



# SLOVENSKI STANDARD

## SIST EN 1012-3:2014

01-januar-2014

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### Kompresorji in vakuumske črpalke - Varnostne zahteve - 3. del: Procesni kompresorji

Compressors and vacuum pumps - Safety requirements - Part 3: Process compressors

Kompressoren und Vakuumpumpen - Sicherheitsanforderungen - Teil 3: Prozesskompressoren

Compresseurs et pompes à vide - Prescriptions de sécurité - Partie 3: Compresseurs de procédé

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23.140	Kompresorji in pnevmatični stroji	Compressors and pneumatic machines
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EUROPEAN STANDARD

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## Compressors and vacuum pumps - Safety requirements - Part 3: Process compressors

Compresseurs et pompes à vide - Prescriptions de sécurité  
- Partie 3: Compresseurs de procédé

Kompressoren und Vakuumpumpen -  
Sicherheitsanforderungen - Teil 3: Prozesskompressoren

This European Standard was approved by CEN on 8 September 2013.

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. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

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CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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## Foreword

This document (EN 1012-3:2013) has been prepared by Technical Committee CEN/TC 232 "Compressors, vacuum pumps and their systems", the secretariat of which is held by SIS.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by May 2014, and conflicting national standards shall be withdrawn at the latest by May 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

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

EN 1012, *Compressors and vacuum pumps*, is composed of the following parts:

— *Part 1: Air compressors*;

— *Part 2: Vacuum pumps*;

— *Part 3: Process compressors* (the present document).

The responsibility of CEN/TC 232 includes coordination of safety standards with CEN/TC 182, Refrigerating systems, safety and environmental requirements, and CEN/TC 234, Gas infrastructure.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

**EN 1012-3:2013 (E)****Introduction**

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

The machinery 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 and 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.

When published in 1996, Part 1 of EN 1012 applied to all types of compressor. The standard is now divided into 3 parts with Part 1 addressing compressors for compressed air, nitrogen and inert gases and Part 3 addressing compressors for process gases. Part 2 continues to address vacuum pumps.

Separating requirements for process gas compressors from those for compressors for air, nitrogen and other inert gases was considered a practical move so that the requirements for one type of compressor could be changed without affecting the complete standard.

Where texts parts of EN 1012-3 are identical with EN 1012-1:2010, these are identified and formatted in italics.

If common requirements for functional safety would be applied to all process compressors, the variety in the application of process compressors may cause significantly different levels of residual risk. Therefore, in addition to the requirements of this standard, the application of risk assessment may be required for safety related control systems in the case of particular applications to specify performance levels and/or safety integrity levels for related aspects of functional safety.

Informative Annex C has been included to provide guidance on risk assessment for related aspects of functional safety, including the determination of safety integrity levels and/or performance levels. The manufacturer of the compressor is responsible for carrying out such a risk assessment and applying appropriate preventive measures. These tasks are outside the scope of this standard.



## 1 Scope

This European Standard is applicable to process gas compressors and process gas compressor units having an operating pressure greater than 0,5 bar (gauge), an input shaft power greater than 0,5 kW and designed to compress all gases other than air, nitrogen or inert gases which are covered in Part 1. This document deals with all significant hazards, hazardous situations and events relevant to the design, installation, operation, maintenance, dismantling and disposal of process gas compressors and process gas compressor units, when they are used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer (see Clause 4).

This part of EN 1012 includes under the general term compressor units those machines which comprise:

- the compressor;
- a drive system including the prime mover;
- any component or device supplied which is necessary for operation.

This part of EN 1012 is not applicable to compressors which are manufactured before the date of publication of this document by CEN.

The requirements of this European Standard do not take into account the interaction between the compressor/compressor unit and other processes carried out on site.

Excluded are:

- refrigerant compressors used in refrigerating systems or heat pumps for which the safety requirements are given in EN 60335-2-34 or EN 12693;
- the specification of performance levels and/or safety integrity levels for safety related parts of control systems.

