Machining recommendation

Duropal XTreme

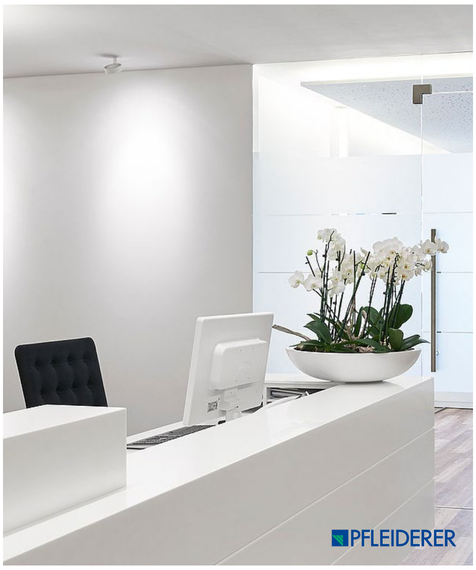
Machining of Duropal XTreme panels

Introduction
When machining Duropal XTreme by sawing, milling, grooving and boring, ensure that suitable tools and machining parameters are selected. The wrong choice of tools and their conditions of use can lead to beading, unacceptable heating or even melting of the workpiece surface and damage. This machining guideline provides recommendations for the optimum machining of this panel material without claiming to be exhaustive.

General machining guidelines
When machining Duropal XTreme panels, the reference values from the table for the selection of the cutting speed (v_c) and the tooth feed rate (f_z) should be observed, depending on the machining method.

Machining method	Cutting speed v_c [m/s]
Sawing	60 - 90
Hogging	60 - 80
Cutting	50 - 70
Routing	10 - 35

Machining method	Tooth feed rate f_z [mm]
Sawing	0.02 - 0.12
Hogging	0.12 - 0.18
Cutting	0.30 - 0.55
Routing	0.15 - 0.25



These parameters are in relation to the tool diameter (D), number of teeth (Z), RPM (n) and feed speed (v_f) used on the processing machine. The right selection of these factors is responsible for a good machining result.

The following formulas apply to the calculation of cutting speed, tooth feed rate and feed speed:

v_c – Cutting speed [m/s]
$v_c = D \cdot \pi \cdot n / 60 \cdot 1000$
D – Tool diameter [mm]
n – RPM of tool [min^{-1}]

f_z – Tooth feed rate [mm]
$f_z = v_f \cdot 1000 / n \cdot z$
v_f – Feed speed [m/min]
n – RPM of tool [min^{-1}]
z – Number of teeth

v_f – Tooth feed rate [m/min-1]
$v_f = f_z \cdot n \cdot z / 1000$
f_z – Feed speed [mm]
n – RPM of tool [min^{-1}]
z – Number of teeth

Cutting material
Basically, both tools with carbide cutting edges (HW) and diamond cutting edges (DP diamond polycrystalline) can be used. The use of tools with diamond cutting edges (DP) is recommended in order to extend the tool life at high cutting volume.

Cutting the panels with circular sawblades

General note:

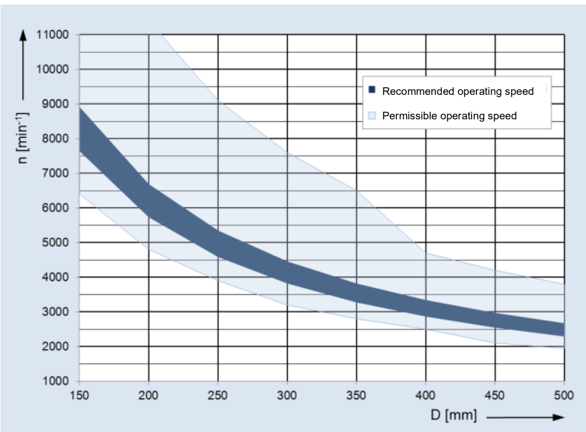
- Visible side upwards
- Make sure that the sawblade protrudes correctly (see table)
- Adjust RPM and number of teeth to feed speed
- The use of a scoring sawblade is recommended for precise cuts on the bottom side of the panel

Depending on the sawblade protrusion, the entry and exit angle and thus the quality of the cutting edge change. If the top cutting edge becomes rough, set the circular sawblade higher. If the cut on the bottom side is rough, the circular sawblade must be set lower. In this way the most favourable height setting must be determined.

