



SLOVENSKI STANDARD
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Safety requirements for superabrasives

Safety requirements for superabrasives

Sicherheitsanforderungen für Schleifwerkzeuge mit Diamant oder Bornitrid

Prescriptions de sécurité pour les produits superabrasifs

Ta slovenski standard je istoveten z: EN 13236:2001

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Safety requirements for superabrasives

Prescriptions de sécurité pour les produits superabrasifs

Sicherheitsanforderungen für Schleifwerkzeuge mit
Diamant oder Bornitrid

This European Standard was approved by CEN on 5 January 2001.

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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 143 "Machine tools – Safety" the secretariat of which is held by SNV.

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of an identical text or by endorsement, at the latest by July 2001, and conflicting national standards shall be withdrawn at the latest by July 2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

0 Introduction

This standard has been prepared to be a European standard to provide one means of conforming with the Essential Safety Requirements of the Machinery Directive and associated EFTA regulations.

This standard is addressed to designers, manufacturers and suppliers of the grinding tools described in the scope. In addition, it helps designers, manufacturers and suppliers of grinding machines in the selection of grinding tools, in order to reduce the risks and achieve conformity of the respective machinery with the Essential Safety Requirements of the Machinery Directive.

The extent to which hazards are covered is indicated in the scope of this standard.

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1 Scope

This standard is applicable to superabrasives which are manufactured or repaired after the date of issue of the standard. It specifies requirements and/or measures for the removal or reduction of hazards resulting from the design and application of the grinding tools.

This standard contains also procedures and tests for verification of the compliance with the requirements as well as safety information for use which is to be made available to the user by the manufacturer.

The hazards taken into consideration are listed in clause 4 of this standard.

This standard applies to grinding wheels, cutting-off wheels, wires, mounted points and other grinding tools with diamond or cubic boron nitride as abrasive. It does not apply to bonded abrasive products, coated abrasive products, rotating dressing tools, truers nor any non-rotating superabrasive tool.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references subsequent amendments to, or revisions of, any of these publications apply to this European standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

prEN 13218 : 1998

Machine tools – Safety – Stationary grinding machines

ISO 286-1

ISO system of limits and fits – Part 1: Bases of tolerances, deviations and fits

ISO 286-2

ISO system of limits and fits – Part 2: Tables of standard tolerance grades and limit deviations for holes and

shafts

ISO 565

Test sieves – Metal wire cloth, perforated metal plate and electroformed sheet – Nominal sizes of openings

ISO 2768-1 : 1989

General tolerances; tolerances for linear and angular dimensions without individual tolerance indications

3 Definitions and symbols

For the purpose of this standard the following definitions apply:

3.1 Material

3.1.1 Abrasives

Diamond, natural or synthetic and cubic boron nitride. Symbols shown in table 1.

Table 1: Abrasives

Symbols	Designation
D	diamond
B	cubic boron nitride (CBN)

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3.1.2 Bond

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Table 2: Type of bond

B	Resinoid and other thermosetting organic bonds
G	Electroplated, single layer and multilayer metal bonds
M	Metal bond
V	Vitrified bond

3.1.3 Additives for bonds

Fillers such as diamond, CBN, silicon carbide, aluminium oxide, graphite, carbides and poreforming agents.

3.1.4 Grain size

Code number for the size of the abrasive grain. There is a differentiation between macro and micro grains, see tables F.1 and F.2.

3.1.5 Concentration

Code number for the volumetric content of abrasive in the section, the concentration 100 corresponding to 25 % diamond or cubic boron nitride volume content.

3.2 Grinding machine

3.2.1 Stationary grinding machine

Machine fixed in position during operation and capable of a combination of one or more types of operations, examples see prEN 13218 : 1998.

3.2.2 Mobile grinding machine

Machine which is manually guided (but not hand-held) during grinding, e.g. joint grinding machine.

3.2.3 Hand-held grinding machine

Machine including those with flexible drive held in the hand during operation.

3.2.4 Stationary cutting-off (Sawing) machine

Machine specifically designed for cutting-off applications. Included are as well mobile cutting-off machines held in position during cutting-off.

3.2.5 Mobile cutting-off (Sawing) machine

Machine which is manually guided (but not handheld) during cutting-off, e.g. joint cutting machine.

3.2.6 Hand-held cutting-off (Sawing) machine

Machine held in the hand during operation.

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3.2.7 Grinding and cutting-off (Sawing) machine with totally enclosed working area

Stationary machine for mechanically guided grinding or cutting-off with operating areas which are protected in such a way by separating guards that machining processes including loading and unloading of workpieces can be carried out inside them and persons are protected against hazards generated by bursting of an abrasive product.

3.3 Type of application

Type of guidance of grinding tool and workpiece during grinding and cutting-off, see table 3.

3.3.1 Mechanically guided grinding

The movements of the grinding tool and/or the workpiece are guided by mechanical means.

