



# SLOVENSKI STANDARD

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**Kompresorji in vakuumske črpalke - Varnostne zahteve - 1. del: Kompresorji za zrak**

Compressors and vacuum pumps - Safety requirements - Part 1: Air compressors

Kompressoren und Vakuumpumpen - Sicherheitsanforderungen - Teil 1: Kompressoren

Compresseurs et pompes à vide - Prescriptions de sécurité - Partie 1: Compresseurs d'air

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EUROPEAN STANDARD

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**Compressors and vacuum pumps - Safety requirements - Part 1:  
Air compressors**Compresseurs et pompes à vide - Prescriptions de sécurité  
- Partie 1 : Compresseurs d'airKompressoren und Vakuumpumpen -  
Sicherheitsanforderungen - Teil 1: Kompressoren

This European Standard was approved by CEN on 30 July 2010.

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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 Management Centre has the same status as the official versions.

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## Contents

	Page
Foreword.....	3
Introduction .....	4
<b>1 Scope .....</b>	<b>5</b>
<b>2 Normative references .....</b>	<b>5</b>
<b>3 Terms and definitions .....</b>	<b>7</b>
<b>3.1 General terms.....</b>	<b>7</b>
<b>3.2 Specific terms .....</b>	<b>8</b>
<b>4 List of significant hazards — Hazard analysis and risk assessment.....</b>	<b>8</b>
<b>5 Safety requirements and/or protective measures .....</b>	<b>10</b>
<b>5.1 General.....</b>	<b>10</b>
<b>5.2 Mechanical safety .....</b>	<b>11</b>
<b>5.3 Electrical safety.....</b>	<b>13</b>
<b>5.4 Control systems.....</b>	<b>13</b>
<b>5.5 Thermal safety.....</b>	<b>15</b>
<b>5.6 Noise .....</b>	<b>15</b>
<b>5.7 Materials and substances processed, used or exhausted.....</b>	<b>15</b>
<b>5.8 Fire and explosion .....</b>	<b>16</b>
<b>5.9 Ergonomic principles.....</b>	<b>17</b>
<b>5.10 Breaking down of machinery parts and other functional disorders .....</b>	<b>18</b>
<b>5.11 Pressure relief – fragmentation.....</b>	<b>19</b>
<b>5.12 Information and warning devices.....</b>	<b>20</b>
<b>6 Verification of safety requirements and/or protective measures .....</b>	<b>21</b>
<b>6.1 Pressure testing.....</b>	<b>21</b>
<b>6.2 Noise .....</b>	<b>21</b>
<b>6.3 Stability of portable compressor units .....</b>	<b>21</b>
<b>6.4 Structure of verification .....</b>	<b>22</b>
<b>7 Information for use .....</b>	<b>24</b>
<b>7.1 General requirements.....</b>	<b>24</b>
<b>7.2 Accompanying documents (in particular, instruction handbook).....</b>	<b>25</b>
<b>7.3 Specific types of compressors.....</b>	<b>27</b>
<b>7.4 Service instructions .....</b>	<b>28</b>
<b>7.5 Markings, signs and written warnings.....</b>	<b>29</b>
<b>7.6 Noise .....</b>	<b>31</b>
<b>7.7 Dismantling .....</b>	<b>31</b>
<b>Annex A (informative) Labels, signs and tags .....</b>	<b>32</b>
<b>Annex ZA (informative) Relationship between this European Standard and the Essential Requirements of EU Directive 2006/42/EC Safety of machinery.....</b>	<b>37</b>
<b>Bibliography .....</b>	<b>38</b>

## Foreword

This document (EN 1012-1:2010) 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 March 2011, and conflicting national standards shall be withdrawn at the latest by September 2012.

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 supersedes EN 1012-1:1996.

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 EC Directive(s).

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

This document is in three parts:

— *Part 1: Air compressors;*

— *Part 2: Vacuum pumps;*

— *Part 3: Process compressors.*

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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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

**EN 1012-1:2010 (E)****Introduction**

This document is a type C standard as stated in the introduction to EN ISO 12100-1.

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.

This standard when published in 1996 applied to all types of compressors. The standard has now been divided into three parts with this part addressing compressors for compressed air, nitrogen and inert gases, a second part addressing vacuum pumps and a third part addressing compressors for process gases. It was considered a practical move so that if there were provisions that were laid down for compressors covered by CEN/TC 12 or ISO/TC 67, then any revision or amendments could be done to the process compressor part without affecting the provisions laid down for air compressors covered by this part of EN 1012.

Standards dealing with non-safety aspects of compressor units are:

- EN 61000-6-4 and EN 61000-6-2 for stationary compressor units;
- EN 13309 for skid-mounted and mobile compressor units on electromagnetic compatibility.

