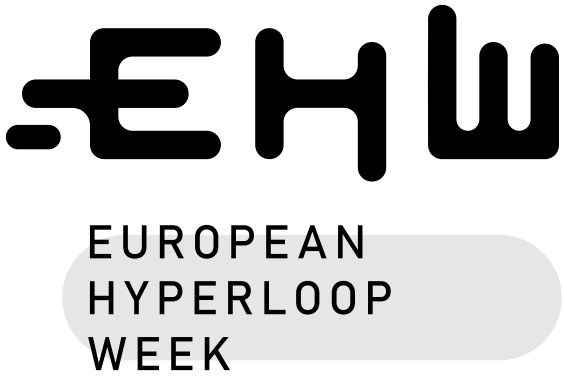

European Hyperloop Week 2021
RULES AND REGULATIONS

Version 1.4
June 01 2021

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June 01 2021, The EHW committee

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:

Delft Hyperloop – Technische Universiteit Delft, Netherlands

HYPED - The University of Edinburgh, Scotland

Hyperloop UPV - Universitat Politècnica de València, Spain

Swissloop - Eidgenössische Technische Hochschule Zürich, Switzerland

2. General Information

2.1 Purpose of the Document

This document outlines the technical aspect of the European Hyperloop Week 2021, also referred to as EHW 2021.

2.2 Terminology

- For the sake of simplicity, any systems, demonstrators, or models capable of being exhibited, presented, or operated at the EHW 2021 are referred to as *Systems*. Where necessary, the term *Subsystem* can also be used if, for example, a subordinate reference shall be made clear. In chapter 8, the term *Demonstrator* is used equivalently.
- Every team, company, start-up, foundation etc. that wishes to apply for the EHW 2021 is referred to as an *Applicant*.
- Every applicant that is admitted to the EHW 2021 is referred to as an *Exhibitor*.

2.3 Eligibility

No restrictions are set with regard to who may apply to participate in the EHW 2021. Furthermore, no exceptions are made for any applicant, therefore each applicant must follow the application process and fulfil the technical requirements in order to be allowed to participate.

Additionally, there are no restrictions concerning which systems, demonstrators or models are allowed to be registered, as long as they stand in context with the Hyperloop concept. Some examples thereof might include:

- Demonstrators of subsystems, either conceptual or operational.
- Fully integrated systems, in real size or to scale, either conceptual or operational.
- Infrastructural concepts or demonstrators.
- Design concepts, either virtual or physical.
- Simulations, visualisations etc.

However, the EHW committee reserves the right to decide who is admitted to the event and which systems are allowed to be brought along with the exhibitors to the EHW 2021.

2.4 Liability & Safety

- Every exhibitor must sign the **European Hyperloop Week 2021 Terms and Conditions of Participations** (hereinafter "EHW Terms & Conditions") which regulates the administrative modalities and the framework of the EHW 2021. The applicants will receive the Terms & Conditions separately via the established communication channels.
- Every exhibitor is required to take full responsibility for their systems even though the EHW committee makes the final decision if a system might be brought to the EHW 2021 or be operated.
- The EHW will NOT be liable for any damages incurred or incidents that may occur.
- Every exhibitor who actively operates a system on site of the EHW 2021 will be obliged to possess a valid liability insurance that covers both personal injury and property damage at any EHW 2021 venues.
- Safety is of utmost priority at any time and every exhibitor must endeavor to guarantee that.
- The instructions of the EHW committee and associated personnel must always be followed. Failure to do so might result in the exclusion from the EHW.

2.5 COVID-19 Situation

This version of the EHW 2021 Rules & Regulations was created with a view to organizing the event with presence in Valencia. As it is not possible at the time of publication of the Rules and Requirements to assess the situation next July, any new measures related to COVID-19 will be released in a future amendment. The EHW committee is certainly aware of the situation and is monitoring it closely in order to be able to react accordingly.

2.6 Intellectual Property of Submitted Documentations

The EHW committee and all associated persons guarantee to treat the submitted documentations of the applicants confidentially and not disclose or disseminate any information from it. 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. Thus, the documentations submitted remains the intellectual property of the respective applicant. This intellectual property regime is also set out in the EHW Terms & Conditions.

2.7 Privacy

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

3. Schedule of EHW 2021

Based on current planning, the European Hyperloop Week is scheduled for July 2021. The event will last for one week and will be completely dedicated to Hyperloop, Hyperloop related technologies and Hyperloop research.

The main constituents of the event will be:

- **Presentations**
  Exhibitors will present their Hyperloop related research, prototypes, and/or technology. To do so, an exhibitor must apply their system for one of the application categories described in chapter 4 and follow the appropriate application process as per either chapter 5 or 6.

- **Conferences**
  Talks, round tables, workshops and others will be presented by industry or academia experts.

- **Design Competition**
  There will be a Design Competition among all exhibitors who present a system during the event. Systems that stand out through innovation, feasibility, technical evaluation, and public appeal have the chance to win one of six EHW awards. Details on the Design Competition are found in chapter 7.

The above-mentioned constituents will take place simultaneously throughout the week. The week itself will be arranged thematically such that presentations and conference elements dealing with similar systems or similar technologies will be held on the same day.
The weekdays will provide the opportunity to present subsystems and smaller systems which do not need large infrastructure to be operated.
Towards the end of the week, some extended infrastructure will possibly be provided such that entire systems can be demonstrated. This includes for example the Test Track as mentioned in chapter 8.1.
The conclusion of the EHW 2021 is currently planned to be a public exhibition and will be the time when the EHW awards will be presented.

More details on the event schedule will be included in future versions of the *EHW 2021 Rules & Regulations*. 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.

4. Application Categories

Technical and safety regulations for the EHW 2021 are specified according to each of two application categories. These are:

- **Showcase**.
- **Demonstration**.

They present two different levels of mandatory safety precautions which must be followed. It is possible to apply for an award in both categories. Although the demonstration of a system has the potential to gain slightly more points, it is definitely possible to gain an award with only showcasing a system. Further details on the awarding system is to be found in section 7.

Furthermore, it is not mandatory to register for an award if an exhibitor is solely interested in showcasing or demonstrating a system outwith the Design Competition. On the contrary, it is not possible to register a certain system for an award if this very system is neither showcased nor demonstrated.

In addition, a system which involves any kind of energy or energy storage such as but not limited to:

- **chemical,**
- **electromagnetic,**
- **kinetic,**
- **potential,**
- **thermal**

may only be brought on site of the EHW 2021 if an application of the respective system for Demonstration was submitted to and accepted by the EHW committee. In any other cases, a system must not contain the named energy carriers, else the applicant would need to seek special approval from the EHW committee.

4.1 Showcase

The basic application category for the EHW 2021 is Showcase. It solely involves the presentation of a physical or virtual model of a system without operating it in any way. This reduces the necessary safety requirements to a minimum and, consequently, simplifies the application process. The application process for Showcase is described in chapter 5.

4.2 Demonstration

The application category Demonstration allows the physical operation of a certain system at the EHW 2021. Consequently, the necessary degree of safety precautions and technical detail involved in the application process is higher than for Showcase. The applicant must prove that the system they want to apply for Demonstration is safe to operate. One of the core requirements to be allowed to demonstrate a system is the previous testing of the respective system. Only systems that have been tested thoroughly and are of the exact same configuration as in the proposed demonstration at the EHW 2021 have the chance to be allowed for a demonstration.

If any of the infrastructure provided by the EHW shall be used, the requirements associated with each infrastructure must be met. Details concerning the available infrastructure are to be found in chapter 8.
An exhibitor may use their own equipment/infrastructure for a demonstration (e.g. a custom test bench). However, any equipment/infrastructure from an exhibitor must be taken into account in the documentation, shall follow the same safety standards as the systems themselves, and will require a certification by the EHW committee. Details on the application process for Demonstration is provided in chapter 6.

4.3 Basics of the Application Process

Concerning the application process the subsequent points must be followed:

AP.1 General

AP.1.1 Every system requires its own explicit application. This means that one applicant might register some systems for Demonstration and some for Showcase.

AP.1.2 It is not necessary to register one system for both Showcase and Demonstration. An application for Demonstration implicitly includes an application for Showcase of the respective system as well.

AP.1.3 Depending on the category for which the system is to be registered, the respective application guidelines must be followed. It is not necessary to follow the application guidelines for Demonstration if that system shall only be showcased.

AP.1.4 The general concept for each system which an applicant wants to register shall be fixed in the first documentation, either ITS or ITD. This means, adaptations of the respective system between ITS/ITD and the second documentation FSD/FDD are allowed to such extent that the basic concept is not changed.

AP.2 Documentation

AP.2.1 If the applicant wants to register multiple systems for the EHW 2021, they are allowed to combine all systems within one application document. In such a case, it is not necessary to mention anything twice in the application. However, the mandatory content, as specified for the various documentations (see chapter 5 and 6), must be included in the application. Furthermore, it must be clear under which application category and, if applicable, for which awards/award category each system is to be registered.

AP.2.2 If the demonstration of a certain system requires the active operation of other systems, such systems must be accounted for as well in every documentation. All documentation must be approved by the EHW committee and be in accordance with the Rules & Requirements for Demonstration (section 6.2).

AP.2.3 If certain systems or parts of a system are not intended for operation, neither for a demonstration nor in a demonstration of another system, or to be showcased, they do not necessarily need to be included in the documentation. However, if it improves the understanding of the entire system, it is strongly recommended to do so anyway.

AP.2.4 On the basis of the various submitted documents, the EHW committee will generally not give any feedback on further improvements that would allow admission. Additionally, a request for feedback will be ignored.