3.3.2 Manually guided grinding

The movements of the grinding tool and/or the workpiece are guided by the hands of the operator.

3.3.3 Hand-held grinding

The grinding machine is entirely guided by the hands of the operator.

3.4 Method of operation

3.4.1 Peripheral grinding

Grinding with the periphery of the wheel with no or limited side loads.

3.4.2 Face grinding

Grinding with the face of the wheel.

3.4.3 Cutting-off

Cutting-off or slotting with the periphery of the cutting-off wheel.

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Table 3: Grinding method, type of machine, type of application

Grinding method	Type of machine	Type of application	Grinding tool	Workpiece	Examples for application / machines
Grinding	Stationary grinding machines	Mechanically guided grinding	Fixed	Mechanically guided	Surface grinding, centerless grinding, creep feed grinding, bevel grinding on glass (glass bevelling machines)
			Mechanically guided	Fixed	Profile grinding of stone and concrete
			Mechanically guided	Mechanically guided	Internal grinding, external, plunge and traverse grinding, jig grinding, decorative stone milling and polishing, pencil edging of glass (automotive glass)
	Stationary and mobile grinding machines	Manually guided grinding	Manually guided	Fixed	Roughing and polishing of stone floors (carriage/floor grinding machines)
			Fixed	Manually guided	Tool grinding (bench grinding machines) decorative glass grinding
			Manually guided	Fixed	Stone and concrete milling and polishing (angle, straight grinders)
Cutting-off	Stationary cutting-off machines	Mechanically guided cutting-off	Fixed	Mechanically guided	Cutting-off of bricks and tiles (table saw)
			Mechanically guided	Fixed	Cutting-off of stone and concrete (bridge-type saw, floor and wall saws, wire saw)
			Mechanically guided	Mechanically guided	Cutting-off of semi-conductors
	Stationary and mobile cutting-off machines	Manually guided cutting-off	Manually guided	Fixed	Cutting-off of stone and concrete (table saw, floor saw)
			Fixed	Manually guided	Cutting-off of bricks (table saw)
			Manually guided	Fixed	Cutting-off of stone and concrete (angle grinding machine, hand-held cutting-off machine)

3.5 Dimensional abbreviations for superabrasive products

Table 4: Dimensional abbreviations

Dimensions in mm

Symbol	Designation	
	Abrasive product	Mounted point
D	Outside diameter	Outside diameter
E	Thickness of a wheel, dish wheel and a recessed or relieved wheel, thickness of a blank	
H	Bore diameter	
J	Smallest diameter of tapered cup, dish or tapered wheel	
K	Internal diameter of recess on tapered cup or dish wheel	
L_0		Overhang length of spindle
L_1		Overall length
L_2	Length of segment	Spindle length
L_3		Clamping length
L_4		Reduced length of spindle
L_v	Length of bond interface between segment and core	
R	Radius	Radius
S_d		Spindle diameter
S_1		Diameter of reduced spindle
T	Overall thickness	Overall Thickness
T_1	Reduced hub thickness	
T_D	Outside diameter tolerance limits	Outside diameter tolerance limits
T_H	Bore diameter tolerance limits	
T_T	Thickness tolerance limits	Thickness tolerance limits
U	Thickness of superabrasive section (if less than T or T_1)	
U_1	Reduced thickness of superabrasive section	
W	Rim width	
X	Depth of superabrasive section	Depth of superabrasive section
X_1	Unsupported depth section	
Z	Number of segments	

3.6 Speeds, test speed factor and safety factors

Table 5: Speeds and safety factors

Symbol	Designation	Definition	Unit
n	Speed of rotation	Revolutions per unit of time (rpm)	min^{-1} or $\frac{1}{\text{min}}$
n_{ab}	Deflection speed of mounted points	Speed in rpm at which the spindle of mounted points is deflecting under centrifugal force	min^{-1} or $\frac{1}{\text{min}}$
n_{\max}	Maximum speed of rotation	Revolutions per unit of time (rpm) of the new superabrasive at maximum operating speed	min^{-1} or $\frac{1}{\text{min}}$
v	Peripheral speed	Speed at the periphery of the superabrasive	m/s
v_s	Maximum operating speed	The maximum permissible peripheral speed of a rotating superabrasive	m/s
v_{pr}	Safety test speed	Peripheral speed at which the superabrasives are tested by the manufacturer	m/s
f_{pr}	Test speed factor	The ratio of the safety test speed, divided by the maximum peripheral operating speed	—
v_{br}	Bursting speed	The peripheral speed at which the superabrasive breaks under rotational stress	m/s
$v_{br \min}$	Minimum bursting speed	Peripheral speed, which the superabrasive shall at least reach without bursting under rotational stress	m/s
S	Safety factor	The bursting speed, divided by the maximum peripheral operating speed, all squared. The formula for S is: $S = \left(\frac{v_{br}}{v_s} \right)^2$	—
S_{ab}	Safety factor of spindle deflection for mounted points	The formula is: $S_{ab} = \frac{n_{ab}}{n_{\max}}$	—

