SLOVENSKI STANDARD
kSIST-TP FprCEN/CLC/TR 17912:2022

01-november-2022

Sistemi Hyperloop - Popis standardov in načrt

Hyperloop systems - Standards Inventory and Roadmap

Hyperloop-Systeme - Normeninventar und Fahrplan

Systèmes Hyperloop - Inventaire des normes et feuille de route

Ta slovenski standard je istoveten z: **FprCEN/CLC/TR 17912**

ICS:

03.220.99	Druge oblike transporta	Other forms of transport
55.020	Pakiranje in distribucija blaga na splošno	Packaging and distribution of goods in general

kSIST-TP FprCEN/CLC/TR 17912:2022 **en,fr,de**

TECHNICAL REPORT

RAPPORT TECHNIQUE

TECHNISCHER REPORT

FINAL DRAFT
FprCEN/CLC/TR 17912

September 2022

ICS 03.220.99; 55.020

English version

Hyperloop systems - Standards Inventory and Roadmap

Systèmes Hyperloop - Inventaire des normes et feuille de route

Hyperloop-Systeme - Normeninventar und Fahrplan

This draft Technical Report is submitted to CEN members for Vote. It has been drawn up by the Technical Committee CEN/CLC/JTC 20.

CEN and CENELEC members are the national standards bodies and national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a Technical Report. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a Technical Report.

CEN-CENELEC Management Centre:
Rue de la Science 23, B-1040 Brussels

Contents

European foreword

This document (FprCEN/CLC/TR 17912:2022) has been prepared by WG1 “Operation and Services” of Technical Committee CEN/CLC/JTC 20 “Hyperloop systems”, the secretariat of the working group is held by UNE and the secretariat of the Joint Technical Committee is held by NEN.

0 Introduction

0.1 General

The objective of this document is to initially gather relevant existing standards as well as legislative documents in order to identify the standards that can be potentially utilized in hyperloop. Some of these standards are generic, technology agnostic and as such can also be applicable to hyperloop. A set of the standards developed specifically for other transport modes and industries are a useful reference for the future standards development in hyperloop. Especially the type of standards that will be required in specific areas of system design provide for the first steps towards a standardization roadmap for the hyperloop standards.

This document identifies the main areas of the standardization roadmap and provides the first inventory of standards and legislative documents relevant to Hyperloop Systems.

This document will be subject to future modifications and additions which will be incorporated into the future versions. This takes into account the fact that the hyperloop technology is in full development.

0.2 Context

The Hyperloop is a new technology which is being developed by several companies around the globe.

The Hyperloop is a new means of transportation for large volumes of passengers and cargo, based on new or emerging technologies such as low pressure environment or magnetic levitation, able to travel at very high speeds, protected from bad weather conditions and other external conditions, with very low environmental impact in terms of energy consumption, emission of greenhouse gases and other pollutants, and noise emission.

A new means of transportation as ambitious and innovative as the Hyperloop will need a large set of standards to achieve different goals such as safety and security, efficiency, low time to market, and compliance to regulations.

Following the expectation that there are several existing standards that could be (partially) reused, this document aims at helping to identify those and the respective areas.

0.3 Purpose

The standards inventory contained in this document is created to take these standards, directives and regulations into account, as input to the development of standards for Hyperloop, and hence serve as a valuable tool for the Hyperloop industry and legislative authorities and regulators.

1 Scope

1.1 General

The original scope from N17 (NWI CEN/CLC TR Hyperloop systems - Standards inventory and roadmap) reads as follows:

This document lists the relevant standards from various fields and provides a standardization roadmap for hyperloop systems. The roadmap will provide guidance on the applicable standards from various fields, those that need amending and the new-to be developed standards.

1.2 Methodology

The WG has listed the relevant documents (standards, directives, etc) from various fields in order to provide a baseline for a standardization roadmap for hyperloop systems. The resulting document hence enhances the scope as it provides guidance on the applicable relevant documents from various fields that the working group has identified, analysed and proposed for an application in the hyperloop field.