The following sawblade protrusions (Ü) must be set for sizing and panel sizing saws, depending on the diameter (D):

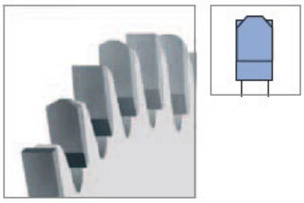
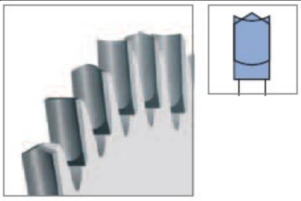
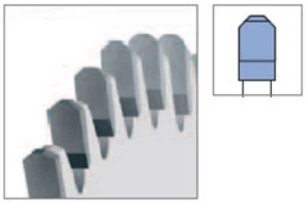
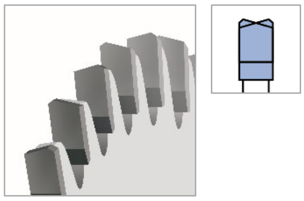
Circular sawblade diameter D [mm]	Protrusions Ü [mm]
250	ca. 5 - 10
300	
350	ca. 8 - 12
400	
450	ca. 10 - 15

Circular sawblades with a high number of teeth are generally recommended for good machining quality.
For circular sawing, the recommended cutting speed v_c is 60 - 80 m/s. For diamond-tipped circular sawblades, the cutting speed can be increased up to v_c 90 m/s.



Speed diagram – depending on the circular sawblade diameter

Recommended tooth shapes

			
FZ/TR (square/trapezoidal teeth)	HZ/DZ (hollow face/inverted V teeth)	TR/TR (trapezoidal/trapezoidal teeth)	WZ/FA (alternating tooth/ bevel)

The tooth shapes FZ/TR, HZ/DZ as well as TR/TR are suitable for cutting to size. The tooth shape WZ/FA with special tooth geometry is suitable for sizing when higher quality requirements are placed on the cutting edge.

Sizing sawblades

Good cutting results and tool life are achieved with the saw tooth shapes HZ/DZ and FZ/TR. With the tooth shape WZ/FA with special tooth geometry, very good cutting results of the cover foil are achieved, but a reduction in tool life must be expected.

Panel sizing sawblades

With tooth shape TR/TR, good cutting results and tool life are achieved. With tooth shape WZ/FA with special tooth geometry, very good cutting results of the cover foil are achieved, but a reduction in tool life must be expected.

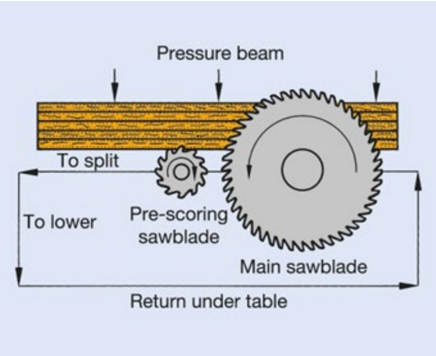
Sizing saws and panel sizing saws with scoring unit and pressure beam

