Scrutineering Checklists

European Hyperloop Week

Tech Committee

May 21, 2025

EUROPEAN
HYPERLOOP
WEEK

Changelog

May 21, 2025, the EHW Committee

Foreword

Dear Participants,
this document intends to give further insights into the Scrutineering processes during the EHW in July. Even though it is still subject to changes, it gives a good representation of what can be expected from the Scrutineering process. More details on logistics will be provided later in the year.

In previous editions, teams used to test their demonstrators upon arrival at the EHW location, and since these demonstrators had not been scrutinized yet, it led to unsafe situations. For this reason, this year, it will not be allowed to test the systems (or subsystems) at the EHW location until these have been scrutinized. The teams will be allowed to start scrutineering approximately one week before the EHW week. This will give time for teams to debug their demonstrators, or test them in case damage has occurred during transport.

The following scrutineering stages are proposed:

- Mechanical Inspection
- Magnets Inspection
- Battery and Low-Voltage Inspection
- Software & Sensors Inspection
- Power Electronics Inspection
- Demonstration Test.

A team applying for a complete system must complete all these stages successfully in order to demonstrate their prototype. Teams applying for promising subsystem awards will only need to complete the stages that apply to them; these will be roughly indicated by the EHW technical committee in the ITD feedback session in January. Due to the nature of the competition and the variety of proposals, the specific points for each team are subject to change depending on what teams intend to bring to the competition. Bear in mind that not all the inspection points contained in this document are contained in the R&R. These come from what the EHW Committee believes is necessary in order to have a safe prototype and ensure a successful demonstration. We therefore encourage teams to think themselves what potential risks their systems pose, and how they can mitigate them. Even if a system complies with all the inspection points in these lists, if it is not considered safe, it will not be allowed to demonstrate.

In addition, the possibility to perform a vacuum test is provided by the EHW. You can find more details in the R&R and in section 6.

Best of regards and good luck!

The EHW Technical Team

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Contents

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1. Pre-Scrutineering

Objective: Ensure teams are prepared for scrutineering and have all safety measures in place before technical inspections.

- Team Safety Briefing: All team members attended and understand the rules.
- Safety Equipment: Certified 1st class powder fire extinguishers (check the expiration date carefully), insulating gloves, safety shoes, and reflective vests are available
- Component Datasheets: Datasheets for critical components (e.g., contactors, pneumatic valves) are prepared and available.
- Workspace Readiness: Workspaces are distraction-free (e.g., no jewelry, no phones near HV systems).
- Tools and Equipment: Rated for expected voltages and inspected for damage.

2. Mechanical Inspection

Objective: Verify the structural integrity, safety mechanisms, and assembly of mechanical systems.

- Structural Safety: No sharp edges, loose parts, or insufficiently fastened components.
- Manufacturing Quality: Welds, bolts, and lock nuts are secure and match CAD models.
- Overheating Prevention: Effective cooling systems are in place and leak-proof.
- Pneumatics
  Hydraulics Certification: Systems meet design ratings and have proper nameplates.
- Emergency Brakes: Functional and engage in power-loss scenarios.
- Track Compatibility: Meets specifications for alignment, grounding, and fire prevention.

3. Magnets Inspection

Objective: Ensure the safety and functionality of permanent and electromagnets.

- Magnetic Field Safety: Flux density not exceeding 1 mT on the cover's surface.
- Safety Warnings: Magnets are covered, and warning stickers are present.
- Coil Insulation: Coils are insulated, and overheating is prevented.
- Current Paths: High-current paths avoid soldered joints.

4. Battery and Low-Voltage Inspection

Objective: Evaluate the safety and compliance of battery systems and low-voltage installations.

- Voltage Safety: Low-voltage systems under 50V with terminals clearly identified and secured.
- BMS Functionality: Battery Management System is operational.
- High-Voltage Safety Compliance: Main fuse and isolation relays are installed and rated.
- Pre-charge Circuits: Functionality is verified.
- Wiring Separation: LV and HV wiring are separated by at least 25 mm.
- HV Wiring Standards: Orange, insulated, and rated for voltage/power.

5. Software
Sensors Inspection

Objective: Verify that software and sensors ensure safe and effective control of the prototype.