Performance levels and/or safety integrity levels are an important aspect of compressor design and should be determined by the manufacturer and the user based on a risk assessment (see Introduction).

This European Standard does not cover those safety aspects of road transport dealt with by EC legislation for trailers.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 626-1:1994+A1:2008, *Safety of machinery — Reduction of risks to health from hazardous substances emitted by machinery — Part 1: Principles and specifications for machinery manufacturers*

EN 764-7:2002, *Pressure equipment — Part 7: Safety systems for unfired pressure equipment*

EN 837-2, *Pressure gauges — Part 2: Selection and installation recommendations for pressure gauges*

EN 953:1997+A1:2009, *Safety of machinery — Guards — General requirements for the design and construction of fixed and movable guards*

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EN 1005-2, *Safety of machinery — Human physical performance — Part 2: Manual handling of machinery and component parts of machinery*

EN 1005-3, *Safety of machinery — Human physical performance — Part 3: Recommended force limits for machinery operation*

EN 1127-1, *Explosive atmospheres — Explosion prevention and protection — Part 1: Basic concepts and methodology*

EN 12021, *Respiratory protective devices — Compressed air for breathing apparatus*

EN 12195-1, *Load restraining on road vehicles — Safety — Part 1: Calculation of securing forces*

EN 13001-2, *Crane safety — General design — Part 2: Load actions*

EN 13155, *Cranes — Safety — Non-fixed load lifting attachments*

EN 13309, *Construction machinery — Electromagnetic compatibility of machines with internal power supply*

EN 13445-5:2009, *Unfired pressure vessels — Part 5: Inspection and testing*

EN 13445-6, *Unfired pressure vessels — Part 6: Requirements for the design and fabrication of pressure vessels and pressure parts constructed from spheroidal graphite cast iron*

EN 13463-1, *Non-electrical equipment for use in potentially explosive atmospheres — Part 1: Basic method and requirements*

EN 15198, *Methodology for the risk assessment of non-electrical equipment and components for intended use in potentially explosive atmospheres*

EN 60079-0, *Explosive atmospheres — Part 0: Equipment — General requirements (IEC 60079-0:2011, modified)*

EN 60079-1, *Explosive atmospheres — Part 1: Equipment protection by flameproof enclosures "d" (IEC 60079-1)*

EN 60079-14, *Explosive atmospheres — Part 14: Electrical installations design, selection and erection (IEC 60079-14)*

EN 60204-1:2006<sup>1)</sup>, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements (IEC 60204-1:2005, modified)*

EN 60204-11, *Safety of machinery — Electrical equipment of machines — Part 11: Requirements for HV equipment for voltages above 1 000 V a.c. or 1 500 V d.c. and not exceeding 36 kV (IEC 60204-11)*

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

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

EN 61310-2:2008, *Safety of machinery — Indication, marking and actuation — Part 2: Requirements for marking (IEC 61310-2:2007)*

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<sup>1)</sup> EN 60204-1:2006 is impacted by the stand-alone amendment EN 60204-1:2006/A1:2009 (IEC 60204-1:2005/A1:2008).

