SLOVENSKI STANDARD
oSIST prEN 12110-1:2023

01-maj-2023

Stroji za vrtanje predorov - Zračne zapore - 1. del: Zahteve za zračne zapore, ki uporabljajo stisnjen zrak kot sredstvo za komprimiranje ali dihanje, skupaj z zahtevami za kisikove dihalne sisteme pri dekompresiji

Tunnel boring machines - Air locks - 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

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Tunnelbohrmaschinen - Druckluftschleusen - Teil 1: Sicherheitstechnische Anforderungen an Druckluftschleusen, die Druckluft als Druck- oder Atemmedium verwenden, sowie Anforderungen an Sauerstoff-Atemsysteme zum Zweck der Dekompression

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Tunneliers - Sas de transfert - Partie 1 : Prescriptions relatives aux sas de transfert utilisant de l'air comprimé comme fluide de pressurisation ou de respiration et prescriptions relatives aux systèmes respiratoires à oxygène pour la décompression

Ta slovenski standard je istoveten z: **prEN 12110-1**

ICS:

91.220	Gradbena oprema	Construction equipment
93.060	Gradnja predorov	Tunnel construction

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2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 12110-1

February 2023

ICS 91.220; 93.060

Will supersede EN 12110:2014

English Version

Tunnel boring machines - Air locks - 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

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If this draft becomes a European Standard, CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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European foreword

This document (prEN 12110-1:2023) 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 12110-2 will supersede EN 12110:2014.

prEN 12110-1:2023 includes the following significant technical changes with respect to EN 12110:2014:

— a second part has been added covering mixed gas and saturation use along with pressurized transfer shuttles;

— 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.*

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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 document 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.

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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.

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1 Scope

This document applies to the design, construction, equipping, marking and testing of air locks, as defined in 3.3, which form an integral part of a tunnel boring machine. It covers requirements for personnel locks utilizing compressed air as the pressurizing or breathing medium along with requirements for oxygen breathing systems for decompression purposes. The intended use is restricted to the temperature range 5 °C to 50 °C.

This document also applies to the design, fabrication and testing of pressure bulkheads intended for use in forming in-tunnel or in-shaft air locks.

In addition, this document extends to control functions and control information relating to intermediate chambers (defined in prEN 12110-2:2023, 3.7) (if fitted) but which are accessed via the personnel lock control panel.

prEN 12110-2 sets out additional requirements to those in Part 1, for personnel locks which are intended to have the capability to utilize non-air breathing mixtures such as nitrox, trimix and heliox. prEN 12110-2 sets out additional requirements for personnel locks intended to be used for saturation exposure techniques at pressures not exceeding 20 bar(g) associated with tunnelling work. It also sets out requirements for pressurized transfer shuttles as defined in 3.3.5.

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

Air locks are normally connected to or incorporated in tunnel boring machines and consequently there are a number of interfaces between machinery covered by this standard and machinery covered by prEN 16191:2023. These interfaces are identified in both standards as appropriate.

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

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NOTE 1 Air locks can be formed by the construction of one or more bulkheads in a tunnel secured to the tunnel lining. However, although the equipment required for tunnel air locks will be similar to that for TBM air locks, prEN 12110-1:2023 applies only to the design, fabrication and testing of bulkheads in this situation.

NOTE 2 Air locks can also be attached to an air deck in a shaft. Again, although the equipment required for such air locks will be similar to that for TBM air locks, prEN 12110-1:2023 applies only to the design, fabrication and testing of bulkheads (air decks) in shafts.

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).

The supply of compressed air and oxygen to the air lock is partly within the scope of prEN 12110-1:2023 and partly within the scope of prEN 16191:2023 and this division is clearly indicated within the text of both standards.

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

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 250:2014, *Respiratory equipment — Open-circuit self-contained compressed air diving apparatus — Requirements, testing and marking*

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EN 751-3:2022, *Sealing materials for metallic threaded joints in contact with 1st, 2nd and 3rd family gases and hot water — Part 3: Unsintered PTFE tapes and PTFE strings*

EN 837-1:1996[1], *Pressure gauges — Part 1: Bourdon tube pressure gauges — Dimensions, metrology, requirements and testing; Amendment AC*

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*

prEN 12110-2:2023, *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*

EN 12449:2016+A1:2019, *Copper and copper alloys — Seamless, round tubes for general purposes*

EN 12464-1:2021, *Light and lighting — Lighting of work places — Part 1: Indoor work places*

EN 13348:2016, *Copper and copper alloys — Seamless, round copper tubes for medical gases or vacuum*

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, *Tunnel boring machines — Safety requirements*

EN 60204-1:2018, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2016, modified)*

EN 60529:1991, *Degrees of protection provided by enclosures (IP code) (IEC 60529:1989)*

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 IEC 61000-6-1:2019, *Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity standard for residential, commercial and light-industrial environments (IEC 61000-6-1:2016)*

[1] As impacted by EN 837-1:1996/AC:1998.