- Safe Ranges in GUI: Monitored variables show safe ranges.
- Emergency Commands: Stop commands and emergency braking are functional.
- Fault State Handling: Fault state opens relays and engages braking actions.

6. Power Electronics Inspection

Objective: Ensure the power electronics are safe and comply with technical regulations.

- HV Insulation Safety: HV wiring is insulated, orange, and properly rated.
- Pre-charge Circuits: Prevent high inrush currents.
- Energy Management: Regenerated energy is treated correctly.

7. Vacuum Test

Objective: Test compatibility with low-pressure environments (if applicable).

- Electrical Ratings: Components rated/tested for vacuum conditions.
- Structural Integrity: Vehicle withstands low-pressure environments.
- Data Logging: Accurate during vacuum testing.

8. Demonstration Test

Objective: Confirm readiness for safe and compliant operation during the demonstration.

- HV Indication: Visual indicators signal HV presence and proper insulation.
- System Load: Operates under full-load conditions without safety risks.
- Emergency Protocols: Functional and validated.

1 Pre-Scrutineering

Aims: Before the first scrutineering phase, the safety equipment of the team will be inspected.

Team	
Verdict	☐ Pass ☐ Fail

Prior to the start of the inspections, there will be a safety briefing aimed at guaranteeing the safety of all individuals involved. During the competition, all team members must respect the following when working with the prototype:

- No jewelry, no rings
- No cell phone
- No badge / no necklace
- No sources of distraction

Once the safety briefing is done, the following will be checked:

- Safety shoes
  - Safety/steel-toed boots
  - Rated dielectric footwear
- Do people around heavy items or high voltages wear the appropriate footwear?
- Safety glasses (minimum of three (3)): Do safety glasses have side shields?
- Fire extinguisher: Two (2) certified and up-to-date 1st class powder fire extinguishers.
- Do people working on high voltage wear suitable footwear?
  - Safety/steel-toed boots
  - Rated dielectric footwear
- Do people working on high voltage have suitable equipment?
  - Insulating gloves (minimum of two (2) pairs) rated for the maximum expected voltages.
  - Basic set of insulated tools
- Helmets.
- Reflective equipment (like vests).
- Datasheets of critical components such as contactors or pneumatic valves must be prepared in digital or physical format (will be checked on the respective scrutineering stages).

2 Mechanical Inspection

Aim: Check if the mechanical side of the system adheres to the Rules and Regulations and is safe to operate.

Team	
Verdict	☐ Pass ☐ Fail

During this inspection, the definition of assembly points and exit paths in the case of an emergency will be checked. Furthermore, the team must perform the proposed procedures Filling of pneumatic system and Emptying of pneumatic system if applicable.

2.1 Inspection Checklist

The points checked during the scrutineering stage are contained in the following section. The team must fulfill all points that apply to their demonstrator to be considered passed in the stage.

General		
MEC.1	The prototype bears a resemblance to the proposed FDD concept.	☐
MEC.2	Enough space to place the scrutineering sticker in a visible spot.	☐
MEC.3	The safety factor of all the structural elements in the worst-case scenario is higher than 2 (Contrasted with FDD).	☐
MEC.4	There are no sharp edges.	☐
MEC.5	There are no loose parts (all parts are correctly fastened.	☐
MEC.6	The quality of the welds is sufficient.	☐
MEC.7	The bolts are secured tight to the required pretension.	☐
MEC.8	Nuts are prevented from coming loose by either using positive locking mechanisms or (nylon) lock nuts.	☐
MEC.9	A minimum of two full threads must project from any lock nut.	☐
MEC.10	All lock nuts are marked (Figure 1).	☐
MEC.11	There are no significant changes between CAD models and manufactured parts.	☐
MEC.12	Manufactured processes are coherent with documents provided.	☐
Comments:		
Thermal Management		
MEC.13	There is a system in place to prevent components from overheating. If not, the team must have implemented measures to prevent this or be able to explain why it can not happen.	☐

