselves.

TSL. 15 The EHW organization will oversee the storage of the demonstrators. More details will be included in further editions of the Rules and Regulations.

10 Administrative Information

AI. 1 Each applicant shall determine one representative, who will be in correspondence with the EHW Committee. The representative will be responsible for submitting the documentation and will receive feedback and updates from the EHW Committee. If any questions arise, the correspondence between the applicant and the EHW Committee shall be conducted via the representative only.

AI. 2 All required documentation should be uploaded as a single PDF document to the respective form which will be provided via email.

AI. 3 In case of any uncertainties or suggestions concerning the present version of the EHW 2025 Rules & Regulations please contact the following email address:

technical@hyperloopweek.com
subject: Rules & Regulations Query

Important: The EHW will only react to queries sent to the EHW email address, thus do not message EHW members individually. Typically the response time for queries is one week.

10.1 Document Version and Further Updates

AI. 4 The EHW Committee explicitly reserves the right to alter, add or delete any regulations within this document at any time and release a new version.

AI. 5 Any exhibitor who wants to compete in the EHW 2025 must implement any changes from this document and must comply with the latest version at the EHW 2025.

AI. 6 Any updates from the EHW Committee's side will be sent to the representative via email.

AI. 7

References

EHW (2024a). ITSR layout document. url: https://tinyurl.com/342sz94x (visited on 11/01/2024).

— (2024b). Research Reports 2024. url: https://hyperloopweek.com/ehw-2024-reports (visited on 11/01/2024).