3.7 Other abbreviations

Table 6: Other abbreviations

Symbol	Designation	Unit
R_e	Yield point	N/mm ²
M_b	Bending moment	Nm
E	Modulus of elasticity	N/mm ²
F	Force	N
F_A	Shearing force	N
L_f	Lever arm	mm
e	Distance between centre of gravity and geometrical centre of wheel	mm
k_m	Reducing factor for the shaft mass	—
σ_b	Bending strength	N/mm ²
ρ	Density	g/cm ³
ρ_s	Density of shaft material	g/cm ³
ρ_G	Density of plated bond	g/cm ³
ρ_V	Density of vitrified bond	g/cm ³
ρ_{Vt}	Density of vitrified or other wheel core	g/cm ³
ρ_B	Density of resinoid bond	g/cm ³
ρ_M	Density of metal bond	g/cm ³
▼	Grinding face of superabrasive, i.e. that part that actually grinds the workpiece, see annex E.	—

3.8 Other definitions

3.8.1 Labels

Labels contain essential information on the superabrasives to which they belong.

3.8.2 Blotters

Blotters are placed between the superabrasive and flanges.

4 List of hazards

Table 7: List of hazards

Hazard designation	Hazardous situation (Examples)	Relevant clauses in this standard
Ejection of parts	1. Breakage of superabrasive caused by:	
	– improper design, manufacturing defect	5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 and Annex C
	– insufficient strength	6
	– wrong selection	7 and Annex A
	– improper handling and storage	7
	– improper use (mounting and grinding process)	7, Annex A and Annex B
	2. Loosening of grinding particles	7
Vibration	Unbalance caused by:	
	– manufacturing defects	5.1.4, 6
	– improper use, mounting	7

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5 Requirements

Superabrasives are subject to high stresses during the grinding and cutting operation. They shall therefore have specified safety factors and minimum bursting speeds, as a function of machine type, type of application and maximum peripheral operating speed and comply with the additional requirements laid down in this clause.

5.1 Requirements for superabrasive grinding wheels

5.1.1 General

Shapes and dimensions, see Annex E.

5.1.2 Bore tolerances

The tolerance class for bores on superabrasive wheels is H 7, as per ISO 286-2.

If high temperatures can be expected when using vitrified cores, nominal diameter and bore tolerances may be adopted by the manufacturer to this application.

5.1.3 Maximum permissible plastic deformation

In superabrasives with a metal core, centrifugal forces may induce a permanent increase in outside diameter. At the minimum bursting speed, according to table 8, this permanent increase in diameter in relation to the original outside diameter, shall not exceed IT 11, according to ISO 286-1.

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5.1.4 Maximum unbalance

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Standard on requirements for maximum unbalance in preparation.

5.1.5 Maximum operating speeds

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Superabrasives shall be manufactured for maximum operating speeds conforming to the following sequence:

5 – 6 – 8 – 10 – 12 – 16 – 20 – 25 – 32 – 35 – 40 – 45 – 50 – 63 – 80 – 100 – 125 – 140 – 160 – 180 – 200 – 225 – 250 – 280 – 320 – 360 – 400 – 450 – 500 in m/s.

Conversion table for speeds of rotation and peripheral speeds as a function of external diameter D of the grinding wheel see Annex D

5.1.6 Safety factors

The safety factors against breakage caused by centrifugal forces shall be as specified in table 8.

Table 8: Maximum operating speeds, safety factors and minimum bursting speeds for superabrasive grinding wheels

Type of machine	Type of application	Maximum operating speed v_s in m/s	Safety factor S	Minimum bursting speed $v_{br \text{ min}}$ in m/s
Stationary grinding machines	Mechanically guided grinding	< 40	3,00	–
		40	3,00	70
		50	3,00	87
		63	3,00	109
		80	3,00	139
	Mechanically guided grinding with totally enclosed working area	< 80	1,75	–
		80	1,75	106
		100	1,75	132
		125	1,75	165
		140	1,75	185
		160	1,75	212
		180	1,75	238
		200	1,75	265
		225 ¹⁾	1,75 ¹⁾	298
		250 ¹⁾	1,75 ¹⁾	331
		280 ¹⁾	1,75 ¹⁾	370
		320 ¹⁾	1,75 ¹⁾	423
360 ¹⁾	1,75 ¹⁾	476		
400 ¹⁾	1,75 ¹⁾	529		
450 ¹⁾	1,75 ¹⁾	595		
500 ¹⁾	1,75 ¹⁾	661		
Stationary and mobile grinding machines	Manually guided grinding	< 50	3,00	–
		50	3,00	87
		63	3,00	109
		80	3,50	150
Hand-held grinding machines	Hand-held grinding	< 50	3,00	–
		50	3,00	87
		63	3,50	118
		80	3,50	150

¹⁾ These safety factors are provisional. Wheels running at these speeds are currently under development.