MEC.14	(If applicable) Visual check of the system.	☐
MEC.15	(If applicable) The system does not leak.	☐
MEC.16	(If applicable) The system is watertight.	☐
MEC.17	(If applicable) The system is vacuum-proof.	☐
MEC.18	(If applicable) All parts are rated for the working pressures.	☐
MEC.19	(If applicable) Data sheets for cooling fluid or provided.	☐
MEC.20	(If applicable) If the cooling fluid can be harmful to people or the environment, proper procedures must be implemented to reduce risks of damage.	☐
Comments:		
Pneumatic/Hydraulic System		
MEC.21	(If applicable) Visual check of the system.	☐
MEC.22	(If applicable) Pneumatic/Hydraulic system is drawn with accompanying specifications.	☐
MEC.23	(If applicable) Vessels and enclosures are marked with a certification nameplate with all the certified maximum allowable pressure (MAWP) ratings being provided (At least most critical components like pressurized tanks).	☐
MEC.24	(If applicable) The operation conditions of team-made pressurize systems must meet the design ratings with a safety factor higher than 2.	☐
MEC.25	(If applicable) In case of power or connection loss, the system can be vented (vents are present).	☐
Comments:		
Braking System		
MEC.26	In a neutral, not powered state, the emergency brakes apply the required braking force for an emergency stop at full speed.	☐
MEC.27	The team can explain how braking forces are applied in a symmetrical way on the track.	☐
MEC.28	The team can explain how, in case of power loss, the state of the pressurized system is safe.	☐
MEC.29	The team can explain how, in case of connection loss, the state of the pressurized system is safe.	☐
MEC.30	The actuator movement doesn't affect any surrounding system.	☐
MEC.31	(Electromagnetic braking) Generated/Recuperated energy is handled properly.	☐
Comments:		
Wheels		
MEC.32	The wheels are in good condition (not damaged).	☐
MEC.33	The axles of the wheels are in good condition.	☐

MEC.34	The hardness of the wheels' material is lower than the track's.	☐
MEC.35	If there are springs or dampers, they are in good condition and safely attached.	☐
MEC.36	The wheels do not bend in undesired axes.	☐
MEC.37	Rotational symmetry is met (the wheels are balanced).	☐
MEC.38	Bearings and wheel contact surfaces withstand the rotational speeds, as well as frictional head loads and deformations.	☐
Comments:		
Custom Track		
MEC.39	The length of the track is within the specified dimensions.	☐
MEC.40	The track is well aligned. (The team must justify the tolerance used.)	☐
MEC.41	There is a buffer stop at both ends of the track.	☐
MEC.42	It is not possible for the pod to leave the track when the buffer end stop is attached.	☐
MEC.43	The track is well anchored to the ground - Can withstand strong weather conditions, won't be able to move during a run...	☐
MEC.44	The stability of the infrastructure is great enough to avoid rollover in the worst-case scenario.	☐
MEC.45	Safe/danger are zones well-defined and marked (with, for example, tape on the ground). Safety perimeter and assembly points are well-defined.	☐
MEC.46	(If applicable) The path to get out of the tent safely in case of an emergency is cleared and well-defined.	☐
MEC.47	The custom track is provided with sufficient electrical grounding, to prevent harm or injury to people.	☐
MEC.48	If the track contains electrical components, no hazardous components shall be exposed.	☐
If the custom track includes a tube-like structure		
MEC.49	The track is not made of flammable materials.	☐
MEC.50	The team can explain the extinguishing plan in case of a fire inside the tube.	☐
Comments:		

The following procedures must be performed after the inspection in front of the scrutineers to ensure every step is performed safely.

2.2 Procedure: Filling and emptying of pneumatic system

- Does everyone stay in the safe designated zones at all times?
- Are there high risks taken while performing the procedure?

- Is the system leak-tight?

3 Magnets Inspection

Aims: Check the adherence of the permanent and electromagnets to the Rules and Regulations, their safety, and overall quality.

Team	
Verdict	☐ Pass ☐ Fail

This scrutineering inspection is necessary for those teams that use permanent or electromagnets. Upon arrival at the EHW location, the permanent magnets of the prototype must be covered at all times until the inspection takes place. This means, that the magnets must either be:

A. Mounted on the pod, and at all times have their magnet cover box on.

B. Stored in a transport crate box which satisfies a 1 mT requirement on its surface. In this case, the team must perform the proposed procedures Mounting of magnets and Dismounting of magnets respectively).