AP.2.5 However, if there is feedback from the EHW committee, the applicant is obliged to implement/follow that feedback.

AP.2.6 The documentation timeline as presented in 4.4 must be followed. Failure to do so might result in the exclusion from the EHW 2021.

AP.2.7 All documentations shall be established as a *Formulated Engineering Documentation*, meaning that they are developed and written documents and consequently are not in presentation or slides format.

AP.3 Registration for Awards

AP.3.1 Every system which has been applied to be either showcased or demonstrated in the first stage of the application process can be registered for an award in the second stage. However, registering for an award is not mandatory.

AP.3.2 Every system that is to compete for an award must first be registered and accepted for one of the two categories.

4.4 Application Timeline

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

4.4.1 Application Timeline for Showcase

The application process for Showcase consists of three stages. However, the applicant will receive the final acceptance or rejection for their application after the first stage. The second stage is primarily used for operational reasons for the EHW 2021 and to register the respective system for an award. The last stage is simply the submission of the required Transport, Lifting and Safety Procedures.

Due Date	Action	Who
13 December 2020 23:59 CET	Submission of *Intent to Showcase*	Applicant
Early 2021	Applicant receives the acceptance or rejection for the applied Showcase	EHW committee
14 March 2021 23:59 CET	Submission of *Final Showcase Documentation*	Applicant
18 June 2021 23:59 CEST	Submission of *Safety Instruction*	Applicant
Before EHW 2021	Further information concerning the event week provided to the exhibitor	EHW committee
July 2021	European Hyperloop Week	

Table 4.1: Application timeline for Showcase

4.4.2 Application Timeline for Demonstration

The application process for Demonstration is a three-stage process as well. Since an application for Demonstration is simultaneously also an application for Showcase, the applicant will get a final acceptance or rejection for Showcase already after the first stage.
In order to qualify for Demonstration, the applicant must pass all three stages successfully. However, the successful pass of all three stages is not a final guarantee that a demonstration will be permitted, since the EHW committee has the right to prohibit a demonstration at any point of time.
If a demonstration were to be denied by the EHW committee at any point after the successful completion of the first stage, the applicant may still showcase their system as successfully passing the first stage implies acceptance for Showcase. Should this occur, the applicant may be required to submit a *Final Showcase Documentation* (second stage of Showcase qualification) even if the corresponding deadline has already passed.

Due Date	Action	Who
13 December 2020 23:59 CET	Submission of *Intent to Demonstrate*	Applicant
Early 2021	Applicant receives: • Acceptance or rejection for Showcase • Notification if successfully qualified for the next step in the Application for Demonstration	EHW committee
14 March 2021 23:59 CET	Submission of *Final Demonstration Documentation*	Applicant
Spring 2021	Applicant receives notification if successfully qualified for the next step in the Application for Demonstration	EHW committee
18 June 2021 23:59 CEST	Submission of *Testing and Safety Documentation*	Applicant
Before EHW 2021	• Applicant receives notification if successfully qualified for Demonstration • Further information concerning the event week will be provided to the exhibitor	EHW committee
July 2021	European Hyperloop Week	

Table 4.2: Application timeline for Demonstration

5. Showcase Application

As stated in chapter 4.1 the application of a system for Showcase shall be considered, if the applicant intends to solely present the system at the EHW 2021 without operating it.

5.1 Rules & Requirements for Showcase

In order to receive the permission for a showcase at the EHW 2021, the applicant must follow the following rules:

SC.1 The system is powerless.

SC.2 No kind of potential, kinetic, chemical or electromagnetic energy stored in, on, within or around the system (thus especially no batteries within the system). This includes that no kind of the mentioned energy storages are allowed on the site of the EHW 2021.

SC.3 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 system.

SC.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 committee.

SC.5 The requirements for Transport, Storage and Lifting as specified in section 8.4 must be followed.

5.2 Application Process for Showcase

In order to get the approval for a showcase at the EHW 2021, the applicants shall document the respective systems by submitting the three required documents in PDF form by the indicated deadlines. Failure to do so might result in exclusion from the EHW 2021. For details on the submission itself refer to chapter 9.2.

5.2.1 Intent to Showcase (ITS)

This document is used as a first application for the EHW 2021. It shall contain the types of showcases that the exhibitor intends to do and further provide a brief overview of the current status and upcoming steps of the respective system.

- Due: 13 December 2020, 23:59 CET

- Document format: Formulated engineering documentation (see AP.2.7)
  Preferably using bullet points, tables, and descriptive images
- Document scope: Generally no limitation
  Suggested half to one page per system
- Minimum content:
  - General
    - Description of the applicant and list of team members
    - Details on the development environment and the research objectives
    - Determination of one representative who will be in correspondence with the EHW committee
  - System
    - Description of system to be showcased
    - Size, components, appearance of the system
    - Integration of the system into a subordinate structure/system (if applicable)
    - Key elements of the system
  - Safety
    - Precautions taken in order to comply with the Rules & Requirements for Showcases

5.2.2 Final Showcase Documentation (FSD)

With this document, the applicants shall give further exact details of the system they want to showcase at the EHW 2021. Content wise, it is similar to the Intent to Showcase and shall provide additional insight into the development of the respective systems. It is of special use for the organisational unit of the EHW committee. Although the final acceptance or rejection of the application for showcase already happens after the ITS, the FSD is of the same importance and failure to submit the FSD might still lead to the exclusion from the EHW 2021. The EHW committee reserves the right to reject an application if the FSD does not meet expectations or if it differs greatly from the ITS.
Most importantly, the applicant shall state in the FSD which award the system shall be registered for.

- Due: 14 March 2021, 23:59 CET
- Document format: Formulated engineering documentation (see AP.2.7)

- Note: Teams will have until May 17 to send in an addendum to their FSD. Only minor, inevitable changes will be accepted. You can only alter the system within the scope of your concept.
- Minimum content:
    - General
        - Description of the applicant and list of team members
        - Details on the development environment and the research objectives
    - System
        - Description of system to be showcased
        - Size, components, appearance of the system
        - Section specifying the needed equipment and infrastructure (both expected to be provided by the EHW and brought by the team)
        - Integration of the system into a subordinate structure/system (if applicable)
        - Key elements of the system
        - How is the system transported and lifted?
    - Non-prototype work / Research
        - An elaborate proposal shall be submitted with the FSD including at least the research questions, research methods and hypotheses. Complete research with conclusions shall be included in the SI.
    - Awards
        - For which award(s) the applicant wants to register the system?
    - Safety
        - Precautions taken in order to comply with the Rules & Requirements for Showcase (see 5.1)
        - Requirements for Transport, Storage and Lifting as defined in section 8.4, especially TS.4.

5.2.3 Safety Instruction (SI)

In order to comply with the requirements for Transport, Storage and Lifting as specified in section 8.4 the applicant must establish procedures for those actions. These procedures

shall be submitted in the last stage of the application process for Showcase. Furthermore, if the system utilises a transport cart to be transported, this must be tested according to TS.2 in section 8.4. Evidence of this test shall be included in the Safety Instruction as well.

- Due: 18 June 2021, 23:59 CEST
- Content:
    - Required Procedures:
        - Transport Procedure
        - Lifting Procedure
    - Safety Requirements
        - Test evidence of the transport cart for the system according to TS.2 (if applicable)
        - Requirements for Transport, Storage and Lifting as defined in section 8.4
    - Precise explanation of what is going to be showcased
        - Part list (including dimensions and mass)
        - Objects that cannot be carried by one person (>25kg) require detailed lifting procedures

6. Demonstration Application

As stated in chapter 4.2 the application for Demonstration shall be considered, if the applicant intends to operate a system at the EHW 2021.

Every applicant who wishes to register a system for demonstration at the EHW 2021 shall read the following subchapters carefully and check if they can meet the requirements, with special emphasis to all the safety precautions. If the applicant fails to fulfil even one point for a certain system, then the particular system will not be permitted for a demonstration.

6.1 Safety Considerations

It must be understood that the operation of any system requires a significant amount of understanding of the respective system. Safety must be guaranteed at all times and the EHW committee will only allow a demonstration if it is convinced of the system's safety. Thus, the applicant is expected to put in significantly more effort into the application process, the documentation and the testing of a system compared to showcasing.

Most importantly, no demonstration will be permitted if the systems involved in the demonstration have not been tested prior to the EHW 2021 by the applicant themselves. Furthermore, the conducted tests must be provided to the EHW committee prior to the event. This means that there will NOT be the possibility to test the systems on site but just to demonstrate what has already been tested. Additionally, there will NOT be the opportunity to prove a system's functionality on site and be allowed for a Demonstration last minute. Thus, if a certain system has not been approved for a potential Demonstration prior to EHW 2021, it cannot qualify to do so during the event.

6.2 Rules & Requirements for Demonstration

In order to receive the permission for a demonstration at the EHW 2021, the applicant must follow the following rules:

DM.1 General

DM.1.1 The applicant must specify the subsystem(s) intended for demonstration and the manner in which they are to be operated. If an entire system is to be demonstrated, specification for the operation of the entire system must be provided.

DM.1.2 In order to be approved for the desired demonstrations within this category, detailed technical documentation and proof of testing/functionality of the respective systems must be provided prior to the EHW 2021, according to a timeline prescribed in the subsequent sections. Any safety tests between this deadline and the EHW 2021 will be ignored. The technical

documentations are the sole measure for admitting an exhibitor to demonstrate, and the EHW committee will not retrospectively provide feedback on further improvements that would allow admission.

