SLOVENSKI STANDARD
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Stroji za vrtanje predorov - Zračne zapore - 2. del: Varnostne zahteve za uporabo mešanic dihalnih plinov v prostorih brez prezračevanja in tehnik nasičenja v nepredušno zaprtih prostorih za osebje in za transportna vozila s kabinami pod tlakom

Tunnel boring machines - Air locks - Part 2: Safety requirements for the use of non-air breathing mixtures and saturation techniques in personnel locks and for pressurised transfer shuttles

Tunnelbohrmaschinen - Druckluftschleusen - Teil 2: Sicherheitstechnische Anforderungen bei der Verwendung von luftfremden Atemmischungen und Sättigungsverfahren in Personenschleusen sowie unter Druck stehenden Transfer Shuttles

Tunneliers - Sas de transfert - Partie 2: Prescription de sécurité pour l'utilisation de mélanges respiratoires non-air et de techniques de saturation dans les sas du personnel et pour les navettes de transfert pressurisées

Ta slovenski standard je istoveten z: **prEN 12110-2**

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91.220	Gradbena oprema	Construction equipment
93.060	Gradnja predorov	Tunnel construction

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This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 151.

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European foreword

This document (prEN 12110-2:2023) has been prepared by Technical Committee CEN/TC 151 “Construction equipment and building material machines – Safety”, the secretariat of which is held by DIN.

This document is currently submitted to the CEN Enquiry.

This document together with prEN 12110-1 will supersede EN 12110:2014.

prEN 12110-2:2023 includes the following significant technical changes with respect to EN 12110:2014:

— the standard has been split into two parts; this part deals with mixed gas use and pressurized transfer shuttle, neither of which was covered in EN 12110:2014;

— revision of definitions;

— revision of all safety requirements;

— update of list of significant hazards;

— revision of Annex ZA.

prEN 12110, *Tunnel boring machines — Air locks* comprises the following parts:

— *Part 1 — Requirements for air locks utilising compressed air as the pressurising or breathing medium along with requirements for oxygen breathing systems for decompression purposes.*

— *Part 2 — Safety requirements for the use of non-air breathing mixtures and saturation techniques in personnel locks and for pressurised transfer shuttles.*

For simplicity in use, the structure of part 2 has been aligned with that of part 1 to the greatest extent possible. This has resulted in the repetition of some text in both parts but greater clarity for users.

The standard has been prepared under a Standardization Request given to CEN by the European Commission and the European Free Trade Association, and support essential requirements of EU Directive(s) / Regulation(s).

For relationship with EU Directive(s) / Regulation(s), see informative Annex ZA, which is an integral part of this document.

Introduction

This document is a type C standard as stated in EN ISO 12100:2010.

The machinery and equipment concerned and the extent to which hazards, hazardous situations and events are covered are indicated in the scope of this document.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

1 Scope

This document sets out additional requirements to those in prEN 12110-1 for personnel locks which are intended to have the capability for mixed gas breathing techniques or saturation techniques at pressures not exceeding 20 bar(g) and associated with tunnelling work. This document also sets out requirements for pressurized transfer shuttles as defined in 3.1.

prEN 12110-1 applies to the design, construction, equipping, marking and testing of air locks, as defined in 3.3, in tunnelling. prEN 12110-1 also covers requirements for manlocks utilizing compressed air as the pressurizing and breathing medium along with requirements for oxygen breathing systems for decompression purposes.

Air locks are normally an integral part of TBMs. Hence there are interfaces between the scope of prEN 12110-1:2023 and prEN 16191:2023. These are detailed in Clause 4 of this document.

The intended use of the machinery is agreed between the manufacturer and the user taking into account information on intended use, exposure techniques and decompression procedures provided by the user.

This document is not applicable to machinery and equipment which is manufactured before the date of publication of this document by CEN.

NOTE This document can help the design of air locks and bulkheads in other compressed air work in construction.