Scoring sawblades

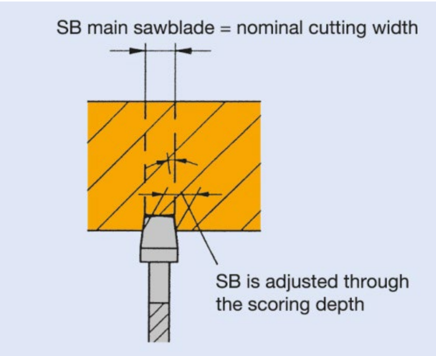
For coated workpieces, the use of a scoring unit is recommended to achieve a good cutting edge quality on the tooth exit side. The cutting width of the scoring sawblade must be set slightly larger than that of the main circular sawblade so that the exiting tooth of the main saw can no longer touch the cutting edge. Since a secure, flat support of the workpieces is only guaranteed with pressure equipment, divided scoring circular sawblades are used on table and sizing saws.

Machining recommendation

Duropal XTreme



Panel sizing system with scoring unit and pressure device



Application diagram of conical scoring sawblade. When maintaining the tools (always in sets), the cutting widths must be matched to each other.

Circular sawblades for sizing saws and circular table saws (TC-tipped)
The following circular sawblades are suitable for cutting on table and sizing saws.

D [mm]	SB [mm]	TDI [mm]	BO [mm]	NLA	Z	ZF	SW °	ID
250	3.2	2.2	30	KNL	80	FZ/TR	10	**163003**
300	3.2	2.2	30	KNL	96	FZ/TR	10	**163006**
350	3.5	2.5	30	KNL	108	FZ/TR	10	**163008**
220	3.2	2.2	30	KNL	42	HZ/DZ	10	**163050**
250	3.2	2.2	30	KNL	48	HZ/DZ	10	**163051**
303	3.5	2.5	30	KNL	60	HZ/DZ	10	**163052**
350	3.5	2.5	30	KNL	72	HZ/DZ	10	**163053**

Other dimensions available on request

Circular sawblades for panel sizing saws (TC-tipped)
The following RazorCut PLUS circular sawblades are suitable for cutting on panel sizing saws.

Machine	D [mm]	SB [mm]	TDI [mm]	BO [mm]	NLA	Z	ZF	SW °	ID
	300	4.4	3.0	30	KNL	60	TR/TR	15	**161137**
Holz-Her, Mayer, Schelling	350	4.4	3.2	30	KNL + 2/13/94	72	TR/TR	15	**161149**
Homag	350	4.4	3.2	60	2/14/100	72	TR/TR	15	**161150**
Giben	350	4.4	3.2	75	-	72	TR/TR	15	**161151**
Selco	355	4.4	3.2	80	2/9/130 + 4/19/120	72	TR/TR	15	**161153**
Giben	380	4.4	3.2	50	4/13/80	72	TR/TR	15	**161157**
Homag	380	4.8	3.5	60	2/14/100 + 2/14/125	72	TR/TR	15	**161159**

Machining recommendation

Duropal XTreme

Machine	D [mm]	SB [mm]	TDI [mm]	BO [mm]	NLA	Z	ZF	SW °	ID
SCM, Gabbiani, Selco	400	4.4	3.2	80	2/14/110 + 2/7/110 + 4/9/100 + 4/19/120 + 2/9/130	72	TR/TR	15	**161163**
SCM, Gabbiani, Selco	430	4.4	3.2	80	2/14/110 + 2/7/110 + 4/9/100 + 4/19/120 + 2/9/130	72	TR/TR	15	**161167**
Mayer, Schelling	450	4.4	3.2	30	KNL + 2/13/94	72	TR/TR	15	**161168**
Homag	450	4.8	3.5	60	2/14/125 + 2/19/120	72	TR/TR	15	**161169**
Schelling	460	4.4	3.2	30	2/13/94	72	TR/TR	15	**161170**

Other dimensions available on request

Panel sizing with circular sawblades is basically to be understood as pre-machining. In order to create an optimal surface for edging and a break-out-free decorative edge, the saw cut must be reworked using a hogger or jointing cutter as described in the next chapter.