DM.1.3 In general, it is to be understood that it is NOT the EHW that checks the safety of a system, but, instead, it is the exhibitor who needs to prove to the EHW of the system's safety in order to be allowed for a demonstration. Hence, no exact guidelines on what the documentation must contain are provided. The EHW committee will consequently decide upon what the exhibitor is allowed to demonstrate and when to do so.

DM.1.4 Every application for Demonstration is simultaneously also an application for Showcase. In case an application for demonstration of a system is denied, showcasing will still be permitted provided that the conditions for the Showcase category are fulfilled.

DM.2 Technical Documentations

DM.2.1 If the demonstration of a certain system/subsystem requires the active operation of other subsystems, they must be accounted for as well in every documentation and be described in the same depth. If one subsystem among multiple necessary to conduct a demonstration is considered as unsafe, the demonstration will be prohibited.

DM.2.2 The handling of the high power system, especially for the electromagnetic braking and propulsion systems, should be worked out in detail and tested properly.

DM.2.3 Electromagnetic systems potentially involve a great amount of thermal / electric energy. The affected teams shall focus especially on the processing and handling of the generated energy. They need to document and test such systems extremely precisely and thoroughly.

DM.2.4 Permanent magnets require careful operation. Teams using them shall implement a detailed description of a system for demounting and/or covering the magnets.

DM.3 Proof of functionality (Testing)

DM.3.1 Demonstrations are explicitly not used as tests. Every intended demonstration must be tested by the exhibitor prior to the event in order to be allowed to conduct it. This means that demonstrations may only be conducted in the exact same configuration of the system with the same set of parameters as it was tested before.

DM.3.2 The testing results must be described in the Testing and Safety Documentation. Any deliberate manipulation or wrong presentation of testing results, testing methods or equivalent will lead to the immediate ban from the EHW 2021.

DM.3.3 All critical subsystems, as well as system setpoints utilised during the proof of functionality, must be documented (e.g. pressure, current, voltage etc.).

DM.3.4 Industrial components do not need to be tested individually if they are operated within their authorised range and if they are not manipulated to alter its functionality in any way.

DM.3.5 The system must be tested in the complete configuration with all components attached, just as it is intended to be operated in the demonstration.

DM.3.6 For pod demonstrations on the test track, the first points of contact need to be properly defined. Also, they need to be of significantly softer material (only material softer than 6061-T6 aluminium) than the test track. It has to be proven by all teams that any parts that will (potentially) be in contact with the test track will not harm it.

DM.4 Conduction of Demonstrations

DM.4.1 Prior to a demonstration, the EHW committee (and associated personnel) is allowed to inspect the system. If the inspection reveals any issues, the demonstration can be denied.

DM.4.2 The operation of any system during a demonstration must be performed according to a set of procedures, which needs to be established by the exhibitor and approved by the EHW committee prior to the EHW 2021.

DM.4.3 The demonstrations can take place at the university campus or at the test track, and depending on the type of demonstration, time frames for the demonstrations will be assigned by the EHW committee.

DM.5 Transportation, Storage and Lifting

DM.5.1 The requirements for Transportation, Storage and Lifting as define in section 8.4 must be met.

DM.6 Liability

DM.6.1 Every exhibitor is obliged to possess a valid liability insurance that covers both personal injury and property damage at all the EHW 2021 venues.

DM.6.2 The exhibitor needs to sign the EHW Terms & Conditions. This contains among other things that the exhibitor takes full responsibility for the operation of all systems. Thus, although the EHW committee makes the fundamental decision for a go or no go of a demonstration, any damage, incident, or accident caused by or to an exhibitor's system is solely their responsibility.

DM.7 The EHW committee explicitly reserves the right to impose further restrictions on any demonstration in whatever form (power, force, duration, speed, etc.), and is allowed to change or prohibit demonstrations at any point.

6.3 Application Process for Demonstration

In order to get the approval for a Demonstration at the EHW 2021, the applicants shall demonstrate their understanding of subsystems with the following documents that are to be submitted in PDF format before the indicated deadlines. Failure to do so might result in the exclusion of the EHW 2021. For details on the submission itself refer to chapter 9.2.

6.3.1 Intent to Demonstrate (ITD)

This document is used as a first application for the EHW 2021. It shall contain the types of demonstrations that the exhibitor intends to do and further 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 EHW 2021.

- Due: 13 December 2020, 23:59 CET
- Document format: Formulated engineering documentation (see AP.2.7)
  Preferably using bullet points, tables, and descriptive images
- Document scope: Generally no limitation
  Suggested half to one page per system
- Minimum content:
  - General
    - Description of the applicant and list of team members
    - Details on the development environment and the research objectives
    - Determine one representative, who will be in correspondence with the EHW committee
  - System
    - Description of system to be demonstrated
    - Size, components, appearance of the system
    - Integration of the system into a subordinate structure/system (if applicable)

        - Outline of how the system will be operated during demonstration and what infrastructure will be necessary to do so (either own infrastructure or provided by EHW)
        - What other systems need to run in order to operate the system?
    - Safety
        - What are the key elements of the system? Which features incorporate the highest safety risks?
        - How will the respective subsystems be tested prior to EHW 2021?

6.3.2 Final Demonstration Documentation (FDD)

This document shall contain all relevant information of the final system. It is intended as a 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. Furthermore, the testing of systems shall be described in detail.

- Due: 14 March 2021, 23:59 CET
- Document format: Formulated engineering documentation (see AP.2.7)
- Note: Teams will have until May 17 to send in an addendum to their FDD. Only minor, inevitable changes will be accepted. You can only alter the system within the scope of your concept.
- Minimum content:
    - General
        - Description of the applicant and list of team members
        - Details on the development environment and the research objectives
    - System
        - Description of system to be demonstrated
        - Size, components, appearance of the system
        - Section specifying the needed equipment and infrastructure (both expected to be provided by the EHW and brought by the team)
        - Integration of the system into a subordinate structure/system (if applicable)
        - Detailed explanation of how the system will be operated during a demonstration and what infrastructure will be required

        - If the applicant intends to use own infrastructure (e.g. test bench), its safety must be proven as well.
    - What other systems need to run in order to operate the system?
    - How is the system engineered? Which dimensioning guidelines were followed and which safety factors have been applied?
    - How is the system transported and lifted?
- Non-prototype work / Research
    - An elaborate proposal shall be submitted with the FDD including at least the research questions, research methods and hypotheses. Complete research with conclusions shall be included in the TSD.
- Awards
    - For which award does the applicant want to register the system?
- Safety
    - Which features incorporate the highest safety risks?
    - How are the risks treated and accounted for?
    - What safety measures were taken during the engineering of the system?
    - Summary of all energy storage types and components present in system(s)
- Testing
    - Provide a preliminary testing plan for the respective subsystem
      → How will the respective subsystems be tested prior to EHW 2021?

6.3.3 Testing and Safety Documentation (TSD)

This document shall describe in detail which tests have been performed and how they were conducted. The tests must contain the results, measurements and data in order to prove that they have been performed. Additionally, it is possible and recommended to hand in video recordings of the tests in order to prove that the tests were conducted properly. This will provide a baseline based on which the EHW committee defines the allowed setpoints/operating conditions of each system during the demonstration. Note that Annex B provides some further testing guidelines.

Any deliberate manipulation or wrong presentation of testing results, testing methods or equivalent will lead to the immediate ban from the EHW 2021.

Furthermore, any Demonstration must be executed according to one or multiple predefined procedures. These procedures shall include every important step involved in the operation of the system such that a wrong handling of the system is impossible. These procedures must be established by the applicant and submitted with the Testing and Safety Documentation. Failure to establish such procedures might lead to a denial of a Demonstration.

- Due: 18 June 2021, 23:59 CEST
- Document format: Formulated engineering documentation (see AP.2.7)
- Minimum content:
    - Written report of completed tests of respective systems, which include:
        - Aim/objectives
        - Test description
        - 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)
        - Conclusion
    - Video of performed tests submitted in the following format:
        - Static camera position
        - Clear vision of performed test
        - 1080p resolution
        - **Uploaded to online streaming service** (e.g., YouTube) and provide **link** within the TSD report
        - The **date of the video upload** onto the streaming service must **precede the submission deadline of the TSD (18 June 23:59 CEST)**

- Detailed procedure and safety measures; the procedures should include at least:
    - Power on/off Procedure and Operation Procedure of the system
    - Emergency Procedure
    - Transport & Lifting procedure (if applicable; according to section 8.4)
    - Test Track Load & Unload Procedure (if applicable)
- Evidence of a valid liability insurance that covers both personal injury and property damage in Valencia

7. Design Competition & Awarding System

7.1 Introduction

As one of the core features of the EHW 2021, the best systems showcased or demonstrated will be awarded. There are six different awards that an applicant can register for. The grading of the systems applying for an award will be done by an impartial jury consisting of people with a technical or a design background.

The six awards are:

- Best Mechanical Subsystem Award
- Best Propulsion Subsystem Award
- Best Levitation Subsystem Award
- Best Electrical Subsystem Award
- Complete Pod Design Award
- Full-Scale Award

7.1.1 General Information on the Evaluation

The applicant shall notice the following points concerning how all systems will be evaluated:

AS.1 In order to compete for an award, it is necessary that the corresponding system is either showcased or demonstrated during the event, thus it must go through the application process.

AS.2 As stated in sections 5 and 6, a system must be registered explicitly by the applicant. This shall happen in the Final Demonstration Documentation (FDD) or the Final Showcase Documentation (FSD).

AS.3 The awarding system is designed such that there is no big disadvantage if a competitor is only allowed to showcase their system. However, there are some points which can only be achieved if a demonstration of the corresponding system occurs.