After inspection, whenever the permanent magnets are mounted on the demonstrator and are not being used, they must be covered with their respective magnet cover box.

3.1 Inspection Checklist

The points checked during the scrutineering stage are contained in the following table. The team must fulfill all points that apply to their demonstrator to be considered passed in the stage.

General		
MAG.1	The demonstrator bears a resemblance to the proposed FDD concept.	☐
Magnetic Cover		
MAG.2	The permanent magnets are sufficiently covered.	☐
MAG.3	The magnetic flux density does not exceed 1 mT anywhere on the surface of the cover or storage box of any permanent magnet.	☐
MAG.4	There are warning stickers on the outside of the magnet cover that indicate a magnet danger.	☐
Permanent Magnets		
MAG.5	The permanent magnets do not present (visible) damage to them.	☐
MAG.6	The magnetic flux density does not exceed 0.5 mT at a distance of one meter or more from the pod's outer perimeter.	☐
MAG.7	The team can explain if the magnets are at risk of demagnetizing, and if any actions have been taken to reduce this risk.	☐

MAG.8	If applicable, the team can explain how the permanent magnet will not hit the track at any point in time	☐
Electromagnets		
MAG.9	The team can explain how the coils have been wound. The coils have been wound in an orderly manner.	☐
MAG.10	There is no solder present in the high current path	☐
MAG.11	The coils are isolated from the chassis, and have sufficient clearance with any other conductive surface (at least twice the arcing distance)	☐
MAG.12	The coils are prevented from moving.	☐
MAG.13	If applicable, the team can explain how the electromagnet will not hit the track at any point in time	☐
MAG.14	The team can explain how the electromagnet is kept from reaching extreme temperatures (could be limited on time of use,a cooling system, etc.).	☐
Comments:		

In case the team plans to mount or dismount the permanent magnets from their prototype, the following procedures must be performed after the inspection in front of the scrutineers to ensure every step is performed safely.

3.2 Procedure: Mounting and dismounting of magnets

Great attention will be put to safety aspects related to magnets.

- Are the people involved in the procedure magnet safe? (no phone, chains, watches...)
- Are the people involved in the procedure wearing the respective PPE?
- Is the area clean of loose tools, bolts, nuts, or other elements that can snap onto the magnet?
- Is the magnet being carried safely?
- Is there a clear path from the magnet storage box to the demonstrator?

Aims: Ensure compliance of the battery and low-voltage systems with regulations, focusing on safety and operational integrity.

Team	
Verdict	☐ Pass ☐ Fail

This scrutineering phase is mandatory for teams utilizing batteries or electronics. Both low and high-voltage battery systems, along with low-voltage installations, will be inspected. Teams must store and discharge batteries upon arrival at EHW and refrain from testing them before inspection approval.

Following inspection, low-voltage systems may be tested using the batteries, while high-voltage operations remain restricted until the Sense & Control Inspection and Power Electronics Inspection are completed.

Teams must also demonstrate the procedures for Mounting & Dismounting of LV Battery, Charging of LV Battery, and Charging of HV Battery, where applicable.

Note: Early inspection of the high-voltage battery allows preliminary testing of the high-voltage battery management system.

3.3 Inspection Checklist

The following checklist items must be fulfilled for successful clearance of this stage:

Low Voltage Battery		
BAT.1	Rated voltage does not exceed 50V.	☐
BAT.2	Battery includes an operational Battery Management System (BMS).	☐
BAT.3	Positive and negative terminals are clearly labeled.	☐
BAT.4	Mechanism present to prevent incorrect polarity connections.	☐
Custom Battery		
BAT.5	Team can explain battery production process.	☐
BAT.6	Batteries are manufactured safely.	☐
BAT.7	Short-circuit protection for positive and negative terminals.	☐
BAT.8	Proper current limiting fuses has been installed wherever required.	☐
BAT.9	Secure connections to prevent dislodging during operation.	☐
Comments:		
High Voltage Battery		
BAT.10	Battery includes an operational BMS.	☐
BAT.11	Positive and negative terminals are clearly labeled.	☐