Circular sawblades for cutting HPL laminated panels (approx. 0.8 mm) and coated panels without reworking

With the following BrillianceCut circular sawblades, an optimal finish saw cut of the cover foil is achieved. However, a reduced tool life must be expected. The workpieces produced in this way can be processed directly without an additional work step.

Machine	D [mm]	SB [mm]	TDI [mm]	BO [mm]	NLA	Z	ZF	SW °	ID
Altendorf, Martin, Striebig	303	3.5	2.5	30	KNL	60	TR/TR	10	**161028**
HolzHer, Panhans, Schelling	350	4.4	3.2	30	KNL	72	WZ/FA	15	**161029**
Holzma	350	4.4	3.2	60	2/14/100	72	WZ/FA	15	**161030**
Holzma	380	4.8	3.5	60	2/14/100 + 2/14/125 + 2/19/120	84	WZ/FA	15	**161031**
Panhans, Schelling	400	4.4	3.2	30	KNL	72	WZ/FA	15	**161032**
Scheer, Schelling	450	4.4	3.2	30	KNL	72	WZ/FA	15	**161033**
Holzma	450	4.8	3.5	60	2/14/125 + 2/19/120	72	WZ/FA	15	**161034**

Other dimensions available on request

Machining recommendation

Duropal XTreme

Jointing on table milling machine or throughfeed systems

Cutterheads with TC turnblade knives or diamond-tipped cutters are always suitable for machining Duropal XTreme panels. In order to create break-out-free edges on the top layers of the panel, jointing tools with an alternating shear angle should be used. Standard tools with a 30° shear angle are recommended. For large output quantities in industrial use, special tools with 15° shear angle should be used. Sizing tools with a higher number of teeth (Z) compared to standard tools tend to provide better cutting quality. Furthermore, ensure a low chip removal between 0.7 to 2.0 mm to reduce tool wear.

Only tools marked “MAN” or “BG-Test” may be used when working with manual feed on table milling machines. Furthermore, for safety reasons, the speed range specified on the tool must not be exceeded or fallen short of. The tools for manual feed may only be used when running against the feed.

Advantageous for good cutting results is the use of tools with high concentricity and balance quality, which is achieved by using centring interfaces such as hydro clamping systems, HSK holders or shrinking systems.

Tool examples:

DP-jointing cutter WhisperCut

DP-WhisperCut EdgeExpert

DP-jointing cutter with fixed tipping

DP-jointing cutter EdgeExpert

The application parameters of the jointing cutters should be selected so that the tooth feed (f_z) is between 0.25 and 0.65 mm.

Machining recommendation

Duropal XTreme

Dimensions DxSBxBO [mm]	RPM n [min^{-1}]	No. of teeth Z	Feed speed v_f [m/min]	ID			Machine
				HW Turnblades	WhisperCut DP	Fixed cutters DP	
100x56x30 100x43x30	12,000	3	10 - 18	**LH 024692 RH 024691**	**LH 090885 RH 090886**		Brandt, IMA, Stefani, SCM
125x43x30	9,000	3	10 - 15	**LH 024685 RH 024685**	**LH 075627 RH 075627**		HOMAG, Biesse
125x43x30	9,000	3	10 - 15		**LH 192094 RH 192095**		IMA
125x32x30	9,000	3	10 - 15			**LH 192092 RH 192093**	IMA
180x43x35	6,000	4	15 - 20			**LH 090841 RH 090842**	IMA, HOMAG
180x43x35	6,000	6	15 - 20			**LH 192056 RH 192057**	IMA, HOMAG
180x34x35	6,000	8	20 - 25			**LH 192060 RH 192061**	IMA, HOMAG
200x16-30x35	6,000	4	10 - 15			**LH 192010 RH 192010**	KAL, Double-end tenoner
200x16-30x35	6,000	6	15 - 20			**LH 192011 RH 192011**	KAL, Double-end tenoner
200x16-30x35	6,000	8	20 - 25			**LH 192066 RH 192066**	KAL, Double-end tenoner
200x16-30x35	6,000	10	30 - 35			**LH 192108 RH 192109**	KAL, Double-end tenoner