AS.4 The FDD or the FSD (whichever is applicable) of the respective system form an important part of the grading of the system. This means in particular:

AS.4.1 *Subsystem Awards*
The documentation shall include all aspects of the respective system. It might be advantageous to address new ideas, innovative concepts and groundbreaking aspects of the system in detail.

AS.4.2 *Complete Pod Design Award*
Every aspect of the entire pod might be evaluated for the award. This means that it will be highly recommended to treat all subsystems of the pod in detail.

AS.4.3 *Full-Scale Award*
Every aspect of the system might be evaluated.

AS.5 Depending on the number of competitors and registered systems for every award, the EHW committee might further limit the number of systems that are graded or might choose beforehand the most promising systems which will enter the Design Competition.

7.2 Subsystem Awards

7.2.1 Description

This category focuses on designs and prototypes for a specific subsystem of a Hyperloop pod. The design can be for a full-scale Hyperloop system or a small-scale prototype pod, compatible with the testing facilities. If a certain subsystem could be evaluated in different categories due to the multiple functions it can have, it can be evaluated in each category based on the corresponding functionality.

Participants can enter as many subsystems into each category as they wish, but only one subsystem will be graded per category.

Subsystems eligible for the Subsystem Awards shall fall under the following four categories, which at the same time also represent the four Subsystem Awards:

1. *Mechanical Subsystem*
    a. Mechanical subsystems are those responsible for mechanical suspension and braking, and the chassis of the vehicle.
2. *Propulsion Subsystem*
    a. Propulsion subsystems are open to both self-propelling systems as well as other designs and ideas.
3. *Levitation Subsystem*
    a. Levitation subsystems include the design of a method to enable hovering/contactless motion of pods.
4. *Electrical Subsystem*
    a. Electrical subsystems include the designs of low and high power systems, excluding the following systems:
        i. Motors,
        ii. Motor-controllers,
        iii. Levitation systems,
        iv. Braking systems, and
        v. Guidance systems.
    b. In general, systems that are considered are responsible for information gathering, processing and controlling, as well as power storage.

7.2.2 Evaluation Scheme

Based on the awarding scheme presented below, the registered subsystems belonging to the four categories mentioned above will be evaluated and the four Subsystem Awards will be presented. A maximum of up to 40 points can hereby be earned per subsystem entry. These 40 points are distributed as follows:

Subsystem Award			
Evaluated Categories		*Evaluation Criteria*	*Points*
Design	Concept	- *Technical Evaluation* - *Efficiency* - *Safety considerations* - *Reliability*	*10*
	Originality/Innovation	- *Using technology fully developed by the team* - *Unique idea, never seen before*	*5*
	Feasibility	- *Manufacturing of the system (materials, commercial components…)* - *Integration in a Pod or a full-scale Hyperloop system*	*10*
		*Total points for **Design**:*	*25*
Prototype Subsystem	Non functional	- *Small-scale prototype or 3d-printing prototype* - *Virtual realization on computer software*	3
	True-scale and realization	- *True-scale prototype and manufactured with the adequate materials/components, representative of a full-scale system* - *Subsystem can be incorporated into a pod prototype or a full-scale Hyperloop system*	7
	For Demonstration only: Testing Proof	- *On site demonstration proving subsystems functionality. Subsystems can be demonstrated as part of the full pod demonstration (see section 7.3)* - *Points will be gradually awarded depending on the degree of fulfillment of the design criteria*	5

	*Total points for **Prototype Subsystem**:*	*15*
	Total points per Subsystem Award:	**40**

7.3 Complete Pod Design Award

7.3.1 Description

This category focuses on the presentation of a complete functional design of a small-scale Hyperloop pod prototype. Prototypes considered in this category should range between 1 and 5 meters length. Prototypes should be self-propelled and self-braked. For this category, applicants present a Final Showcase Documentation (FSD) or Final Demonstration Documentation (FDD) for their prototype. Only one design will be graded per exhibitor.

7.3.2 Evaluation Scheme

Complete Pod Design Award			
Evaluated Categories		*Evaluation Criteria*	*Points*
Exterior Design	Aerodynamics	- *CFD analysis*	*5*
	Jury votes on design aesthetics	- *Is it clean looking? Are there sharp edges?* - *Are there any manufacturing defects, damage, welding spots, etc.* - *Are the visible subsystems presented in an orderly fashion?*	*5*
		*Total points for **Exterior Design**:*	*10*
Overall Pod Design	Design	*Explanation of the design* - *How does it achieve its goals and how well is it explained?*	*5*
		Systems Integrations - *Does the design have subsystems that complete each other?* - *Systems Engineering*	*10*

Overall Pod Design	Design	*Top Values* *Points will be awarded on robustness and quality of the simulation (e.g. number of factors and parameters of the pod considered)* - *Acceleration / Deceleration* - *Power Consumption* - *Vibration Dissipation* - *Simulation of theoretical top speed at the track*[1]	*10*
		*Total points for **Design**:*	*25*
	Prototype Pod	*Showcasing* - *Physical system* *Structural integrity; alignment with the detailed design* - *Originality / Innovation* *Technology fully developed by the exhibitor; unique idea; never seen before* - *Scalability / Feasibility*	*5* *10* *10*
		Demonstration - *On site demonstration on the EHW test track proving full pod functionality*	*15*
		*Total points for **Prototype Pod**:*	*40*
		*Total points for **Overall Pod Design**:*	*65*
		Total points Complete Pod Design Award:	**75**

[1] Specifications on the Test Track are provided in section 8.1.

7.4 Full-Scale Award

7.4.1 Description

This category focuses on presenting designs and concepts relating to a real world Hyperloop system. Exhibitors must demonstrate an understanding of the implementation of Hyperloop technologies in today's society, addressing economic, social and legal implications, and infrastructure.

Presentations in this category could include:

1. Passenger pods (customer appeal)
2. Infrastructure (tube, track, station design)
3. Feasibility studies
4. Hyperloop as a means of cargo transport

7.4.2 Evaluation Scheme

Full-Scale Award	
Evaluated Categories	*Points*
Safety Standards	*5*
Standardisation / Harmonization / Homologation	*5*
Audacious Goals	*5*
Commercial viability and appeal to future hyperloop travellers	*5*
Prototype that shows proof of concept	*5*
Sustainability	*10*
Total points Full-Scale Award:	**35**

8. EHW Infrastructure & Associated Requirements

8.1 Test Track

An I-beam test track is installed at the Ricardo Tormo-Cheste circuit, where the MotoGP Valencia Grand Prix is held every year, subsequently referred to as *Test Track*.

8.1.1 Specifications

The specifications of the EHW 2021 Test Track are:

- **Material**: 6061-T6 Aluminium Alloy.
- **Length**: 168 meters
- **Tolerances:** The manufacturing tolerances are specified in the attached section drawing. Regarding the installation, it is based on 6 m extrusions with a lateral tolerance of ± 2 mm between sections.
- **Installation slope**: 2.6 % (In a 2 meter demonstrator means an unevenness of 5.2 cm)
- **Keep out zone**: Under no circumstances shall demonstrators enter the keep out zone of the Test Track which is defined in attached drawings.
- **Test Track interface:** The Test Track consists of an I-beam rail as it is depicted in Figure 8.1. Consequently, there are no side plates available.

Under no circumstances should demonstrators damage the track, as it will be considered a reason for disqualification from the Design Competition of the EHW.

The geometrical specifications of the Test Track and the keep out zones in are depicted in Figure 8.1 or can be found in Annex A.