This document deals with all significant hazards, hazardous situations and events relevant to such machinery when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Annex A).

This document does not cover the supply of services to the air lock from beyond the defined prEN 12110-1:2023/prEN 16191:2023 interface. This interface is set out in the text.

Vibration, noise and EMC (Electromagnetic compatibility) hazards are not significant hazards for air locks.

The provision of mixed gas, air or oxygen is the responsibility of the user.

During transfer under pressure operations, the shuttle requires a fire suppression system, a climate control system, a power supply and a gas supply. Of these, the fire suppression system requires to be continuously connected and available for immediate activation. It is therefore considered to be part of the shuttle equipment covered by this standard as is the power supply. For the other two services only the capability to supply them is considered to be part of the shuttle requirements.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 894-1:1997+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 1: General principles for human interactions with displays and control actuators*

EN 894-2:1997+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 2: Displays*

EN 894-3:2000+A1:2008, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 3: Control actuators*

EN 894-4:2010, *Safety of machinery — Ergonomics requirements for the design of displays and control actuators — Part 4: Location and arrangement of displays and control actuators*

EN 12021:2014, *Respiratory equipment — Compressed gases for breathing apparatus*

EN 13445-1:2021, *Unfired pressure vessels — Part 1: General*

EN 13445-2:2021, *Unfired pressure vessels — Part 2: Materials*

EN 13445-3:2021, *Unfired pressure vessels — Part 3: Design*

EN 13445-4:2021, *Unfired pressure vessels — Part 4: Fabrication*

EN 13445-5:2021, *Unfired pressure vessels — Part 5: Inspection and testing*

EN 14931:2006, *Pressure vessels for human occupancy (PVHO) — Multi-place pressure chamber systems for hyperbaric therapy — Performance, safety requirements and testing*

prEN 16191:2023, *Tunnelling machinery — Safety requirements*

EN 61310-1:2008, *Safety of machinery — Indication, marking and actuation — Part 1: Requirements for visual, acoustic and tactile signals (IEC 61310-1:2007)*

EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*

IEC/TR 60877:1999, *Procedures for ensuring the cleanliness of industrial-process measurement and control equipment in oxygen service*

ISO 1161:2016, *Series 1 freight containers — Corner and intermediate fittings — Specifications*

ISO 6405-1:2017, *Earth-moving machinery — Symbols for operator controls and other displays — Part 1: Common symbols*

ISO 10799-2:2011, *Cold-formed welded structural hollow sections of non-alloy and fine grain steels — Part 2: Dimensions and sectional properties*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in prEN ISO 12100-1:2022 and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp/

— IEC Electropedia: available at https://www.electropedia.org/

3.1
pressurized transfer shuttle "shuttle"
mobile personnel lock for undertaking the transfer under pressure of personnel from one fixed hyperbaric system to another

3.2
non-saturation mode
short duration exposures to pressure in which compression, working period and decompression are all completed within a single working shift which is insufficiently long to allow all body tissues to become saturated

3.3
locking off
process of separating the shuttle from the personnel lock after they had been clamped together to allow persons to pass between them under pressure

3.4
docking
process of aligning and clamping a shuttle to a personnel lock to allow persons to pass between them under pressure

3.5
protective frame
robust steel frame within which the shuttle is mounted to provide impact protection and to facilitate lifting

3.6
external services connection panel
panel within the protective frame on which there are connection points for externally supplied services such as mixed gas, compressed air, power, etc.

4 Safety requirements and/or protective/risk reduction measures

4.1 General

Air locks shall comply with the safety requirements and/or protective/risk reduction measures of this clause, unless modified by requirements of the relevant specific part of the standard series. In addition, the machine shall be designed according to the principles of EN ISO 12100:2010 for relevant but not significant hazards which are not dealt with by this document.

Personnel locks intended for the use of breathing mixtures including as part saturation techniques shall conform to the requirements of prEN 12110-1:2023. Additional requirements specifically required for the use of breathing mixtures or saturation exposure techniques are set out below in 4.1 to 4.4.17.

