SLOVENSKI STANDARD
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Orodja za obdelavo lesa - Varnostne zahteve - 2. del: Zahteve za držalo rezkalnih orodij

Tools for woodworking - Safety requirements - Part 2: Requirements for the shank of shank mounted milling

Maschinen-Werkzeuge für Holzbearbeitung - Sicherheitstechnische Anforderungen - Teil 2: Anforderungen für den Schaft von Fräswerkzeugen/Kreissägeblätter

Outils pour le travail du bois - Prescriptions de sécurité - Partie 2 : Prescriptions pour les queues des fraises à queue

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Tools for woodworking - Safety requirements - Part 2: Requirements for the shank of shank mounted milling tools/circular saw blades

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COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 847-2:2017) has been prepared by Technical Committee CEN/TC 142 “Woodworking machines - Safety”, the secretariat of which is held by UNI.

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of an identical text or by endorsement, at the latest by May 2018, and conflicting national standards shall be withdrawn at the latest by May 2018.

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Introduction

The content of this European Standard is aimed at eliminating hazards which can lead to overloading of the shank of shank mounted milling tools for woodworking by excessive rotational speeds.

1 Scope

This European Standard specifies the determination of the maximum speed for given eccentricity at clamping devices for the shank strength of milling tools with cylindrical and taper shank. It also specifies the marking of the tool. Bore mounted tools e.g. milling tools, circular saw blades which are mounted on an arbor should be considered as a shank mounted tool.

This European Standard complements EN 847-1:2017 and applies also for shank tools with a cutting diameter of less than 16 mm.

This European Standard is not applicable for shanks of tools according to this scope, which are manufactured before the date of its publication.

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 847-1:2017, *Tools for woodworking — Safety requirements — Part 1: Milling tools, circular saw blades*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 847-1:2017 and the following apply.

3.1
7/24 shank
SK
type of tool holder with a 7/24 cone ratio taper

3.2
hollow taper shank
HSK
type of tool holder with a short hollow taper with high positioning accuracy and high grade of rigidity that contacts the spindle on two surfaces

3.3
arbor
device to be mounted on the machine spindle interface and which is designed to carry bore type cutting tools

4 List of significant hazards

Table 1 shows the list of significant hazards.

Table 1 — List of significant hazards

Hazard according to EN ISO 12100:2010	**Condition or causes of hazard related to the tool**	**Corresponding clause of** EN 847–2
Mechanical hazards due to: Inadequacy of mechanical strength	Breaking of the tool	5
Vibration	Dynamic unbalance of tool	5
Variations in the rotational speed of tools	Breaking of the tool	5

5 Safety requirements

5.1 General requirements for cylindrical shank

The minimum value for the clamping length $l_{e\,min}$ shall be as given in Table 2.

Table 2 — Minimum clamping length $l_{e\,min}$

$d_2 \leq 10$ mm	10 mm < d_2 < 25 mm	$d_2 \geq 25$ mm
$l_{e\,min}$ = 20 mm	$l_{e\,min} = 2 \cdot d_2$ (mm)	$l_{e\,min} = 1{,}8 \cdot d_2$ (mm)

The tolerance of the shank diameter d_2 shall be h6 for $d_2 \geq 12$ mm and h8 for $d_2 < 12$ mm.

5.2 Stability of the shank of shank mounted tools

5.2.1 General

For descriptions of symbols for the stability of the shank of shank mounted tools, see Table 3.

Table 3 — Stability of the shank of shank mounted tools — Symbols and units

Symbol	Description	Unit
d	diameter a) shank diameter d_2 b) cone diameter d_3 c) with axial force: d_4 (calculated); without axial force: d_{arbor}	mm
d_{cut}	maximum diameter of the cutting part	mm
d_2	shank diameter, see Figure 2	mm
d_3	cone diameter, see Figure 3	mm
d_4	calculated hub diameter, see Figure 4	mm
d_{arbor}	shank diameter of the arbor, see Figure 4	mm
E	modulus of elasticity of the shank material	N mm^{-2}
e_{sp}	maximum permissible eccentricity at clamping device	mm
f	form factor	—
f_s	safety factor (f_s = 4)	—
F_a	axial clamping force, see Figure 4	N
G	balance quality grade of the tool set (individual tools, arbor, spacers, HSK): product of the permissible eccentricity and the angular velocity according to EN 847–1:2017	mm s^{-1}
I	second moment of area	mm^4
l_{cut}	height of cutting part	mm
l_0	free shank length	mm
$l_1, l_2, l_3, ...$	axial distance of the gravity centre of the mass $m_1, m_2, m_3, ...$	mm
l_s	axial distance of gravity centre, see Figure 1	mm
l_e	clamping length	mm
l_g	total length of shank	mm
$m_1, m_2, m_3, ...$	mass of the parts of the tool set, see Figure 1	g
m_{cut}	mass of the cutting part in the area of l_{cut}, see Figure 2	g
m^*	mass of the tool in the area ($l_0 + l_{cut}$)	g
m_{cut}^*	reduced mass of the cutting part, see Figure 2	g
n	operational speed	min^{-1}
n_{shank}	maximum permissible rotational speed with regard to shank strength	min^{-1}
S	centre of gravity	—

W	section modulus	mm^3
σ_w	fatigue strength under reversed bending stresses of shank material	$N\ mm^{-2}$
ρ	density of material (e.g. shank, tool body, spacers)	$g\ mm^{-3}$

The maximum permissible rotational speed of shank mounted tools n_{shank} shall be calculated referring to the shank strength.