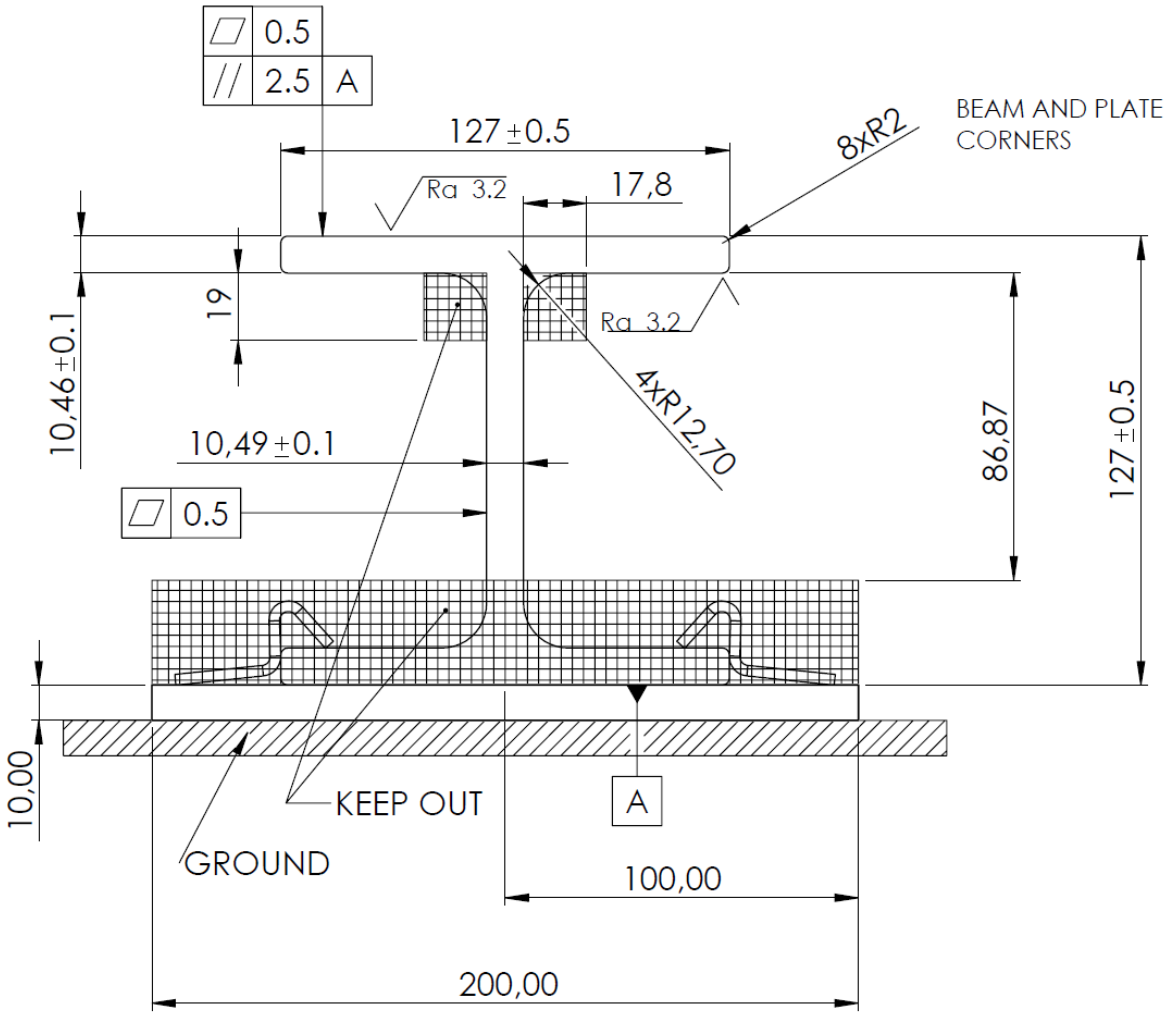

Figure 8.1: Test Track section drawing (all measures in millimeters)

8.1.2 Demonstrator Loading

The Test Track is installed at ground level and on an asphalt surface. Therefore, intermediate areas will not be required to load the prototypes. To load the demonstrated systems (demonstrators), each exhibitor must develop the loading, unloading and assembly procedure following the specifications defined in section 8.4 of this document (Transport, storage and lifting requirements).

In addition, the EHW organization will provide the exhibitors with a crane (as can be seen in Figure 8.2) to be used to load the demonstrator on the Test Track. Exhibitors may take this into account when developing the loading procedures (max load: 2'000 kg).

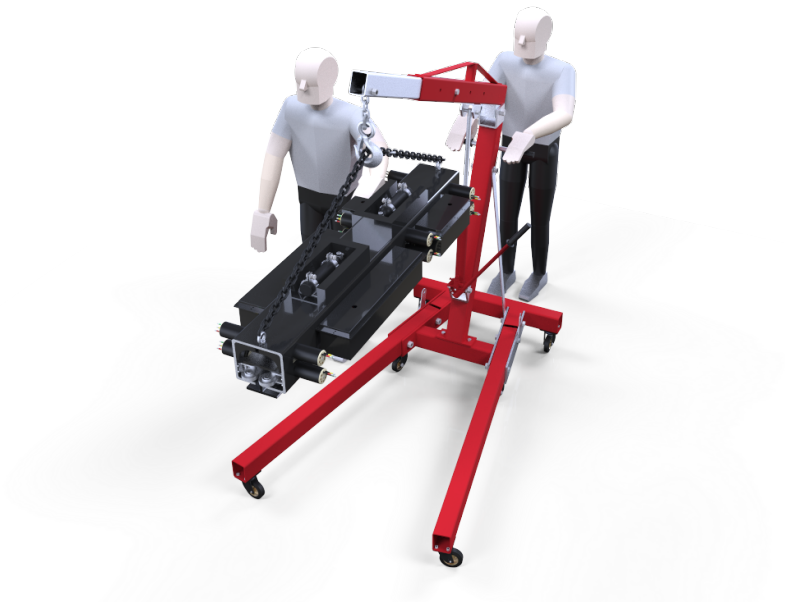

Figure 8.2: Available crane at the Test Track

At the end of the loading and assembly process of the demonstrator on the track, no member must remain in the loading area or in any of the areas marked as safety areas (keep out zones), which can be seen in the attached Figure 8.3 (and in Annex A). The members in charge of the control, telemetry and navigation will be located in the so-called 'Work station'.

Before and after the loading and unloading processes, the organization will provide a forklift to transport the demonstrator, always inside its storage crate or cinched to the base, to the storage area or to the showcase area. If the exhibitor wants to proceed in a different way, either because their prototype has been considered hand-lifted or they will bring their own crane, they must present the loading and unloading procedure in one of the documents that will be specified.

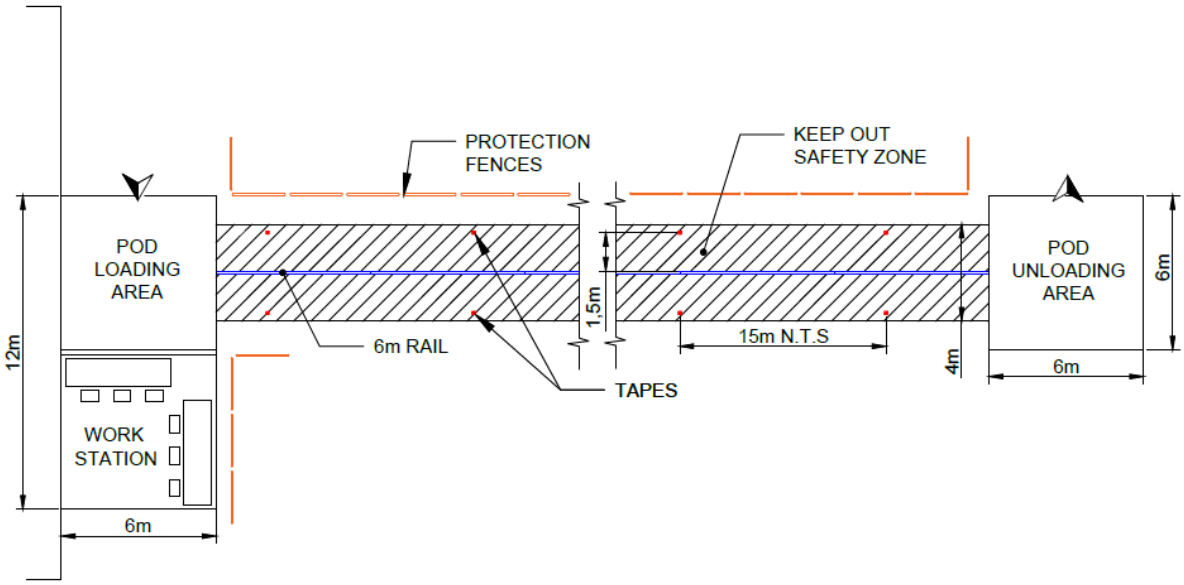

Figure 8.3: Situation at the Test Track

8.1.3 Navigation Aids

Every 15 meters, a 10 cm wide reflective stripe will be installed It will be composed of retroreflective elements with cubic edges (microprism) perfectly bonded to a robust flexible polymeric film in red colour, with retroreflective coefficient equal or higher than the ones that can be found in Table 8.1. The tape stripes are located at 150 cm from the Test Track axis and have a length (vertical height) of 1 m. A detailed scheme of the installation of the tapes can be found in Figure 8.4.

Beta 1 (β1) [°]	0	0	0	0	0
Beta 2 (β2) [°]	5	20	30	40	60
R' [cd/lux/m2]	120	60	30	10	n/a

Table 8.1: Retroreflective coefficients of the tapes as a function of the entrance angle

The reference for the material of the reflective tapes is Reflexite © VC 104+.

It should be noted that the tests will be carried out in the morning and outdoors, so the exhibitors must take these conditions into account when conducting in-house navigation tests before the EHW (sensors calibration).

Further information about the installation of the tapes will be provided to the exhibitors in the future editions of the Rules and Requirements.

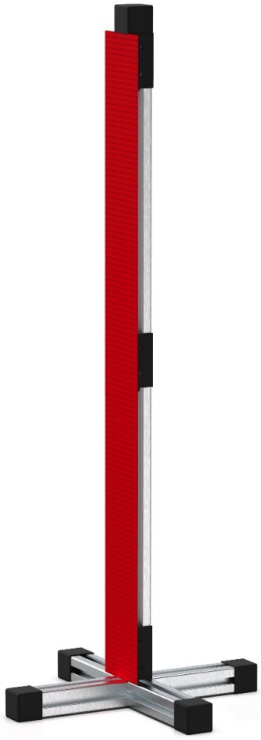

Figure 8.4: Reflective tapes

8.1.4 Test Track Requirements

As a summary, the following requirements must be met in order to be allowed to operate any system on the Test Track.

TT.1 Under no circumstances should the keep out zone be violated.

TT.2 The exhibitor must prove that the demonstrated system does not harm the Test Track infrastructure by any means.

TT.3 During a demonstration, it is forbidden for people or subjects to remain within the pod loading area, the pod unloading area, and the keep out safety zones as they are defined in Figure 8.3.

TT.4 Loading and unloading of a demonstrator has to happen in the designated loading and unloading area respectively.

TT.5 The demonstrator shall preferably be designed such that it can propel itself to the unloading area. Demonstrators which might be stuck on the Test Track may only be pushed by hand to the loading or unloading area, if the exhibitor previously has conducted a procedure to power off the demonstrator, thus showing that touching the demonstrator is safe.