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## 1 Scope

This part of EN 1012 is applicable to compressors and compressor units having an operating pressure greater than 0,5 bar and designed to compress air, nitrogen or inert gases. This document deals with all significant hazards, hazardous situations and events relevant to the design, installation, operation, maintenance, dismantling and disposal of compressors and 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;
- any component or device which is necessary for operation.

This part also covers the general requirements relating to process gas compressors; for specific requirements see prEN 1012-3 which applies.

This part covers compressors driven by any power media, including battery powered and which are fitted in or used with motor vehicles.

This part of EN 1012 does not cover requirements for compressors used in potentially explosive atmospheres.

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

## 2 Normative references

The following referenced documents are indispensable for the application 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 547-1, *Safety of machinery — Human body measurements — Part 1: Principles for determining the dimensions required for openings for whole body access into machinery*

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 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*

EN 982:1996+A1:2008, *Safety of machinery — Safety requirements for fluid power systems and their components — Hydraulics*

EN 983:1996+A1:2008, *Safety of machinery — Safety requirements for fluid power systems and their components — Pneumatics*

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

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

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 1012-1:2010 (E)**

EN 60204-1:2006, *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 1000 V a.c. or 1500 V d.c. and not exceeding 36 kV (IEC 60204-11:2000)*

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

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 4126-1:2004)*

EN ISO 11688-1, *Acoustics — Recommended practice for the design of low-noise machinery and equipment — Part 1: Planning (ISO/TR 11688-1:1995)*

EN ISO 12100-1:2003, *Safety of machinery — Basic concepts, general principles for design — Part 1: Basic terminology, methodology (ISO 12100-1:2003)*

EN ISO 12100-2:2003, *Safety of machinery — Basic concepts, general principles for design — Part 2: Technical principles (ISO 12100-2:2003)*

EN ISO 13732-1, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 1: Hot surfaces (ISO 13732-1:2006)*

EN ISO 13732-3, *Ergonomics of the thermal environment — Methods for the assessment of human responses to contact with surfaces — Part 3: Cold surfaces (ISO 13732-3:2005)*

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)*

EN ISO 13857:2008, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2008)*

EN ISO 14121-1, *Safety of machinery — Risk assessment — Part 1: Principles (ISO 14121-1:2007)*

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 14122-1:2001)*

EN ISO 14122-2, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways (ISO 14122-2:2001)*

EN ISO 14122-3, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2001)*

EN ISO 14122-4, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders (ISO 14122-4:2004)*

EN ISO 14163, *Acoustics — Guidelines for noise control by silencers (ISO 14163:1998)*

EN ISO 15667, *Acoustics — Guidelines for noise control by enclosures and cabins (ISO 15667:2000)*

ISO 3857-1:1977, *Compressors, pneumatic tools and machines — Vocabulary — Part 1: General*

ISO 3857-2:1977, *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*<sup>1)</sup>

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN ISO 12100-1:2003 apply. Terms and definitions specifically needed for compressors are listed below and in ISO 3857-1:1977 and ISO 3857-2:1977.

#### 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

##### **drive system**

system that consists of a prime mover and coupling mechanism

NOTE 1 Prime mover may be an electric motor, steam engine (turbine), etc.

NOTE 2 Coupling mechanism may be a drive belt, shaft, gears, etc.

##### 3.1.4

##### **inert gas**

chemically inactive gas which retains this characteristic even at elevated pressures

##### 3.1.5

##### **pressure**

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

NOTE 1 In many cases, this is referred to as effective pressure.

NOTE 2 The unit bar for pressure is used. 1 bar = 100 kPa.

##### 3.1.6

##### **liquid shock**

excessive force resulting from an attempt to compress incompressible media

##### 3.1.7

##### **maximum allowable pressure**

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

1) IEC 60417 is available only as a database which can be accessed, if necessary, by subscription through the IEC Website (see <http://www.graphical-symbols.info/graphical-symbols/equipment/db1.nsf/welcome?OpenPage>); those symbols relevant to this standard can be found in Annex A.

**EN 1012-1:2010 (E)**

NOTE This is also identified as maximum allowable working pressure.

**3.1.8****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 when compressing the specified media

**3.2 Specific terms****3.2.1****air compressor**

compressor intended for compression of air, nitrogen or inert gases

**3.2.2****compressor assembly**

assembly of compressor units and ancillary equipment to provide a compression facility that functions as an integrated whole

NOTE The limits of the assembly are as defined by the manufacturer.