The following document is a first inventory that identifies

— those standards that the WG considers fully applicable,

— those deemed useful with certain adaptations for an application in hyperloop (or serving as an input for new, specific hyperloop standards to be created),

— and those that the WG considers not directly applicable for Hyperloop purposes.

In addition, this document identifies relevant regulations, directives and related documents as well as some potential areas where new hyperloop standards will be needed.

It needs to be stated that the WG has done its best endeavour to identify the (partial) reusability for hyperloop based on the available information (high-level descriptions of the standards, tables of contents, summary documents etc).

In a next step, a roadmap will provide some guidance regarding those areas and point at new-to be developed standards for which a need has been identified. The yet-to-be-created roadmap will also sketch out the concrete steps to be taken w.r.t. to the development of the necessary Hyperloop standards.

Moreover, an alignment with the other WIs will be performed, as it is important that all WIs are aligned and use the same language.

2 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN XXX (WI = JT020005, Hyperloop vocabulary definitions) apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3 Technical report architecture

3.1 TR architecture introduction

This standards inventory has been classified according to the basic structure of the Publication of the US. Department of Transportation "Hyperloop Standards Desk Review" (January 2021) of the Non-Traditional and Emerging Transportation Technology (NETT) Council.

Some additional elements have been added to the NETT Council structure.

A graphic representation of the technical report architecture is contained in Annex A.

3.2 Architecture

General Safety Requirements

- Risk Assessment and Safety Targets
- Design Principles with Respect to Safety and Reliability
- Basis of Structural and Mechanical Design Assumptions and Analysis
- Materials

System design

- Vehicle/Capsule
  - Vehicle/Capsule Design Criteria
  - Suspension and Vibrations
  - General Travel Comfort & related Systems
  - Passengers with restricted mobility
  - Electrical Systems, Electronics and software on boards
  - Bogie & Wheels
  - Braking
  - Miscellaneous
- Guideway
  - Eurocode Series Standards
  - Free-Span Tube
  - Pylons
  - Buried/Submerged Tube
  - Tube Vacuum Technology
- Energy and power
- Safety-Related Control System and Communications
- Electromagnetic Compatibility and Exposure
- Batteries

Operation and Maintenance

- Operation
  - System Shutdown

Automated Systems

Maintenance

Fire protection and evacuation

Fire protection

Evacuation

Security

Physical Security

Information Security

Conformity Assessment

Accreditation

Certification / Inspection

Testing

Other

4 Standards inventory and roadmap

4.1 Introduction

All references listed in the following tables have been classified in three groups:

I. Applicable

II. Useful as a reference, meaning that the degree of applicability to Hyperloop Systems has not yet been established or thoroughly evaluated. This is the case, for example of many of the standards and legislative documents that come from the aeronautic or railway industry.

III. Not directly applicable, meaning that the reference has been revised by WG1 “Operation and Services” and has been found as not directly applicable.

A set of European standards are developed under Frankfurt/Vienna agreement and as such have an equivalent ISO/IEC standard. For such standard the European Standard is listed. When known the equivalent international ISO/IEC standard is referred as well.

A set of relevant European and/or international legislative references originating from the governmental institutions are referred separately at the end of each table.

4.2 General safety requirements

4.2.1 Risk assessment and safety targets

CODE	TITLE	DOCUMENT OWNER	APPLICABILITY
ISO/IEC 31000	Risk management. Guidelines	ISO/IEC	Applicable document
ISO/IEC 31010	Risk management. Risk assessment techniques	ISO/IEC	Applicable document
EN 50518	Monitoring and alarm receiving centre	CENELEC	Applicable document
ISO/IEC Guide 51	Safety aspects. Guidelines for their inclusion in standards	ISO/IEC	Applicable document
IEC 62267	Railway applications - Automated urban guided transport (AUGT) - Safety requirements	IEC	Useful reference
EN 16601-80	Space project management - Part 80: Risk management	CEN/CENELEC	Useful reference
IEC 61511	Functional safety—Safety instrumented systems for the process industry sector	IEC	Useful reference
Directives, Regulations and related documents			
Article 6(3)(a) of the Railway Safety Directive ERA/GUI/01–2008/SAF	Guide for the application of the Commission Regulation on the adoption of a common safety method on risk evaluation and assessment	European Railway Agency	Useful reference
DEF STAN 00-56	Safety Management Requirements for Defence Systems	UK Ministry of Defence	Useful reference
MIL-STD-882E	Department of Defence standard practice. System safety	USA Department of Defence	Useful reference