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EN IEC 61000-6-2:2019, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity standard for industrial environments (IEC 61000-6-2:2016)*

EN IEC 61000-6-3:2021, *Electromagnetic compatibility (EMC) — Part 6-3: Generic standards — Emission standard for equipment in residential environments (IEC 61000-6-3:2020)*

EN IEC 61000-6-4:2019, *Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments (IEC 61000-6-4:2018)*

EN ISO 3411:2007, *Earth-moving machinery — Physical dimensions of operators and minimum operator space envelope (ISO 3411:2007)*

EN ISO 10380:2012, *Pipework — Corrugated metal hoses and hose assemblies (ISO 10380:2012)*

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

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

IEC 60364-7-706:2005, *Low-voltage electrical installations — Part 7-706: Requirements for special installations or locations — Conducting locations with restricted movement*

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

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3 Terms and definitions

For the purposes of this document the terms and definitions given in EN ISO 12100:2010 and the following apply.

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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
compressed air
air with a pressure of more than 0,1 bar, above atmospheric

Note 1 to entry: All pressures to be measured above atmospheric pressure.

Note 2 to entry: When referring to pressure in compressed air work, “up” indicates an increase in pressure and “down” indicates a decrease in pressure. Opposite meanings sometimes occur in diving where depth can be used as a proxy measure for pressure.

3.2
working chamber
space in which work in compressed air is carried out

3.3
air lock
pressure vessel with one or more compartments that permits passage between areas of different pressure

Note 1 to entry: In tunnelling applications an air lock can be for the passage of material/equipment, personnel or both.

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3.3.1
material lock
air lock for the passage of material or equipment only

3.3.2
personnel lock
air lock for the passage of persons only

3.3.3
combined lock
air lock for the passage of persons and material or equipment

3.3.4
supply lock
air lock of less than 500 mm diameter for the passage of food, drink, medical supplies and consumables to a personnel lock

3.3.5
self-contained in-tunnel air lock (boiler lock)
self-contained single or multi-compartment air lock which is attached to a pressure bulkhead in a tunnel

3.4
pressure bulkhead
structure which separates spaces with different pressure levels in a tunnel, the passage through which is by way of an air lock

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3.5
maximum working pressure
highest pressure to which an air lock may be subjected in normal use

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3.6
design pressure (maximum allowable pressure)
PS
maximum pressure for which the equipment is designed as specified by the manufacturer

Note 1 to entry: The design pressure is the maximum allowable pressure as derived from the EU Directive 2014/68/EU concerning Pressure Equipment (PED).

3.7
test pressure
TP
pressure to which the equipment is tested

3.8
oxygen breathing system
plant, pipework and ancillary equipment as part of a personnel lock used to provide an oxygen supply as part of decompression procedures

3.9
breathing unit
part of a BIBS comprising a mask and regulator combination as part of system enhancements with the option to improve flow characteristics, for delivering oxygen breathing during decompression

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3.10
main compartment
compartment of a personnel lock in which decompression is normally carried out

3.11
entrance compartment
compartment of a personnel lock which allows passage from atmospheric pressure to the main compartment

3.12
oxygen compatible
material which can safely be used in contact with oxygen or gas mixtures containing more than 23,5 % oxygen by volume

3.13
breathing mixture (mixed gas)
respirable gas mixture other than air, of oxygen with nitrogen and/or helium

3.14
transfer under pressure
process whereby personnel are transferred in a pressurized transfer shuttle from one hyperbaric system to another whilst remaining under pressure

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3.15
PVHO
pressure vessel for human occupancy

3.16
control panel
workstation from which the life support to the personnel lock is controlled

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3.17
air deck
horizontal pressure bulkhead used in shafts

3.18
Built in Breathing System
BIBS
system comprising masks, regulators, hoses, supply and discharge lines with the option of system enhancements to improve flow characteristics, for delivering a gas or breathing mixture to persons in a personnel lock

3.19
saturation exposure
long (normally multi-day) duration exposure during which the exposed person lives at a storage pressure and can make transfers to and from the working chamber by means of a pressurized transfer shuttle whilst remaining under pressure

3.20
pressurized transfer shuttle
mobile personnel lock for undertaking the transfer under pressure of personnel from one hyperbaric system to another

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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.

Air locks, as pressure vessels, shall be designed, fabricated and tested in conformity with EN 13445-1:2021, EN 13445-2:2021, EN 13445-3:2021, EN 13445-4:2021 and EN 13445-5:2021.

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.

4.2 General requirements – all air locks

4.2.1 Design pressure

The design pressure (maximum allowable pressure) for the air lock structure shall be 1,1 times the maximum working pressure.