Other dimensions and numbers of teeth available on request

Machining recommendation

Duropal XTreme

Hoggers for throughfeed machines

Diamond compact hoggers, which generate little friction and cutting pressure, are recommended. The Leitz Diamaster DT Premium type mounted on a hydraulic clamping element is particularly suitable for maximum radial and axial runout and excellent machining quality and long tool life. The cutting speed (v_c) is 80 m/s at the usual speed (n) 6000 min^{-1} and diameter (D) 250 mm. The application parameters and the number of teeth of the hoggers should be selected so that the tooth feed (fz) is between 0.12 - 0.18 mm.

Dimensions DxSBxBO [mm]	RPM n [min^{-1}]	No. of teeth Z	Feed speed v_f [m/min]	ID, DT Premium mounted on hydro clamping element for spindle HF40		Machine
				LH	RH	
250x10x60	6,000	24	30	**190382**	**190383**	Edge banding machines, double-end tenoner
250x10x60	6,000	36	40	**190390**	**190391**	Edge banding machines, double-end tenoner
250x10x60	6,000	48	50	**190398**	**190399**	Edge banding machines, double-end tenoner
250x10x60	6,000	60	80	**190406**	**190407**	Edge banding machines, double-end tenoner

Other dimensions available on request

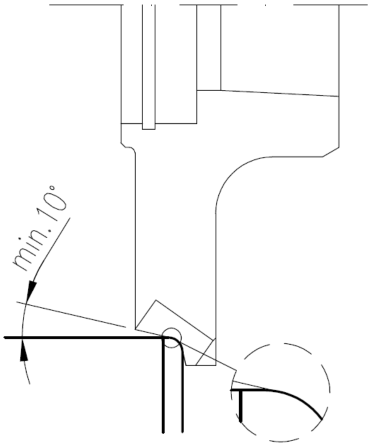
Leitz DT Premium hogger

Edge processing on edge banding machines

Radii cutters and scrapers on edge banding machines must be set so that the tools do not touch the tool material. For panels with protective foil, the foil must not be damaged.

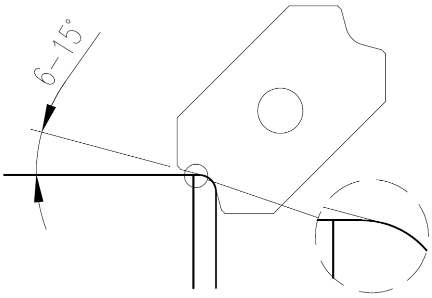
Radii cutter / bevel cutter

Radii cutters should have a profile run-out of at least 10°. The setting of the radius and bevel cutters must be selected so that there is only contact with the edge.



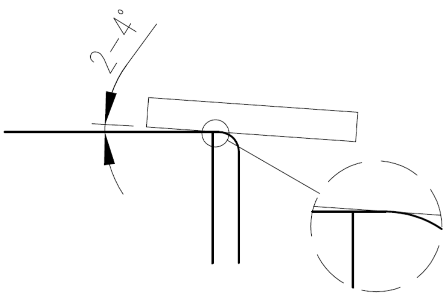
Profile scrapers

Profile scrapers are equipped with a profile relief and can easily be used for finishing the Duropal XTreme panels with exact adjustment. To avoid possible damage to the protective foil or decorative layer, scrapers with an enlarged profile run-out of up to 15° are recommended.



Flat scrapers

Flat scrapers should preferably have an inclination of 2 - 4° from the edge to the plate and should not touch the protective foil and decorative layer.



All dimensions available on request

Machining recommendation

Duropal XTreme

Groove processing

For grooving, tools with a high number of teeth should preferably be selected for optimum edge quality. The tooth feed rate (f_z) should be in the range of 0.03 - 0.06 mm when machining with feed (GLL).