4.2.2 Design principles with respect to safety and reliability

CODE	TITLE	DOCUMENT OWNER	APPLICABILITY
ISO 3745	Acoustics — Determination of sound power levels and sound energy levels of noise sources using sound pressure — Precision methods for anechoic rooms and hemi-anechoic rooms	ISO	Applicable document
EN 62305 (parts 1 to 4)	Protection against lightning	CENELEC	Applicable document
ISO 2041	Mechanical vibration, shock and condition monitoring — Vocabulary	ISO	Useful reference
EN ISO 3095	Acoustics - Railway applications - Measurement of noise emitted by rail bound vehicles	CEN	Useful reference
EN ISO 3381	Railway applications - Acoustics - Noise measurement inside rail bound vehicles (ISO/DIS 3381:2021)	CEN	Useful reference
EN 15461	Railway applications - Noise emission - Characterization of the dynamic properties of track sections for pass by noise measurements	CEN	Useful reference
EN 50122-1	Railway applications - Fixed installations - Electrical safety, earthing and the return circuit - Part 1: Protective provisions against electric shock	CENELEC	Useful reference
EN 50122-2	Railway applications - Fixed installations - Electrical safety, earthing and the return circuit - Part 2: Provisions against the effects of stray currents caused by d.c. traction systems	CENELEC	Useful reference
CENELEC Report R009–004:2001	Railway applications—Systematic allocation of safety integrity requirements	CENELEC	Useful reference
EN 17285	Railway applications - Acoustics - Measuring of door audible warnings	CEN	Not directly applicable
CEN/TC256/WG 03 Pending Number	Railway applications – acoustics - Measurement of source terms for environmental noise calculations	CEN	Not directly applicable
RTCA/DO-254	Design Assurance Guidance for Airborne Electronic Hardware	American Radio Technical Commission	Useful reference

CODE	TITLE	DOCUMENT OWNER	APPLICABILITY
		for Aeronautics.	
RTCA/DO-160	Environmental Conditions and Test Procedures for Airborne Equipment	American Radio Technical Commission for Aeronautics.	Useful reference
SAE ARP 4754A	Guidelines for Development of Civil Aircraft and Systems	US Society of Automotive Engineering	Useful reference
SAE GEIASTD0010	Standard Best Practices for System Safety Program Development and Execution	US Society of Automotive Engineering	Useful reference
Directives, Regulations and related documents			
(EU) No 1321/2014	Continuing airworthiness of aircraft and aeronautical products, parts and appliances, and on the approval of organisations and personnel involved in these tasks	European Commission	Useful reference
FAA Standards - 14 CFR Part 25 C	Code of Federal Regulations - Title 14 Aeronautics and Space - Chapter I FEDERAL AVIATION ADMINISTRATION, DEPARTMENT OF TRANSPORTATION - Subchapter C AIRCRAFT - Part 25 AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES - Subpart C Structure	US Federal Aviation Administration	Useful reference
FAA Standards - 14 CFR Part 25 D	Code of Federal Regulations - Title 14 Aeronautics and Space - Chapter I FEDERAL AVIATION ADMINISTRATION, DEPARTMENT OF TRANSPORTATION - Subchapter C AIRCRAFT - Part 25 AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES - Subpart D Design and Construction	US Federal Aviation Administration	Useful reference
The Canadian Aviation Regulations (SOR/96–433) - Part V	Airworthiness	Government of Canada	Not directly applicable