TT.6 The only manipulations allowed to be performed at the demonstrator while it is on the Test Track are to recover a stuck demonstrator and only after TT.5 is fulfilled.

Any other manipulations are solely permitted if the demonstrator is either at the loading or the unloading area.

TT.7 A moving demonstrator on the Test Track must use two independent and appropriate methods to measure its location or velocity. The utilization of the provided reflective tapes is highly recommended but not mandatory.

TT.8 Further details on the exact procedures for a demonstration on the Test Track will be provided at a later stage.

8.2 Vacuum Chamber

The EHW has a fully functional vacuum tube. It is a 12-meter steel tube that is prepared to work as a vacuum chamber for demonstrations with track-based pods and other types of demonstrators. The vacuum chamber also does not contain side plates. A technical drawing of the vacuum chamber is shown in Figure 8.5.

The vacuum chamber usage at the EHW is dependent on the requirements and different awards of the competition part of the EHW.
The specifications of the vacuum chamber of the EHW are:

- **Diameter:** 1800 (±20) mm
- **Length:** 12 m
- **Material:** S275 Steel (main cylinder) and structural S355 (gates)
- **Minimum pressure:**
  The minimum pressure that an exhibitor can request for their demonstration(s) will be specified based upon the minimum that he is able to prove the demonstrated system(s) and subcomponents (especially batteries) can withstand during its own tests conducted prior to EHW 2021. This and further relevant information regarding such tests must be submitted within the Testing and Safety Documentation (see section 6.3.3). Besides this, a minimum pressure limit will be defined by the organization to allow the tests to be carried out in an agile and relatively fast way. This minimum pressure limit will be 10 mbar.
- **Maximum prototype length**[2]: 3 m
- **Maximum prototype weight**: 100 kg/m if installed on the I-beam section, 300 kg/m^2 otherwise
- **Demonstration characteristics**:
  Only static demonstrations will be allowed in the vacuum chamber. Static hereby means that the vehicle shall not propel itself in the longitudinal direction (along the I-beam). However, given that previous testing was conducted and the necessary safety measures were taken, powering the vehicle will be possible. Therefore, demonstrating a levitation system or powering the propulsion system is generally thinkable. It must be ensured that the vehicle cannot accidentally move along the I-

[2] Only for the vacuum chamber. General constraints are defined in section 7.3.1

beam, which could be achieved, for example, by detaching the propelled wheels from the I-beam.
Since this particular demonstration incorporates high safety risks, an applicant desiring to perform such a demonstration shall get in contact with the EHW committee as early as possible such that the framework and the requirements can be established.

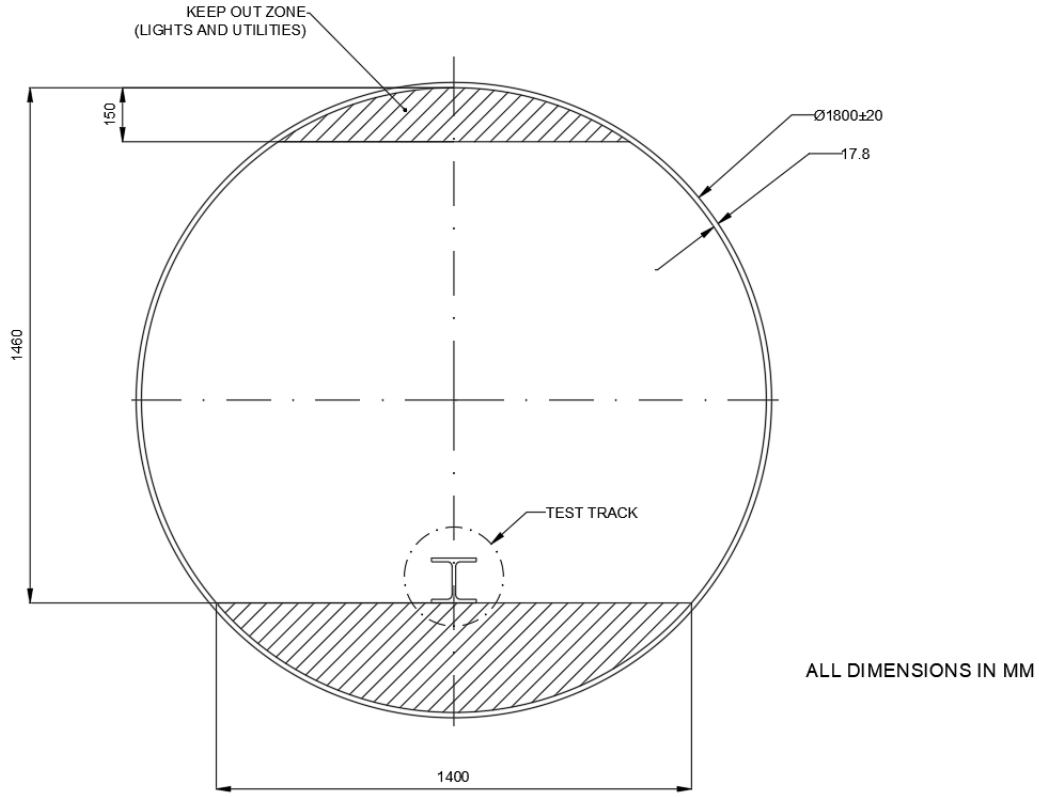

Figure 8.5: Vacuum chamber sectional drawing

It should be noted that the different exhibitors will be able to demonstrate at different pressures, so it will be another criterion that will be considered in the awarding system of the competition.

The vacuum tube is outdoors and does not have a thermal control system, so tube temperatures will depend on the weather (consider 28ºC as an external reference temperature for calculations).

8.3 Communications

General EHW Pod Communications Rules & Requirements:

CM.1 **Test Track** (see section 8.1) communication: Under no circumstances shall the exhibitor transmit in frequency ranges other than the **2.4GHz or 5GHz** bands following IEEE 802.11n standard.

CM.2 **Vacuum chamber** (see section 8.2) communication: Under no circumstances shall the exhibitor transmit in frequency ranges other than the **2.4GHz** bands following IEEE 802.11n standard.

CM.3 The communications maximum bandwidth should not exceed **2.5Mbps.**

CM.4 While a demonstration (run) is being performed, the rest of the exhibitors should be disconnected from the EHW network, and any transmission equipment should be turned off so it cannot interfere.

CM.5 The pod should be always down of control, if a disconnection or other connectivity error that impedes continuous data flow and control is detected, the pod should enter in a safe state, stopping its trajectory.

CM.6 The pods should not have connection to the Internet. Connections are restricted to the IP address of the EHW internal networks.

CM.7 Exhibitors should be equipped with at least one NAP (Network Access Point) for the correct development of all the testing. EHW recommends using the **Ubiquiti Rocket M2** because it is the model that has been tested at the facilities and because it can be easily configured to follow all the previous rules. EHW will provide configuration files for the Ubiquity equipmentEncryption or other safety features (TLS/SSL) should not be implemented.

CM.8 All IP addressing will be static thus DHCP or DNS Servers are not needed.

8.3.1 Possible EHW communications scenarios

- Vacuum chamber:

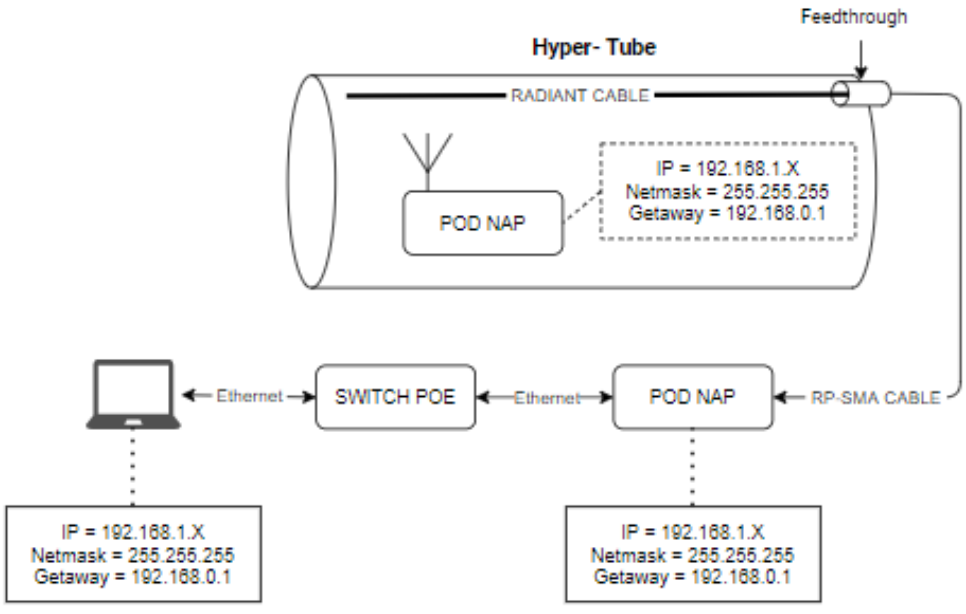

Figure 8.6: Available communication network at the vacuum chamber

- Test Track:

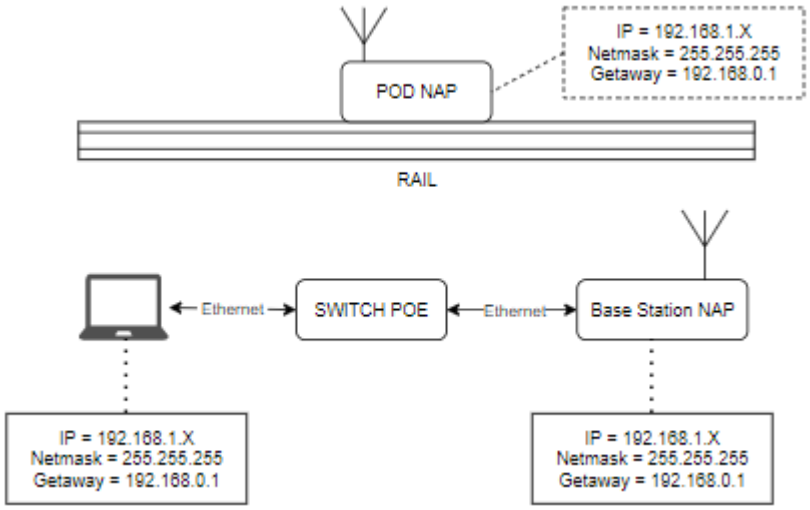

Figure 8.7: Available communication network at the Test Track

8.4 Transport, Storage and Lifting Requirements

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

TS.2 Any transport cart must be tested prior to EHW with its maximum payload. The conducted test shall either be covered in the TSD or in the SI whichever is applicable.