CNC Machining Centres

Spiral solid carbide cutters (VHW) or preferably diamond tipped (DP) routers are best suited for machining on router and machining centres.

In order to produce break-out-free edges on the top layers of the panel, DP routers with a spiral-shaped cutting arrangement with alternating shear angle are to be used. It is advantageous to use routers with an increased shear angle (>30°). When machining Duropal XTreme panels, it is particularly recommended to use the Leitz Diamaster EdgeExpert routers with a large shear angle of up to 50° for the best edge quality, such as for zero-joint edging.

Sizing tools with a higher number of teeth compared to standard tools generally tend to offer better cutting quality. Pre-milling of the workpieces is recommended to reduce tool wear during finish machining due to the low chip removal (between 0.5 to 2.0 mm).

Good workpiece clamping on the machine must be ensured. To support the vacuum suction devices, additional mechanical clamping elements can be used if necessary. We recommend stable und rigid Leitz ThermoGrip® shrink chucks for maximum concentricity and balance quality, for perfect cutting quality. A good machining result can only be achieved with sufficient rigidity of the machine, such as on gantry machines.

Recommended application data:
RPM n = 18,000 - 24,000 min^{-1}

Feed speed
v_f = 8-10 (Z2) and 14-18 (Z3) m^{-1}
v_f = 20-24 (Z2 Nesting) m^{-1}

Tooth feed rate
f_z = 0.15-0.25 mm
f_z = 0.40-0.60 mm (Nesting)

Machining recommendation

Duropal XTreme

Diamond tipped shank router cutters

D [mm]	NL [mm]	S [mm]	No. of teeth Z	Direction of rotation	Version	ID
16	28	20	2+2	RH	Diamaster PRO	**191042**
20	28	20	2+2	RH	Diamaster Quattro	**091235**
20	28	20	3+3	RH	Diamaster PLUS³	**191051**
12	24	12	2+2	RH	Diamaster PRO, Nesting	**191060**
20	32	20	2+2	RH	Diamaster Quattro EdgeExpert	**191071**
20	48	25	2+2	RH	Diamaster Quattro EdgeExpert	**191072**
25	30	25	3+3	RH	Diamaster PLUS³ EdgeExpert	**191073**
25	35	25	3+3	RH	Diamaster PLUS³ EdgeExpert	**191074**
25	48	25	3+3	RH	Diamaster PLUS³ EdgeExpert	**191075**

Other dimensions available on request

Machining examples

Machining recommendation

Duropal XTreme

Bohren

Boreholes tend to flare and fray slightly due to the surface finish of the coating. In principle, therefore, only sharp drills with a cutting edge geometry should be used.

Drilling on the opposite side is possible without tearing. For drilling, carbide-tipped or preferably twist, dowel hole and hinge boring bits made of solid carbide (VHM) are recommended.

On CNC machining centres, it is advisable to use the drills in the main spindle instead of in the drilling beam, due to the higher stability and the possibility of drilling at higher speeds.

Dowel drills

RPM n [min^{-1}]	4,000 - 6,000
Feed speed v_f [m/min]	0.5 - 2.0

Through-hole boring bits

RPM n [min^{-1}]	4,000 - 6,000
Feed speed vf [m/min]	0.5 - 1.0

Hinge boring bits

RPM n [min^{-1}]	3,000 - 4,500
Feed speed v_f [m/min]	0.5 - 2.0

Performance times

Tool performance times are influenced by a variety of factors, so that no performance time statements or rights can be derived within the scope of this machining guideline. The information on the tools and machining parameters are recommended guide values. Machine or process constellations can lead to deviating parameters. An optimal adaptation of machine, tool and material as well as customer-specific requirements can only be carried out on site together with a Leitz application engineer.