Shuttles shall conform with the requirements of prEN 12110-2:2023, 4.1 to 4.4.17 as well as 4.5 to 4.7 in respect of risks arising from the mobility of the shuttle. Many of the clauses in prEN 12110-2:2023 relating to requirements for shuttles in turn make reference to requirements in prEN 12110-1:2023 to limit duplication of text.

4.2 General requirements

4.2.1 Design pressure

The requirements for design pressure and calculation method in prEN 12110-1:2023, 4.2.1 shall be adhered to for shuttles.

Shuttles as pressure vessels shall be designed, fabricated and tested in conformity with prEN 12110-1:2023, 4.2.1 and EN 13445-1:2021, EN 13445-2:2021, EN 13445-3:2021, EN 13445-4:2021 and EN 13445-5:2021.

4.2.2 Pressure relief valve

The requirements for pressure relief valves in prEN 12110-1:2023, 4.2.2 shall apply to shuttle compartments also.

4.2.3 Pipes, hoses, valves and gauges

4.2.3.1 General

Pipes, hoses and valves which form an integral part of the shuttle shall conform with the requirements of prEN 12110-1:2023, 4.2.3.1.

All pipework, hoses, valves and gauges containing helium shall be suitable for helium operation.

NOTE Helium can cause separation of the layers of a hose.

4.2.3.2 Pipework

Only materials specified for oxygen use in prEN 12110-1:2023, 4.2.3.2 shall be used for the conveyance of breathing mixtures.

Pipework on shuttles shall conform with prEN 12110-1:2023, 4.2.3.2, however mild steel shall not be used for pipework on shuttles.

4.2.3.3 Hoses

Hoses on personnel locks intended for mixed gas use or on shuttles shall conform with the requirements of prEN 12110-1:2023, 4.2.3.3.

4.2.3.4 Valves

Valves on personnel locks intended for mixed gas use or on shuttles shall conform with the requirements of prEN 12110-1:2023, 4.2.3.4.

4.2.3.5 Servo-operated valves

The requirements of prEN 12110-1:2023, 4.2.3.5 in respect of servo valves shall apply to shuttles.

4.2.3.6 Gauges

Gauges on personnel locks intended for mixed gas use or on shuttles shall conform with the requirements of prEN 12110-1:2023, 4.2.3.6.

Gauges used in mixed gas systems shall be helium compatible.

4.2.3.7 Pressure regulators

Pressure regulators shall be fitted to compressed air, oxygen and mixed gas supplies to shuttles.

4.2.3.8 Gas analysis

Connections including means of isolation to allow for removal or calibration, shall be provided for gas analysis equipment to be fitted to personnel locks and shuttles. Means shall be provided to ensure the gas analysis information and the locations for which it is required shall meet the requirements of 4.4.15.

Gas analysis equipment may be supplied by the user.

4.2.3.9 Protection against inlet line breaks

The requirements of prEN 12110-1:2023, 4.2.3.9 in respect of protection against line breaks shall apply to shuttles.

Outflow lines shall be fitted with excess flow detection and prevention as required by prEN 12110-1:2023, 4.2.3.4.

4.2.4 Air lock control functions

On shuttles there shall be a pressure gauge outside each compartment, for controlling the pressure in the compartment. In addition, there shall be a pressure gauge inside each compartment adjacent to the compartment door, indicating the pressure of the adjacent compartment or trunking.

For shuttles there shall be separate slow acting valves outside each compartment for controlling the pressurization and de-pressurization of the compartment. The valves shall be within 500 mm of the gauge display for controlling the pressure in the compartment. It shall be possible to observe the gauge whilst operating the valves. Valves and gauges shall be mounted on a control panel.