TS.3 Each demonstrator shall provide the possibility to be lifted either by hand or with a forklift/small crane.

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

TS.5 If a demonstrator is hand-lifted, the allowable weight for each person is limited to 25 kg.

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

TS.7 The EHW organization will provide forklifts with a 2000 kg capacity, and the forklift swivel hook adaptors.

TS.8 The number of forklifts and adaptors will depend on the number of exhibitors, ensuring efficient handling of demonstrated systems.

TS.9 Unstable demonstrators must have a straight base for the demonstrator handling.

TS.10 For each demonstrator displacement, pieces and prototypes must be protected inside a standard wood box with a maximum dimension of 5200 x 2500 x 1500 mm. If an exhibitor needs a larger box, they shall be responsible for the handling and storage of the prototype, and they should communicate their desire to bring a larger box and the procedure of transport to the organization in the FDD or FSD (where applicable).

TS.11 For external events, the EHW organization should provide cargo trucks in which each demonstrator must go inside its pertinent box.

TS.12 Exhibitors must provide the Transport Procedure in which they explain how they will transport their system, always ensuring the safety requirements. Demonstrator handling includes:

TS.12.1 From the UPV entrance to the place where the demonstrators will be kept.

TS.12.2 From demonstrator storage to UPV venues.

TS.12.3 From demonstrator storage to the cargo trucks, situated outside the UPV.

TS.12.4 From the cargo trucks to Cheste Circuit venues.

TS.12.5 From the cargo trucks to the location of the Final Event.

TS.13 The exhibitor shall contact the EHW committee if they intend to ship their demonstrator directly to the event site.

TS.14 The EHW organization will oversee the storage of the demonstrators. More details will be included in further editions of the R&R.

9. Practical Information for the EHW

9.1 General outline of dates before and during event

This section gives an overview of what to expect from the on-site event. This includes deadlines for the testing and safety documentation, as well as an overview of the specific dates the teams need to be present in Valencia.

The table below gives a structured overview of the deadlines before and during the event. Below these deadlines will be discussed in more detail.

What?	When?
TSD / SI deadline	June 18
Prototype arrival	until July 16
Scrutineering by EHW Jury	July 17 - July 18
Open day of the European Hyperloop Week for the general public	July 19

9.1.1 TSD/SI deadline

In the coming weeks the final documents of each team need to be submitted. The technical jury will check the documentation and assess the safety of the prototypes. If a prototype is considered to be not safe or the documentation is not sufficient, the prototype will not be allowed to be demonstrated. Prototypes that have not been cleared for demonstration can showcase their non-powered system during the EHW. Information regarding the TSD and the SI submission can be found in section 5.2.3 and 6.3.3.

9.1.2 Prototype arrival

The prototypes need to arrive on time in Valencia to allow enough time for all preparations for the on-site event.

The EHW will manage the reception and storage of the prototypes in the week prior to the competition and during the week.

The team must ensure that their box(es) arrive in the period between the **12th and 16th of July, between 8:00 and 19:00 (CEST)**. If a team needs to ship their prototypes in a different

time frame, they shall be responsible for the handling and storage of the prototype, and they should communicate the procedure of transport to the organization.

Specifications of the box(es) (size, mass and further considerations) shall be sent to the EHW prior to their shipment. The deadline for this document is the 18th of June, and it must be delivered separately from the TSD / SI.

Shipping address:

Universitat Politècnica de València
Edificio NEXUS (6G)

A.A.: Fanny Collado (+34 963877751)
A.A.: Ferran de Andrés (+34 627186578)

Camino de Vera, s/n, 46022
Valencia, Spain

The consignor and all details (team name, name of responsible person, telephone number and e-mail address) must be included in the package.

After the EHW all goods need to be collected between **26th and 29th of July between 8:00 and 19:00 (CEST)**. The collection of the goods must be **arranged by the team**. Once said periods have expired, all goods remaining in the storage areas will be disposed by the cleaning company. The team forfeiting any right to claim for loss or damage.

If pod transport requires extensive assembly // disassembly, the procedures for this should be scrutineered as well.

9.1.3 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. That is why there will be a round of scrutineering before the event.

During the scrutineering, prototypes will be inspected by the technical jury. The technical jury will assess the manufacturing and the 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 TSD) will be checked. Examples:

- Are wires connected properly?
- Are the batteries produced in a safe way?
- Are there any sharp edges?
- …… etc.

If there are significant changes from the FDD and TSD, the prototype will not be allowed to demonstrate.

The scrutineering will happen on the **17th and 18th of July**. Team members will need to be present during the scrutineering.

9.1.4 During the week

During the event, each day of the week, demonstration and showcasing for different awards will take place. After that, lectures and conferences about the topic of the day will be arranged at the university of Valencia. At the end of the week there will be one public day at the Valencia city hall. The awards will be announced at the end of the week.

10. Administrative Information

10.1 Representative of the Applicant

Each applicant shall determine one representative, who will be in correspondence with the EHW committee. The representative will be responsible for submitting the documentations 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.

10.2 Submission of Documentations

All required documentations should be submitted as a single PDF document to PolyformaT:

http://poliformat.upv.es

If the PDF document exceeds the maximum uploadable size for PolyformaT, an alternative will be offered.
All video submissions related to the TSD need to be submitted through an online streaming service as specified in section 6.3.3.

10.3 Questions & Suggestions

In case of any uncertainties or suggestions concerning the present version of the *EHW 2021 Rules & Regulations* please contact the following email address:

info@hyperloopweek.com
subject: Rules & Regulations

10.4 Document Version and Further Updates

- 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.
- Any exhibitor who wants to compete in the EHW 2021 must implement any changes from this document and must comply with the latest version at the EHW 2021.
- Any updates from the EHW committee's side will be sent to the representative via email.
- **The copyright for the present document lies with the EHW 2021 committee. It is prohibited to copy, reproduce, or distribute extracts from this document in any form.**
- The present document represents version 1.4 of the *EHW 2021 Rules & Regulations* and dates on 01 June 2021. It replaces version 1.3 of the *EHW 2021 Rules & Regulations*, thus version 1.4 is the only valid version as of 01 June 2021.

10.5 Changelog

Subsequently, the major changes between different published versions of this document are listed.

10.5.1 Version 1.0

- First published version of EHW 2021 Rules & Regulations
- Dates on Tuesday, 10 November 2020

10.5.2 Version 1.1

- Chapter 2.4: Modalities and framework of the EHW 2021 event are now regulated in the EHW Terms & Conditions (European Hyperloop Week 2021 Terms and Conditions of Participation). This document will be released seperately to the applicants through the established communication channels.
    - Adapted chapter 2.6
    - Adapted SC.3 in chapter 5.1
    - Adapted DM.6.2 in chapter 6.2
- Chapter 4.3 AP.1.1: Corrected the statement (former wording was “Every subsystem needs its own application.”)
- Added AP.1.4 and AP.2.7 in chapter 4.3
- Chapter 5.2.1 and 6.3.1: Added specifications on the document format and document scope of ITS and ITD
- Chapter 6.2: Adapted and extended DM.3.1 and DM.3.2.
- Chapter 6.3.2, minimum content, testing: A preliminary testing plan shall be included in the FDD.
- Adjusted Test Track tolerances in section 8.1.1
- Adjusted drawings depicted in Figure 8.1 and Figure 8.3 as well as in Annex A
- Changed chapter 8.1.3
    - Especially reduced tape distance to 15 m
- Added chapter 8.1.4
- Added prototype specifications in chapter 8.2
- Detailed outlines on demonstrations in vacuum chamber provided in chapter 8.2 (Demonstration characteristics in the specifications section)
- Added Annex B – Testing Guidelines
- Further minor changes which do not affect the content

- Dates on Saturday, 12 December 2020

10.5.3 Version 1.2

- Update submission date for FSD/FDD *6.3.2 and 5.2.2*
- For pod demonstrations on test track: *DM.3.6*
    - Define first points of contact; make them significantly softer than test track
    - Mention that teams must prove that any parts in (potential) contact with test track will not harm the test track
- Chapter *8.3:*
    - 5 GHz will not be allowed for vacuum chamber demonstrations, only 2.4 GHz is allowed.
    - Ubiquiti Rocket M5 is not recommended by EHW anymore
- Hyperloop UPV logo's update
- Implement the general comments from the feedback documents *6.2: DM.2.2, DM.2.3, DM.2.4*
    - Handling of power in electromagnetic propulsion and braking system
    - Effects of electromagnetic systems on test track and safety distance
    - Permanent magnets to be covered or removed
- Addendum option 6.3.2, *5.2.2*
- Research and non-prototype work required for FSD/FDD and SI/FSD 6.3.2, *5.2.2*