For calculation of n_{shank} with a given e_{sp} the following formula applies:

$$n_{shank} = \frac{30}{\sqrt{f_s} \cdot \pi} \cdot \frac{-G + \sqrt{G^2 + \frac{W \cdot \sigma_w}{m^* \cdot l_s} \cdot \left(e_{sp} + \frac{W \cdot \sigma_w \cdot l_s^2}{3 \cdot E \cdot I} \right) \cdot 10^6}}{e_{sp} + \frac{W \cdot \sigma_w \cdot l_s^2}{3 \cdot E \cdot I}} \quad (1)$$

with

$$I = \pi \cdot \frac{d^4}{64} \quad (2)$$

$$W = \pi \cdot \frac{d^3}{32} \quad (3)$$

For balance quality, see EN 847-1:2017.

Better balance quality grades for tools or tool sets may be applied, if these can be permanently maintained due to the tool design.

NOTE 1 The safety requirements for the shank strength are fulfilled when, using the given tool sizes and material characteristics with defined free shank length l_0, gravity centre displacement e_{per} and eccentricity at clamping device e_{sp}, the maximum permissible rotational speed for the shank n_{shank} is not exceeded during operation. The cutting force is not significant in comparison with the centrifugal force. Therefore, the cutting force has not been taken into account.

For the determination of the maximum rotational speed n_{max} of shank mounted tools the lower value of either

- n_{shank} (maximum speed value for the shank strength) and

- n_{max} (strength against centrifugal force in accordance with EN 847-1:2017)

shall be considered.

NOTE 2 If the value of the axial distance of gravity centre l_S is unknown, l_S can be determined approximately according to the example as shown in Figure 1 and Formula (4).

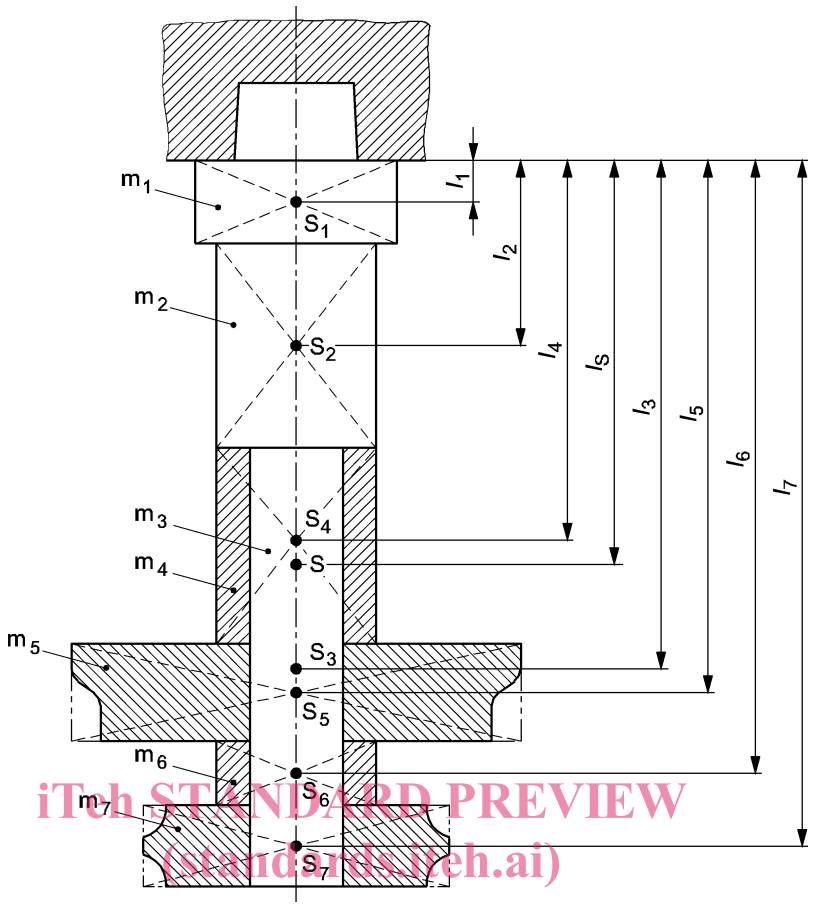

Figure 1 — Distances of the gravity centres of the tool components

$$l_s = \frac{m_1 \cdot l_1 + m_2 \cdot l_2 + m_3 \cdot l_3 + m_4 \cdot l_4 + m_5 \cdot l_5 + m_6 \cdot l_6 + m_7 \cdot l_7}{m_1 + m_2 + m_3 + m_4 + m_5 + m_6 + m_7} \quad (4)$$

5.2.2 Cutting tools with cylindrical shank

For cutting tools with cylindrical shank the maximum permissible rotational speed n_{shank} shall be calculated referring to the shank strength in the mounted position in a clamping device with quantities and units as shown in Figure 2 and Table 3.