4.2.3 Basis of structural and mechanical design assumptions and analysis

CODE	TITLE	DOCUMENT OWNER	APPLICABILITY
EN 15227	Railway applications. Crashworthiness requirements for rail vehicles	CEN	Useful reference
EN 17343	Railway applications - General terms and definitions	CEN	Not directly applicable
CEN/TC250/WG4 Report on Reinforced Polymer or Plastic (FRP)	Prospect for new guidance in the design of FRP - Support to the implementation, harmonization and further development of the Eurocodes	European Commission - Joint Research Centre	Useful reference
AS 5100 series	Bridge design	Standards Australia	Not directly applicable
Directives, Regulations and related documents			
Advisory Circular AC 25.571–1D	Damage Tolerance and Fatigue Evaluation of Structure	US Federal Aviation Administration	Useful reference
NASA-HDBK-5005	Standard for the Design and Fabrication of Ground Support Equipment	US National Aeronautics and Space Administration	Useful reference
NFPA 101	Life Safety Code	US National Fire Protection Association	Useful reference
NFPA 5000	Building Construction and Safety Code	US National Fire Protection Association	Useful reference
AASHTO LRFDUS	Bridge Design Specifications	American Association of State Highway and Transportation Officials	Not directly applicable

4.2.4 Materials

CODE	TITLE	DOCUMENT OWNER	APPLICABILITY
ISO 6780	Flat pallets for intercontinental materials handling — Principal dimensions and tolerances	ISO	Applicable document
EN 10029	Hot-rolled steel plates 3 mm thick or above - Tolerances on dimensions and shape	CEN	Applicable document
EN 10051	Continuously hot-rolled strip and plate/sheet cut from wide strip of non-alloy and alloy steels - Tolerances on dimensions and shape	CEN	Applicable document
EN 10056-1	Structural steel equal and unequal leg angles - Part 1: Dimensions	CEN	Applicable document
EN 10056-2	Structural steel equal and unequal leg angles - Part 2: Tolerances on shape and dimensions	CEN	Applicable document
EN 10106	Cold rolled non-oriented electrical steel sheet and strip delivered in the fully processed state	CEN	Applicable document
EN 10107	Grain-oriented electrical steel strip and sheet delivered in the fully processed state	CEN	Applicable document
EN 10111	Continuously hot rolled low carbon steel sheet and strip for cold forming - Technical delivery conditions	CEN	Applicable document
EN 10120	Steel sheet and strip for welded gas cylinders	CEN	Applicable document
EN 10130	Cold rolled low carbon steel flat products for cold forming - Technical delivery conditions	CEN	Applicable document
EN 10131	Cold rolled uncoated and zinc or zinc-nickel electrolytically coated low carbon and high yield strength steel flat products for cold forming - Tolerances on dimensions and shape	CEN	Applicable document

CODE	TITLE	DOCUMENT OWNER	APPLICABILITY
EN 10139	Cold rolled uncoated mild steel narrow strip for cold forming - Technical delivery conditions	CEN	Applicable document
EN 10140	Cold rolled narrow steel strip - Tolerances on dimensions and shape	CEN	Applicable document
EN 10143	Continuously hot-dip coated steel sheet and strip - Tolerances on dimensions and shape	CEN	Applicable document
EN 10152	Electrolytically zinc coated cold rolled steel flat products for cold forming - Technical delivery conditions	CEN	Applicable document
EN 10162	Cold rolled steel sections - Technical delivery conditions - Dimensional and cross-sectional tolerances	CEN	Applicable document
EN 10164	Steel products with improved deformation properties perpendicular to the surface of the product - Technical delivery conditions	CEN	Applicable document
EN 10169	Continuously organic coated (coil coated) steel flat products - Technical delivery conditions	CEN	Applicable document
EN 10204	Metallic products - Types of inspection documents. Steel and metallic products including fasteners shall be accompanied with material certificates according to EN 10204 or equivalent attestation.	CEN	Applicable document
EN 10207	Steels for simple pressure vessels - Technical delivery requirements for plates, strips and bars	CEN	Applicable document
EN 10268	Cold rolled steel flat products with high yield strength for cold forming - Technical delivery conditions	CEN	Applicable document