FDD/FSD must include a section specifying which equipment and infrastructure (both provided by EHW (or expected to be) and brought by the team) they need for their showcases/demonstrations. 6.3.2, *5.2.2*

- Dates on Monday, 01 March 2021

10.5.4 Version 1.3

- Update submission date for SI section *5.2.3*
- SI now also includes details about the showcase and what the teams plan to bring to Valencia in section *5.2.3*
- Update submission date for TSD section *6.3.3*
- TSD written report requirements have been updated in section *6.3.3*
- Details around video format submission of testing videos updated in section *6.3.3*
- Changed demonstration points in subsystem award evaluation scheme *7.2.2*
- Changed demonstration points in complete pod award evaluation scheme *7.3.2*
- New full-scale award evaluation scheme, adapted to fit the applications allowing for a more generic judging in section *7.4.2*
- Added Practical information for the EHW in chapter *9*.
- Changed submission format for documents in section *10.2*

10.5.5 Version 1.4

- Updated submission date for the SI and TSD *5.2.3, 6.3.3*

11.ANNEX A - DRAWINGS

[DRAWING PAGE 1]

[DRAWING PAGE 2]

12. ANNEX B – TESTING GUIDELINES

12.1 Purpose

Subsequently, we provide an idea of the testing information that could be expected the applicant to deliver in the Testing and Safety Documentation (TSD). Some of the points mentioned could be considered for any system tested while others refer to specific systems. Please note that the listed points are not a requirement but just a suggestion. Thus, some points might remain unconsidered while other points not included in the list could be added in the TSD. For the content of the TSD, refer to section 6.3.3.

12.2 General Safety Remark

Always be safe when testing a system!
Although the EHW is not responsible for any conducted tests, we strongly encourage you to NOT test a system in an unsuitable environment, with insufficient equipment and protection gear, or in an unsafe manner.

12.3 Guidelines

12.3.1 General

- Execute the tests according to the various procedures that are demanded for demonstrations at EHW anyways. By doing so, train the workflows and improve the procedures.
- Show and/or describe the safety measures that are implemented in the operation of a system. List the utilised safety gear and emergency equipment.
- For each performed test provide the relevant data to assess the tested system undoubtably, especially the peak values and the respective durations.
- Make use of video recordings where appropriate. Note, however, that although video recordings can provide information about the basic functionality, the exact behaviour and the condition of a system can only be assessed using measurement data.
- It is recommended to test a system beyond the operating point to be used in a demonstration on site of the EHW to prove the reliability of the system.
- Compare the tests and the resulting measurement data with the expected behaviour of the system
- Provide the mass of the system
- Show how the connecting elements are fastened appropriately and secured against unintentional loosening. This could include:
    - Mechanical connections, such as screws, bolts, etc.
    - Electrical connections, such as connectors, cables, etc.

12.3.2 Mechanical Systems

- Top-level:
    - Prove that the assembly does not contain any hazardous sharp edges that might cause damage to the vacuum chamber, the track, or the public
    - Testing data and videos that prove that the system can withstand applicable vibrations. If possible, suggested to perform vibration testing by placing the whole assembly on a vibration plate to ensure it can undergo the full range of frequencies without failure
    - Demonstrate an emergency mechanism in case of power outage during run
    - Prove that the system does not damage any infrastructure in case the emergency mechanism is triggered
- System specific:
    - Braking
        - Perform braking (friction, magnetic, etc) performance test to ensure proper deceleration (to zero speed) with pod trajectory and telemetry data presented for worst case scenario
        - Prove that braking will not damage the provided or the custom track
        - Demonstrate the redundancy of brakes (the design should be at least 1-fault tolerant)
        - Prove that braking is capable of handling the misalignments in the track
    - Suspension
        - Proof of the guidance systems reliability through strength test (FEM and/or test video)
        - Test shock absorber with maximum loads and show that suspension is capable of withstanding misalignments in the track
    - Propulsion
        - Demonstrate that the pod can withstand maximum design speeds while being stable on the track through video and sensor data
    - Structures
        - Perform an I-beam (or customized track) assembly test while showing that the keep-out zone is not violated at all times
        - Pull-out/shear tests for main subsystems (chassis, shell, etc.), any critical linkages and subsystems interfaces (FEM is acceptable too)
    - Levitation Systems
        - Prove that the system does not damage the test track/infrastructure in case of power outage of the levitation system (defined contact points)

12.3.3 Electrical Systems

- Description of functionality of the device/subsystem (e.g. conventional three-phase inverter using PWM driven IGBTs)
- Documentation of electrical characteristics (supply voltage, peak and continuous power)
- Proof (video or time series) of the system in operation, displaying supply voltage and current drawn

- Proof (video or time series) of induced failure of the device and reaction of the system
- Proof (video or time series) of the thermal characteristics of the system (e.g. FLIR camera, thermistors)
- Proof (photo or schematic documentation) of isolation, electromagnetic interference, short circuit protection mechanisms
- Proof (photo or description) of battery enclosure(s)
- Proof (photo or list) of safety equipment

12.3.4 Thermal Systems

- Temperature time history during intended operation at least for desired duration of demonstration(s)
- Proof (data and/or videos) that temperature does not exceed any justified temperature limits, (e.g. material properties)
- (Recommended) Thermal imaging video (i.e FLIR) of test(s) highlighting relevant Temperature distribution and time-development during operation
- Atmospheric conditions (ambient temperature, pressure) at which the tests were conducted
- Operating boundary conditions/value setpoints of all relevant powered systems (for reference see the previously defined data to be provided depending on the subsystem) that correspond to the thermal measurements
- For electrical devices:
    - Description of short circuit projections (e.g. max short for 5 ms @ 200 A → heat up to 75°C)

12.3.5 Pressurised Systems

- Define the operating pressure P_{op} and the maximum pressure P_{max} of the system such as $P_{op} < P_{max}$
- Suggested data:
    - Prove that the system is able to withstand an adequate time at a pressure of P_{max} in order to detect evidence of malfunctioning and verify the system.
    - Prove that the system has no leaks:
        - Unplugging the pressure vessel after filling the pressurised circuit at P_{op} and studying the evolution. Prove that there are no leaks.
    - Test that the electro valves can protect against a regulator failure.
- If the pressurised system is part of the braking system:
    - Ensure the actuators have no leaks and the piston movements are correct for different values of pressure.
    - Check that the return system is well dimensioned and it can reach its initial position (different values of pressure).
    - Increase the pressure to P_{max} gradually and verify the system has no losses and the structure does not experience any problem.
    - Perform a test of an adequate number of cycles on the actuator with the most convenient pressure studied on the previous points and demonstrate the system continues working properly.

    - Perform a load test in which the actuator performs some cycles at high pressure values and some load is added to simulate shear stress. Ensure the system dynamics is not affected by the load.
    - If it is going to be implemented into a vehicle/pod, it is required to test it in a testbench simulating a real run (video-test).
- If the pressurised system is part of the propulsion system:
    - Ensure the propulsion system has no leaks.
    - Perform a test of an adequate number of cycles of pressurization and depressurization with the most convenient pressure limits.
    - Define the pressure limits of the system (P_{max} and P_{min})
    - Increase the pressure as much as possible and verify the system is able to withstand the forces.
    - Decrease the pressure until its minimum and verify the system is able to withstand the forces.
    - Test previously the correct work of the system (video-test). General data:
        - Thrust
        - Temperature evolution

12.3.6 Rotating Systems

- Identify rotating components. Specifications that could be considered for each component:
    - Inertia
    - Maximum operational rotational speed and stored energy
    - Are components/assemblies balanced; what are possible outcomes that imbalance could lead to.
    - Describe how the speed will be measured and monitored
    - State and illustrate loads that are on the assembly: static, inertial, centrifugal, imbalance
    - Identify bearings types and include specifications (load and speed ratings)
    - Show the load paths from component/assembly to the chassis/supporting structure
- Structural integrity proof for their expected operational speeds and loads.
- Video or photos to show the test and measured speed of the rotating component/assembly.

12.3.7 Complete Systems & Pods

- Full Video of the complete system demonstration in the manner as intended at the EHW, preferably different angles or viewpoints that show the behaviour of critical subsystems (for instance levitation, braking, stability, and acceleration)
- General data:
    - Achieved maximum speed, maximum horizontal/vertical acceleration, and deceleration
    - Horizontal and vertical Acceleration-time, speed-distance, and speed-time plot
    - Mention of braking distance and distance safety margin to end of track in worst case
    - Total Duration of demonstration

    - Sensor data for vertical or horizontal distances between pod and track throughout the whole test
    - Time series of total power consumption (e.g. v(t) and i(t) for all sources of power
- Operating boundary conditions, value setpoints and value limits of all relevant powered systems (for reference see also the above suggested data to be provided depending on the subsystem), that are specified and measured during the complete system demonstration. Examples of the most important values to be recorded are:
    - Voltage, current, electrical power consumption of electrical systems
    - Rotational speed of rotating systems
    - Operating pressure and actuator speeds of pressurized systems
    - Temperature of thermal systems
    - Ambient pressure and temperature
- Images, short protocol of condition of or any damage to infrastructure after test
- Images, short protocol of an inspection of the pod systems after the test
- Procedures for complete system power-on/power-off and operation during demonstration
- Conditions and critical values that lead to abortion of the test/demonstration. Verify that they work properly and reliably
- Provide the state diagram of the system and test all states and conditions of the system as far as possible