BAT.12	Mechanism present to prevent incorrect polarity connections.	☐
BAT.13	Battery pack is securely mounted to the chassis, using appropriate mechanical fasteners and vibration-resistant methods.	☐
BAT.14	Mounting system can withstand operational loads and complies with structural integrity requirements.	☐
BAT.15	HV connectors are firmly latched and cannot be disconnected unintentionally	☐
BAT.16	All mounting points are accessible for inspection and maintenance.	☐
	Custom Battery	
BAT.17	Team can explain battery production process.	☐
BAT.18	Batteries are manufactured safely.	☐
BAT.19	Short-circuit protection for positive and negative terminals.	☐
BAT.20	Secure connections to prevent dislodging during operation.	☐
Comments:		
	Low Voltage Installation / Wiring	
BAT.21	No loose connectors in sensor and communication networks.	☐
BAT.22	Clear labeling or color coding of all wire connections.	☐
BAT.23	All low-voltage wiring can independently support battery weight.	☐
BAT.24	All circuit boards are securely anchored to prevent mechanical stress.	☐
BAT.25	Non-conductive anchoring materials used (e.g., nylon screws).	☐
Comments:		

3.4 Procedure: Mounting & Dismounting of LV Battery

This procedure ensures the correct and safe handling of the low-voltage battery before and after final vehicle demonstrations. Before installation, the battery must be visually inspected for damage, leakage, or corrosion. Once confirmed safe, the vehicle's power systems should be turned off, and the battery carefully positioned in its designated compartment, ensuring the correct orientation. Electrical connections should be made by first connecting the positive terminal, followed by the negative, and secured using insulated tools and appropriate torque settings. The battery must then be firmly mounted using approved brackets and hardware, with a stability check to confirm there is no movement. After installation, system diagnostics should be performed to verify proper operation. Post-demonstration, the battery must be safely shut down, disconnected in reverse order (negative first, then positive), carefully removed from the vehicle, and transported to the designated charging station for secure storage in accordance with safety protocols.

Charging Station Safety Considerations:

- Is the battery's charge status visible to a responsible team member at all times?

- Is the charging zone clearly defined and restricted?
- Is the charging area sufficiently distant from other work zones (e.g., track assembly, power electronics testing)?
- Are necessary fire safety materials available (insulated gloves, fire extinguisher)?

Final Notes

Teams must complete all relevant inspections to qualify for the European Hyperloop Week 2025 demonstration. Compliance with safety and technical standards is mandatory to ensure a successful and secure competition.

4 Software & Sensors Inspection

Aims: Check the adherence of software and sensors to the Rules and Regulations, its safety, as well as its overall quality.

Team	
Verdict	☐ Pass ☐ Fail

This inspection intends to check that the sense and control subsystem contains all safety implementations before any high-voltage systems are used. In addition to inspection points, the team must perform the proposed procedures Power On, State Machine Transitions, and Power Off if applicable.

4.1 Inspection Checklist

The points checked during the scrutineering stage are contained in the following table. The team must fulfill all points that apply to their demonstrator to be considered passed in the stage.

General		
SC.1	The demonstrator bears resemblance with the proposed FDD concept.	☐
GUI		
SC.2	Safe range for monitored variables is clearly indicated.	☐
SC.3	The demonstrator can break using a physical button of the Control Station.	☐
SC.4	GUI monitors the speed of the demonstrator.	☐
SC.5	GUI does not display outdated values.	☐
SC.6	Stop command is implemented on the GUI.	☐
SC.7	Person monitoring the speed of the demonstrator has quick access to the emergency breaks.	☐
SC.8	Demonstrator's health must be visible to an external viewer using colored visual indicators.	☐
SC.9	Test cut off battery command and verify correct result.	☐
SC.10	Test emergency command and verify correct result.	☐
SC.11	All safe actuations must be tested (brakes, contactors, relays, valves)	☐
Comments:		
Low Voltage Battery		
SC.12	The GUI logs individual cell voltage of 100% of low voltage Cells.	☐
SC.13	The GUI logs data of at least 25% of cell temperatures.	☐