- EN 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 1: General requirements (IEC 61508-1:2010)*
- EN 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems (IEC 61508-2:2010)*
- EN 61508-3, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 3: Software requirements (IEC 61508-3)*
- EN 61508-4, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 4: Definitions and abbreviations (IEC 61508-4)*
- EN 61508-5, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 5: Examples of methods for the determination of safety integrity levels (IEC 61508-5)*
- EN 61508-6, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3 (IEC 61508-6)*
- EN 61508-7, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 7: Overview of techniques and measures (IEC 61508-7)*
- EN 61511-1, *Functional safety — Safety instrumented systems for the process industry sector — Part 1: Framework, definitions, system, hardware and software requirements (IEC 61511-1)*
- EN 61511-2, *Functional safety — Safety instrumented systems for the process industry sector — Part 2: Guidelines for the application of IEC 61511-1 (IEC 61511-2)*
- EN 61511-3, *Functional safety — Safety instrumented systems for the process industry sector — Part 3: Guidance for the determination of the required safety integrity levels (IEC 61511-3)*
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- EN 62061, *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems (IEC 62061)*
- EN ISO 2151:2008, *Acoustics — Noise test code for compressors and vacuum pumps — Engineering method (Grade 2) (ISO 2151:2004)*
- EN ISO 4126-1, *Safety devices for protection against excessive pressure — Part 1: Safety valves (ISO 4126-1)*
- EN ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components (ISO 4413:2010)*
- EN ISO 4414:2010, *Pneumatic fluid power — General rules and safety requirements for systems and their components (ISO 4414:2010)*
- EN ISO 11688-1, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1)*
- EN ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction (ISO 12100:2010)*
- EN ISO 13849-1:2008, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design (ISO 13849-1:2006)*
- EN ISO 13850:2008, *Safety of machinery — Emergency stop — Principles for design (ISO 13850:2006)*

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EN ISO 13857, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857)*

EN ISO 14122-1, *Safety of machinery — Permanent means of access to machinery — Part 1: Choice of fixed means of access between two levels (ISO 14122-1)*

EN ISO 14122-2, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2)*

EN ISO 14122-3, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails (ISO 14122-3)*

EN ISO 14122-4, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders (ISO 14122-4)*

EN ISO 14163, *Acoustics — Guidelines for noise control by silencers (ISO 14163)*

EN ISO 15156-1, *Petroleum and natural gas industries — Materials for use in H<sub>2</sub>S-containing environments in oil and gas production — Part 1: General principles for selection of cracking-resistant materials (ISO 15156-1)*

EN ISO 15667, *Acoustics — Guidelines for noise control by enclosures and cabins (ISO 15667)*

ISO 3857-1, *Compressors, pneumatic tools and machines — Vocabulary — Part 1: General*

ISO 3857-2, *Compressors, pneumatic tools and machines — Vocabulary — Part 2: Compressors*

ISO 8573-1, *Compressed air — Part 1: Contaminants and purity classes*

ISO 8573-2, *Compressed air — Part 2: Test methods for oil aerosol content*

ISO 8573-3, *Compressed air — Part 3: Test methods for measurement of humidity*

ISO 8573-4, *Compressed air — Part 4: Test methods for solid particle content*

IEC 60417 (2002-10), *Graphical symbols for use on equipment*

### 3 Terms and definitions

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

Definitions specifically needed for compressors are listed below and in the standards ISO 3857-1 and ISO 3857-2.

#### 3.1 General terms

##### 3.1.1

##### **compressor**

*part of a compressor unit that compresses a gas or vapour media to a pressure higher than that at the inlet*

##### 3.1.2

##### **compressor unit**

*unit that comprises the compressor, a drive system and any component or device which is necessary for operation*

**3.1.3****depressurisation**

reduction of the pressure difference between the inside of a pressure containing part and its environment to zero

EXAMPLE Stopping a compressor may lead to higher pressures on the suction side. In such cases, achieving a safe state may include depressurizing.

**3.1.4****drive system**

*system that consists of a prime mover and coupling mechanism*

Note 1 to entry: *Prime mover may be an electric motor, steam engine (turbine), etc.*

Note 2 to entry: *Coupling mechanism may be a drive belt, shaft, gears, etc.*

**3.1.5****harm**

physical injury or damage to health

[SOURCE: EN ISO 12100:2010, definition 3.5]

**3.1.6****hazard**

potential source of harm

[SOURCE: EN ISO 12100:2010, definition 3.6]

**3.1.6.1****hazard zone**

danger zone

space within and/or around machinery in which a person can be exposed to a hazard

[SOURCE: EN ISO 12100:2010, definition 3.11]

**3.1.6.2****hazardous event**

event that can cause harm

Note 1 to entry: A hazardous event can occur over a short period of time or over an extended period of time.

**3.1.6.3****hazardous situation**

circumstance in which a person is exposed to at least one hazard

Note 1 to entry: The exposure can result in harm immediately or over a period of time.