**3.2.3****portable and skid mounted compressor****3.2.3.1****portable compressor unit**

compressor unit which is wheel-mounted and can be towed on- and off-site

**3.2.3.2****skid-mounted compressor unit**

compressor unit which is mounted on skids and which can be towed short distances on-site or transported

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**3.2.3.3****gross mass**

maximum specified mass of a skid-mounted or portable compressor unit (including tools, equipment and fuel)

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NOTE Tools and equipment includes for example concrete breakers, picks and hoses likely to be carried for a typical working application.

**3.2.4****process compressor**

compressor intended for compression of all gases other than air, nitrogen or inert gases

**3.2.5****water-injected compressor**

compressor design in which the compressed media and the water are mixed

**4 List of significant hazards — Hazard analysis and risk assessment**

To provide the suitable level of safety taking into consideration the design, guarding and the provision of information, the appropriate risk assessment procedure shall be adopted in accordance with the principles identified in EN ISO 12100-1, EN ISO 12100-2 and EN ISO 14121-1.

Hazards listed in Table 1 are related to all compressors/compressor units within the scope of this standard.

Table 1 — Hazard listing

No.	Hazard type	Reference to safety requirement	
		By design or guarding	Information for use
<b>1</b>	<b>Mechanical hazards due to:</b>		
1.1	Machine parts or work-pieces, e.g.:		
	a) shape;	5.10.1	
	b) mass and stability (potential energy of elements which may move under the effect of gravity);		7.3.2 a) & d), 7.5.4.1
	c) mass and velocity (kinetic energy of elements in controlled or uncontrolled motion);		7.3.2 a)
	d) inadequacy of mechanical strength; 1) accumulation of energy inside the machinery	5.10.1	
	e) liquids and gases under pressure	5.10.1., 5.11.1, 5.11.2, 5.12	7.2.1.4 c), d) & g), 7.2.2 m)
1.2	Cutting or severing hazard friction or abrasion hazard	5.2.1.1	7.2.1.4 n), 7.2.2 a)
1.3	Drawing-in or trapping hazard	5.2.1.2	7.3.3
1.4	Impact hazard stabbing or puncture hazard		7.2.1.4 o)
1.5	High pressure fluid injection or ejection hazard	5.2.2	7.2.1.4 o)
<b>2</b>	<b>Electrical hazards due to:</b>		
2.1	Contact of persons with live parts (direct contact)		7.2.1.3.2, 7.4.2
2.2	Contact of persons with parts which have become live under faulty conditions (indirect contact)		7.4.2
2.3	Lack of isolation of energy source		7.2.1.3.2
2.4	Electrostatic phenomena	5.8.1	
<b>3</b>	<b>Thermal hazards, resulting in:</b>		
3.1	Burns, scalds and other injuries by a possible contact of persons with objects or materials with an extreme high or low temperature, by flames or explosions and also by the radiation of heat sources	5.5	7.2.1.4 k). 7.2.2 d)
<b>4</b>	<b>Hazards generated by noise, resulting in:</b>		
4.1	Hearing loss (deafness), other physiological disorders (e.g. loss of balance, loss of awareness)	5.6	7.2.2 a), 7.5.1, 7.6.2
<b>5</b>	<b>Hazards generated by materials and substances (and their constituent elements) processed or used by the machinery</b>		
5.1	Hazards from contact with or inhalation of harmful fluids, gases, mists, fumes, and dusts	5.2.2, 5.7.2, 5.10.1	7.2.2 e), 7.3.2 e), f)
5.2	Fire or explosion hazard	5.8	7.2.1.4 j), m), 7.2.2 f)
5.3	Biological or microbiological (viral or bacterial) hazards	5.7.1	7.2.2 i)
<b>6</b>	<b>Hazards generated by neglecting ergonomic principles in machinery design as, e.g. hazards from:</b>		

## EN 1012-1:2010 (E)

Table 1 (continued)