SC.14	The GUI logs SOC of the low voltage battery.	☐
SC.15	The GUI logs individual cell voltage of 100% of low voltage Cells.	☐
Comments:		
	Sensors	
SC.16	The demonstrator enters Fault State after sensor disconnection	☐
SC.17	The demonstrator enters Fault State after reading out-of-range values (provoke them by manipulating movement sensors. If not possible, the team is responsible for manually triggering the protection system with code.)	☐
Comments:		
	State Machine Transitions	
SC.18	The demonstrator breaks after entering Fault State	☐
SC.19	The demonstrator opens relays after entering Fault State	☐
SC.20	The demonstrator enters in Fault State after a disconnection.	☐
SC.21	The demonstrator logs data in Fault State.	☐
SC.22	The demonstrator can be restarted from Fault State.	☐
Comments:		

The following procedures must be performed after the inspection in front of the scrutineers to ensure every step is performed safely.

4.2 Procedure: Power On & Off

The control systems of the demonstrator must be powered on in the intended way during the demonstration. The jury may then require additional validation of the state machine to ensure the safety of the vehicle. Finally, the control systems of the demonstrator must be powered off in the intended way during the demonstration.
Great attention will be put to the placement of the control switch, such as:

- Is the switch accessible for an operator in case of an emergency?
- Is the switch protected from accidental collisions that may turn the vehicle off?

5 Power Electronics Inspection

Aims: Check if the mechanical side of the system adheres to the Rules and Regulations and is safe.

Team	
Verdict	☐ Pass ☐ Fail

Only after this inspection will the teams be allowed to operate high voltage on the EHW location. Furthermore, the team must perform the proposed procedures Mounting of HV Battery, Power On, State Machine Transitions, Power Off, and Dismounting of HV Battery if applicable.

5.1 Inspection Checklist

The points checked during the scrutineering stage are contained in the following table. The team must fulfill all points that apply to their demonstrator to be considered passed in the stage.

General		
PE.1	People working on high voltage wear insulating gloves (rated, used along with leather/cloth linings for shock protection).	☐
PE.2	Insulated tools of the correct rating are used when working with high voltage.	☐
PE.3	High voltage and low voltage wires are separated from each other.	☐
PE.4	HV wires are well recognizable from the outside (they are coloured orange).	☐
PE.5	The HV wires have the correct Voltage and Power ratings.	☐
PE.6	All HV isolation distances are appropriate to the Voltage levels used (+buffer) (for Vacuum if applicable)	☐
PE.7	The HV connections have good insulation.	☐
PE.8	If there are HV connections with screws, they tightened to the correct level.	☐
PE.9	A visual indicator (LED) shall clearly signal when the pre-charge process is active. The indicator must be labeled with function.	☐
Comments:		
Manual Insulation Disconnects (MIDs)		
PE.10	The MID isolates at least one pole of the battery pack when removed.	☐
PE.11	The MID is placed on the high voltage line and independent of the low voltage electronics.	☐
PE.12	The MID is removable without any tools.	☐

PE.13	The MID is accessible if the pod/subsystem is stuck.	☐
PE.14	The MID is attached through positive locking mechanisms preventing disconnection through external forces.	☐
PE.15	There are no conducting surfaces on the MID apart from the electrical connection.	☐
PE.16	The MID can disrupt short currents.	☐
PE.17	Is there a mechanism to stop short-currents (eg. fuse) and is it rated correctly?	☐
PE.18	Is the insulation of all HV cables physically intact?	☐
Comments:		
Insulation Monitoring Device (IMD)		
PE.19	Each high-voltage pack features a separate Insulation Monitoring Device, monitoring high-to-chassis and low-to-chassis insulation.	☐
PE.20	There are visual indications (LEDs) signaling proper insulation and must be properly labeled.	☐
Comments:		
Power Electronics		
PE.21	If there are high capacitive loads connected, there is a proper precharge circuit with related precharge time.	☐
PE.22	If the propulsion system regenerates energy into the batteries, this energy is properly treated.	☐
PE.23	If the guiding system regenerates energy into the batteries, this energy is properly treated.	☐
PE.24	If the braking system regenerates energy into the batteries, this energy is properly treated.	☐
Comments:		

The following procedures must be performed after the inspection in front of the scrutineers to ensure every step is performed safely.