[SOURCE: EN ISO 12100:2010, definition 3.10]

**3.1.6.4****hazardous gas or vapour**

gas or vapour with chemical, radioactive or biological properties (such as flammable, explosive, unstable, pyrogenic, corrosive, caustic, toxic, carcinogenic), which generate hazards by reactions inside the compressor or through dispersal or through reactions with the environment

Note 1 to entry: A hazardous gas may be a mixture of gases with these properties.

**EN 1012-3:2013 (E)****3.1.7****inert gases**

*chemically inactive gas which retains this characteristic even at elevated pressures and temperatures*

**3.1.8****liquid shock**

*excessive force resulting from an attempt to compress incompressible media*

**3.1.9****maximum allowable pressure**

*maximum allowable working pressure*

*maximum pressure for which the compressor or compressor unit is designed, as specified by the manufacturer*

**3.1.10****maximum allowable temperature**

*maximum allowable working temperature*

*maximum operating temperature, as specified by the manufacturer*

**3.1.11****maximum continuous shaft speed**

*highest rotational speed at which the compressor at any of the specified operating conditions is capable of continuous operation*

Note 1 to entry: The maximum continuous speed is specified by the manufacturer.

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**3.1.12****nominal discharge pressure**

*rated discharge pressure*

*pressure at the outlet of the compressor, as specified by the manufacturer*

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**3.1.13****normal operating conditions**

*conditions considered to be when the compressor is properly maintained and operated within admissible limits in particular ambient temperature, as specified by the manufacturer compressing the specified media*

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**3.1.14****pressure**

*pressure relative to atmospheric pressure, i.e. gauge pressure*

Note 1 to entry: In many cases, this is referred to as effective pressure.

Note 2 to entry: The unit bar for pressure is used. 1 bar = 100 kPa.

**3.1.15****rated power**

*maximum permitted power (mechanical or electrical)*

Note 1 to entry: Nominal power is a synonym for rated power.

**3.1.16****risk**

*combination of the probability of occurrence of harm and the severity of that harm*

[SOURCE: EN ISO 12100:2010, definition 3.12]

**3.1.17****residual risk**

risk remaining after protective measures have been taken

Note 1 to entry: See EN ISO 12100:2010, Figure 2.

[SOURCE: EN ISO 12100:2010, definition 3.17]

**3.1.18****safety function**

function of the machine whose failure can result in an immediate increase of the risk(s)

[SOURCE: EN ISO 12100:2010, 3.30; EN ISO 13849-1:2008, 3.1.20]

**3.1.19****safety related control**

safety instrumented system

SIS

control device that carries out one or more safety function(s)

Note 1 to entry: This definition corresponds to safety instrumented system (SIS) according to EN 61511-1.

**3.1.20****shutdown**

stopping of all prime movers of a compressor

**3.1.20.1****automatic shutdown**

automatically initiated stopping of a compressor initiated by limiting device or safety device

Note 1 to entry: Automatic shutdown is commonly denoted as "tripping".

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Note 2 to entry: This definition describes the way of initiating a normal, safety related controlled or emergency shutdown.

**3.1.20.2****normal shutdown**

manually or automatically initiated stopping of a compressor which may include full sequential actuation of auxiliary equipment and drive system

**3.1.20.3****safety related controlled shutdown**

manually or automatically initiated stopping of a compressor which includes a reduced (compared to normal shutdown) sequential actuation of auxiliary equipment and drive system

Note 1 to entry: This type of shutdown is initiated by a safety related function.

Note 2 to entry: Reduced sequential actuation means a reduced number and/or duration of steps of the sequence.

Note 3 to entry: After a normal shutdown the energy to the prime movers can be cut off or not (see stop category 1 or 2 of 9.2.2 of EN 60204-1:2006).

Note 4 to entry: Manually initiated stopping of a compressor which includes a reduced (compared to normal shutdown) sequential actuation of auxiliary equipment and drive system is often denoted as emergency stop.