The design pressure for pressure bulkheads shall be 1,1 times maximum working pressure, however where bulkheads cannot be pressure tested, the design pressure shall be two times the maximum working pressure.

NOTE The maximum working pressure is agreed between the manufacturer and the user.

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4.2.2 Pressure relief valve

Each air lock compartment shall be equipped with a pressure relief valve which shall not operate until the maximum working pressure has been exceeded and shall close before the pressure drops below the maximum working pressure. With the maximum inflow of air, the chamber pressure shall not exceed the design pressure (maximum allowable pressure) by more than 10 %.

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Where fitted, an intermediate chamber shall also be equipped with a pressure relief valve.

For penetrations feeding pressure relief valves, the compartment shell valves shall be secured in the open position by seals.

NOTE The means of securing can be by tape or light wire to allow operation of the valves if needed.

4.2.3 Pipework, hoses, valves and gauges

4.2.3.1 General

Pipework, hoses and valves which form an integral part of the air locks shall be designed to withstand a maximum working pressure which arises from their function.

NOTE 1 The maximum working pressure in pipes and hoses reflects their function which is fluid supply and discharge and hence is likely to be significantly different to that of the air lock structure.

NOTE 2 The terms “pipework” and “hoses” include all fittings such as bends, T-pieces, etc.

NOTE 3 Fluid includes gases and liquids.

The use of hoses shall be minimized and if used they shall be as short as possible.

First stage pressure reduction should be adjacent to the point of supply - see prEN 16191:2023.

All pipework, hoses, valves and gauges carrying mixtures containing a gas or breathing mixture with 23,5 % oxygen or more by volume shall be oxygen compatible.

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Pipework and hoses shall be marked with their function, contents and direction of flow. There shall be marking close to valves or gauges, and it shall be repeated at intervals not exceeding 5 m. The marking shall be readily visible. Colour coding shall be used to facilitate identification of contents – oxygen white; nitrogen black; helium brown with appropriate colour combinations for mixtures including air.

All valves and gauges shall be marked with their function, e.g. “compression - main compartment” and valves shall be marked with their direction of operation. Marking shall conform to EN 61310-1:2008.

NOTE 4 Valve functions will include but are not limited to “compression”, “decompression”, “BIBS oxygen supply”, BIBS oxygen discharge” combined with “main compartment”, “entrance compartment”. Gauge functions will include but are not limited to “air pressure”, “oxygen pressure” combined with “main compartment”, etc.

4.2.3.2 Pipework

Pipework shall have a maximum working pressure commensurate with its purpose.

In-line regulators shall be fitted to control pressure.

NOTE Pressure in pipework varies from typically 200 bar to 300 bar at the point of supply to under 40 bar at the point of use.

Pipework shall be supported. Allowance shall be made for expansion.

Pipework shall withstand a burst pressure of at least 4 times the maximum working pressure of the fluid contained. Pipework installations shall be pressure tested to 1,5 times maximum working pressure.

Pipework for compressed air may be steel with threaded fittings if agreed between the user and manufacturer.

Pipework for oxygen shall be fabricated from aluminium nickel silicon brass (copper alloy) tube to EN 12449:2016+A1:2019 CW 700R, or austenitic stainless steel with a chromium nickel content of >22 %, or from copper tube conforming to EN 13348:2016.

Pipework other than mild steel pipework, shall be jointed using compression fittings which are compatible with the material of the tube being jointed. Double ferrule fittings shall be preferred.

PTFE thread tape, if used, on screw fittings shall conform with EN 751-3:2022 GRp grade.

4.2.3.3 Hoses and non-metallic pipework

Fixed pipework shall be preferred to hoses or non-metallic pipework.

NOTE 1 The term “hoses” as used hereafter in this document includes all non-metallic pipework.

Hoses shall have a burst pressure at least four times the maximum working pressure of any fluid they carry. Hose installations shall be pressure tested to 1,5 times maximum working pressure.

Hoses shall be restrained against excessive movement and whiplash.

Hoses for oxygen supply to the compartment shall be externally stainless steel braided with heat sink and restraining cable and shall conform to EN ISO 10380:2012. The corrugated element of the hose shall be formed from austenitic stainless steel. Hoses shall only be used for applications with a maximum working pressure not exceeding 40 bar. Hoses directly attached to masks may be unbraided.

Self-sealing quick couplings if used, shall be compatible with the fluid and for their intended purpose.

NOTE 2 ISO 7241:2014 Series A gives an appropriate standard for self-sealing quick couplings on supply manifolds, however the flow resistance of such couplings might render such couplings unsuitable for use on discharge line connections and on both mask supply and discharge connections for breathing units.

Hoses for the compartment heating/cooling system shall have an operating range of -10 °C to 100 °C.