5.2 Procedure: Mounting & dismounting of HV Battery

The high voltage battery must be mounted and anchored to the vehicle in the intended way during the final demonstration.
Then it must be dismounted and put in the teams charging station. Great attention will be put to the placement of the charging station, such as:

- Is the battery state visible at all times by a responsible?
- Is the battery charging zone delimited?

- Is the battery charging zone far enough from the rest of the working zones (mounting of the track, power electronics testing)?
- In case of electric fire, is the material needed such as protective gloves and fire extinguisher available for the responsible?

6 Vacuum Test

Aims: Check if the demonstrator can operate under a low pressure environment.

Team	☐
Verdict	☐ Pass ☐ Fail

In this section, the term 'vacuum' is frequently employed, indicating a condition of reduced pressure.

The capability of the system to withstand a vacuum is an important aspect of a hyperloop system. If the team's demonstration does not include a vacuum, but they would like to prove vacuum compatibility, the possibility of performing a vacuum test is offered. It is not compulsory to undergo such a test and only those teams that have accounted for vacuum conditions in their design will be allowed to participate in this stage. In addition, the team must have successfully passed all previous inspections. Failure to pass this stage will award 0 points in the vacuum section of the respective application, independent of the FDD or any previous video shown in the POD.

There are several aspects to take into account when operating a system in a vacuum, both for the system's health as well as the vacuum chamber's. It is therefore important that the team can show that the components of the vehicle can withstand a vacuum. This can be done in several ways, which include:

- Providing a video proof of individual subsystems being tested under vacuum conditions.
- Providing data sheets of components (especially electrical components, which may contain gas trapped inside and may explode under low-pressure environments).
- Showing the appropriate calculations done to ensure a proper operation under vacuum and their respective implementation (for example, calculating the arcing distance, and then showing the actual distance of the components).

To find more information regarding the tube itself and other specifications, please consult EuroTube. A description of what the team would like to test inside the chamber shall be provided in the FDD and detailed in the SPD.

Pre-Vacuum Check		
VAC.1	The team shows proof that their electrical components on PCBs must be rated for vacuum [1] or must have been tested under such conditions.	☐
Vacuum check		
VAC.2	Does the vehicle structure withstand the low-pressure environment?	☐

[1]Pay special attention to components like relays that may contain gas inside which may explode under vacuum

VAC.3	Is the temperature reading coherent? Are temperatures within acceptable operating values?	☐
VAC.4	Is there accurate logging of vehicle data and events?	☐
Custom track		
VAC.5	Is the track properly sealed?	☐
VAC.6	Is there a proper vacuum procedure? In case of leaks, is there any remedy?	☐
Comments:		

7 Demonstration Test

Aims: Check if the demonstrator adheres to the Rules and Regulations and is safe to be operated during Demonstration Day.

Team	
Verdict	☐ Pass ☐ Fail

This test is the final test before the demonstration on Saturday the 20th of July. All systems must pass this test to be able to demonstrate. To participate in this stage, all the (applicable) previous stages must have been passed. This test will be performed at the track (or respective test bench area) where the team will perform in the same way that they will on Saturday (Demonstration Day). Once this test has been passed, it is not possible to make any changes to the vehicle. Otherwise, this stage will have to be approved again.

To start this test, the system will be in a ready-to-start state, with magnets, and batteries already mounted with all respective procedures performed. This test will start by turning on the low voltage on the system and performing the procedures necessary to perform the demonstrations. The jury will look especially at safety during the run and the procedures around it. Apart from this, some other things will be inspected, including:

General		
DEM.1	(If a system uses high voltage) Visual indications (e.g., LEDs) are placed, signaling proper insulation (IMD).	☐
DEM.2	(If a system uses high voltage) Visual indications (e.g., LEDs) are placed, signaling the presence of high voltage on the connectors (i.e., relays closed).	☐
Comments:		

A Additional information

Figure 1: If the nuts are marked in this way with, for example, a white permanent marker, it will be clear if any have slipped. This is a quick and easy way to inspect your prototype before and after a test.