Machining recommendation

Duropal XTreme

Explanation of abbreviations

A	=	dimension A
a_e	=	cutting thickness (radial)
a_p	=	cutting depth (axial)
ABM	=	dimension
APL	=	panel raising length
APT	=	panel raising depth
AL	=	working length
AM	=	number of knives
AS	=	anti sound (low noise design)
b	=	overhang
B	=	width
BDD	=	thickness of shoulder
BEM	=	note
BEZ	=	description
BH	=	tipping height
BO	=	bore diameter
CNC	=	Computerized Numerical Control
d	=	diameter
D	=	cutting circle diameter
D0	=	zero diameter
DA	=	outside Diameter
DB	=	diameter of shoulder
DFC	=	Dust Flow Control (optimised chip clearance)
DGL	=	number of links
DIK	=	thickness
DKN	=	double keyway
DP	=	polycrystalline diamond
DRI	=	rotation
FAB	=	width of rebate
FAT	=	depth of rebate
FAW	=	bevel angle
FLD	=	flange diameter
f_z	=	tooth feed
$f_{z\,eff}$	=	effective tooth feed
GEW	=	thread
GL	=	total length
GS	=	Plunging edge
H	=	height
HC	=	tungsten carbide, coated
HD	=	wood thickness (thickness of workpiece)
HL	=	high-alloyed tool steel
HS	=	high-speed steel (HSS)
HW	=	tungsten carbide (TCT)
ID	=	ident number
IV	=	insulation glazing
KBZ	=	abbreviation
KLH	=	clamping height
KM	=	edge breaker
KN	=	single keyway
KNL	=	combination pinhole consists of 2/7/42 2/9/46,35 2/10/60
L	=	length
I	=	clamping length
LD	=	left hand twist
LEN	=	Leitz standard profiles
LH	=	left hand rotation
M	=	metric thread
MBM	=	minimum order quantity
MC	=	multi-purpose steel, coated
MD	=	thickness of knife
min^{-1}	=	revolutions per minute (RPM)
MK	=	morse taper
$m\ min^{-1}$	=	metres per minute
$m\ s^{-1}$	=	metres per second
n	=	RPM
$n_{max.}$	=	maximum permissible RPM
NAL	=	position of hub
ND	=	thickness of hub
NH	=	zero height
NL	=	cutting length
NLA	=	pinhole dimensions
NT	=	grooving depth
P	=	profile
POS	=	cutter position
PT	=	profile depth
PG	=	profile group
QAL	=	cutting material quality
R	=	radius
RD	=	right hand twist
RH	=	right hand rotation
RP	=	radius of cutter
S	=	shank dimension
SB	=	cutting width
SET	=	set
SLB	=	slotting width
SLL	=	slotting length
SLT	=	slotting depth
SP	=	tool steel
ST	=	Cobalt-basis cast alloys, e.g. Stellit®
STO	=	shank tolerance
SW	=	cutting angle
TD	=	diameter of tool body
TDI	=	thickness of tool
TG	=	pitch
TK	=	reference diameter
UT	=	cutting edges with irregular pitch
V	=	number of spurs
v_c	=	cutting speed
v_f	=	feed speed
VE	=	packing unit
VSB	=	adjustment range
WSS	=	workpiece material
Z	=	number of teeth
ZA	=	number of fingers
ZF	=	tooth shape (cutting edge shape)
ZL	=	finger length

In this machining recommendation, corresponding parameters for optimum machining of the designated materials are presented. The information on tools and machining parameters are guideline values without any claim to completeness or general validity. Machine or process-related marginal conditions can lead to deviating application parameters. Individual adjustments may be necessary in individual cases. In particular, the respective manufacturer's information on the intended use of the machine, tool and material must be observed. No rights can be derived from this machining recommendation. For solutions to complex tasks, please contact our technical advisor.

The information is based on the current state of the art and has been prepared with particular care and to the best of our knowledge. Due to continuous technical development as well as new standards and laws, technical changes may occur.