4.2.5 Fire protection

Personnel locks and material locks shall be constructed from materials and components selected to Shuttles shall be fitted with a fire suppression system which shall conform with the requirements of prEN 12110-1:2023, 4.2.5 which relate to personnel locks. All parts of the fire suppression system outside the shuttle compartment shall be mounted within the protective frame (see 4.6.5). In addition, there shall be a fire suppression system covering the power supply (see 4.2.6, 4.6.18) if mounted within the protective frame.

4.2.6 Electrical equipment

The requirements of prEN 12110-1:2023, 4.2.6 in respect of electrical equipment shall apply to shuttles. All electrically powered equipment on the shuttle shall be controlled from the shuttle control panel.

Connections to the TBM main and emergency power supplies shall be possible when the shuttle is in the docking position and at the point of transfer to the tunnel transport vehicle.

The shuttle shall have an on-board power supply, see 4.6.18 for use during transfer under pressure.

Electrical installations in the shuttle shall be earthed.

4.2.7 Lighting and Emergency Lighting

The valves and gauges shall be lit with an intensity of 200 lux at the valve or gauge display in accordance with EN 894-2:1997+A1:2008.

The shuttle emergency power supply (see 4.6.18) shall come into operation automatically when required. Lighting levels may be reduced to 15 lux in each compartment of the shuttle at seat level and at least 100 lux at any control panel.

4.2.8 Control panel – mixed gas operations

The requirements of 4.2.8 shall apply to shuttles.

Instructions for the functional operation of the control panel shall be in the instruction handbook.

NOTE 1 Instructions for the functional operation of the control panel are the responsibility of the manufacturer.

NOTE 2 Instructions for procedural operation of the control panel are the responsibility of the user.

4.2.9 Doors, closing and sealing

The requirements of prEN 12110-1:2023, 4.2.9 in respect of doors, closing and sealing shall apply to shuttles.

4.2.10 Inlets to pipes

The requirements of prEN 12110-1:2023, 4.2.10 shall apply to shuttles.

4.2.11 Services in shuttle

No services shall pass through the shuttle.

4.3 Shuttle – size and configuration

4.3.1 Number of compartments

Shuttles shall be of single compartment construction with a main compartment only or shall consist of two directly interconnected compartments, a main compartment and an entrance compartment, depending on the country of intended use. In two compartment shuttles, it shall be possible to use the entrance compartment as an entry lock in an emergency.

Shuttle doors shall conform with 4.3.4.

4.3.2 Dimensional requirements

4.3.2.1 Dimensions

Shuttles and their protective frames shall meet the following requirements.:

Table 1 — Dimensional requirements

	Main compartment	**Entrance compartment**
Minimum cross-sectional dimension	1,5 m diameter with a non-slip floor covering	As main compartment
Minimum length	See 4.3.2.2 below	Compartment door must open clear of seats
Minimum number of persons	4	2
Minimum volume per person	1 m^3	1 m^3
Maximum width of protective frame	1,75 m	
Maximum height of protective frame	1,75 m	

In the absence of specific information from the user, the designer of a TBM shall be entitled to assume that the protective frame shall not exceed 1,75 m wide, 1,75 m high and 5,0 m long.

NOTE It is a requirement of prEN 12110-2:2023 that means should be provided to align the shuttle docking flange with the TBM docking flange and thereby allow the docking clamp to be closed. Means can include a docking alignment frame and guide rails on to which the shuttle can be driven.

4.3.2.2 Compartment lengths

The shuttle shall be large enough and so designed that before locking off it shall be possible for a casualty to be placed on a rescue stretcher (of at least 1,85 m length) under pressure in the main compartment and clear of the closing door. Where fitted, the entry compartment shall accommodate 2 persons sitting and still allow the outer compartment door to open/close.

4.3.3 Seats

The requirements of prEN 12110-1:2023, 4.3.3 in respect of seats shall apply to shuttles. In shuttles less than 1,8 m in diameter, seats shall either be in a single line or shall be staggered so as not to be opposite each other.