No.	Hazard type	Reference to safety requirement	
		By design or guarding	Information for use
6.1	Inadequate design, location or identification of manual controls	5.9	
<b>7</b>	<b>Unexpected start-up, unexpected over-run/over-speed (or any similar malfunction) from:</b>		
7.1	Failure/disorder of the control system		7.2.2 b)
7.2	External influences on electrical equipment	5.4.5	
<b>8</b>	<b>Failure of the power supply</b>		7.2.1.3.1
<b>9</b>	<b>Failure of the control circuit</b>	5.4	7.2.2 b)
<b>10</b>	<b>Errors of fitting</b>		
<b>11</b>	<b>Break-up during operation</b>	5.10, 5.11.1	7.2.1.4 i)
<b>12</b>	<b>Falling or ejected objects or fluids</b>		7.3.2 b), h)
<b>13</b>	<b>Loss of stability / overturning of machinery</b>	5.2.3	7.2.2 l)
<b>14</b>	<b>Slip, trip and fall of persons (related to machinery)</b>	5.2.4	7.4.2
Additional hazards, hazardous situations and hazardous events due to mobility			
<b>15</b>	<b>Linked to the work position (including driving station) on the machine</b>		
15.1	Exhaust gases/lack of oxygen at the work position		7.2.2 e) & h), 7.3.2, e) & f)
15.2	Noise at the operator's position		6.2.1, 7.6
<b>16</b>	<b>From handling the machine (lack of stability)</b>	5.9.2 b) & c)	7.3.2 d)
<b>17</b>	<b>Due to the power source and to the transmission of power</b>		
17.1	Hazards from the engine and the batteries	5.3.2	
17.2	Hazards from coupling and towing	5.9.2 b), 5.9.3	7.3.2 a), g)
<b>18</b>	<b>From/to third persons</b>		
18.1	Lack or inadequacy of visual or acoustic warning means		7.5
<b>19</b>	<b>Insufficient instructions for the driver/operator</b>		7.3.2
<b>20</b>	<b>Unhealthy postures or excessive effort</b>	5.9.3	

## 5 Safety requirements and/or protective measures

### 5.1 General

Machinery shall comply with the safety requirements and/or protective measures of this clause. In addition, the machine shall be designed according to the principles of EN ISO 12100 (all parts) for relevant but not significant hazards, which are not dealt with by this document.

When choices are necessary for the application of type B standards referred to in this European Standard, i.e. listed in Clause 2, the manufacturer shall carry out an appropriate risk assessment for making these choices.

The measures adopted to comply with the requirements of this clause shall take account of the state-of-the-art when more effective technical means become available.

## 5.2 Mechanical safety

### 5.2.1 Guards

#### 5.2.1.1 General

When fixed guards have to be removed for periodic maintenance or repair their fixing systems shall remain attached to the guard or machinery when the guards are removed.

#### 5.2.1.2 Cutting and severing, friction and abrasion

All moving parts shall be enclosed within the permanent compressor casing or compressor unit cover, enclosure or canopy. When this is not possible, separate guards shall be provided to prevent contact with all rotating and reciprocating parts to minimize the risk of cutting and severing, friction and abrasion to personnel in accordance with Clause 5 of EN 953:1997+A1:2009 and EN ISO 13857 for safety distances.

#### 5.2.1.3 Bodily contact

Guards shall be sufficiently rigid so as not to deflect excessively as a result of bodily contact. Such deflections shall not result in contact with moving parts, or that the deflection should not result in permanent deformation of the guard. The provisions for rigidity of guards shall be in accordance with 5.5.3 of EN 953:1997+A1:2009.

#### 5.2.1.4 Ejection of parts

Moving parts shall be designed and mounted in such a way that in all foreseeable modes of operation the risk of ejection of parts is minimised. Where the risk assessment identifies a remaining risk of ejection, e.g. a drive belt from a belt driven compressor, then the impact resistance for guarding shall be in accordance with 5.5.2 of EN 953:1997+A1:2009.

#### 5.2.1.5 Entry to inlet ducts and enclosures

Atmospheric inlets and inspection openings in inlets shall be provided with protective devices, so that persons cannot be drawn in or danger zones reached when the compressor is running. For this purpose, any openings shall comply with Table 4 of EN ISO 13857:2008 for upper limbs and Table 7 of EN ISO 13857:2008 for lower limbs, when applicable.

Openings giving access to moving parts creating a risk of trapping or shearing shall be prevented by either:

- total enclosure with an interlocked means of access, e.g. door, cover, etc. such that the compressor is shut down when the access is opened and cannot be started until the access is closed; or
- total enclosure without interlock when access to moving parts, e.g. fan belts, barring gear, timing marks, etc., shall be prevented by local guarding; or
- without total enclosure when access to moving parts, e.g. fan belts, barring gear, timing marks, etc., shall be prevented by local guarding.

Where service, maintenance or inspection activities require access within the enclosure doors whilst the compressor is still operational, consideration shall be given to the additional hazards created and the measures taken shall be in accordance with 5.2.4 of EN ISO 12100-2:2003. The provisions of 7.3.3 shall also be applied.

Where whole body access is required to inlet ducts and enclosures for service, maintenance or inspection the provisions of EN 547-1 shall be followed when determining the minimum dimensions of openings for such whole body access.

Where whole body access is required to inlet ducts for service, maintenance or inspection, a guard shall be fitted to prevent unauthorised access. The guard shall be: