Machining of stainless steel laminated materials

During the last two years a new composite material laminated with stainless steel has been developed. The laminate is a 0,05 to 0,1 mm thin stainless steel foil, connected to an HPL-layer. There are smooth, brushed as well as decoratively structured surfaces available. These layers can be deposited onto different carrier panels (chipboard, MDF, Multiplex, etc.). Application areas for example are fronts for carcass furniture, laboratory equipment or floor panels.

Tools and application parameters have to be adjusted especially for machining the stainless steel laminate, as this considerably influences tool wear. The standard values valid for machining laminated board materials cannot be applied in this case. The main machining problem when using wood working machines is that coolant is not available. Therefore the cutting speed has to be decreased on a very low level compared to the conventional wood machining parameters.

Tungsten carbide blades create burfree edges at the stainless steel laminate when they are used with low cutting speeds (lower than 10 m/s) and comparably large feed rates per tooth (larger than 0,5 mm).

Diamond cutting edges are not suitable, as they break early due to the chemical affinity of carbon to the stainless steel layer.

Cutting with feed goes along with less chip compression, than cutting against feed. The result is: less generation of heat, less wear of the cutting edges and a better quality of the machined steel edges. Notice: due to safety reasons, cutting with feed is only allowed in case of working with mechanical feed.

In the following the basic rules for machining stainless steel laminated materials as well as the most important applications are explained exemplarily.

Attention:
Due to the arising sharp steel edges and the small possibly hot chips, gloves and protection glasses have to be worn necessarily!

Tools (T): • **available ex stock** □ **available at short notice**

Circular saw blades

Tools:

Sizing of carrier panels with stainless steel coating, AS-OptiCut UT **WK 872-2-87**

D (mm)	**SB/TDI** (mm)	**BO** (mm)	**BO max.** (mm)	**FLD** (mm)	**Z**	**Leitz ID-No.**	**T**	**Remark**
300	4,4/3,0	30	80	120	60	**069016**	•	Toothshape: FZ/TZ
350	4,4/3,2	30	100	120	72	**069018**	•	Toothshape: FZ/TZ
For thicker stainless steel foils (0,1mm) special tooth form TZ/TZ								

Sizing of stainless steel foil on HPL **WK 452-2-37**

D (mm)	**SB/TDI** (mm)	**BO** (mm)	**BO max.** (mm)	**FLD** (mm)	**Z**	**Leitz ID-No.**	**T**	**Remark**
300	3,2/2,6	30	80	120	96	**059951**	•	Tooth: FZ/TZ

Application data: n = 3.000 to 5.000 min^{-1} v_f = 3 to 5 m/min

Machining Recommendations:

- Stainless steel coating towards the top (leading-in side of the sawblade),
- **Splitting and scoring on double end tenoners resp. edging machines with mechanical feed rate:** This working step should be necessarily effected with feed, as the tool cutting edges wear too fast in case of cutting against feed.
- **Saw benches with MAN-feed:**
  Due to safety reasons, working steps have to be carried out only against feed!

Jointing / rebating on spindle moulders resp. double end tenoners

Tools:Rebating and jointing cutterhead **WW 420-1-01**

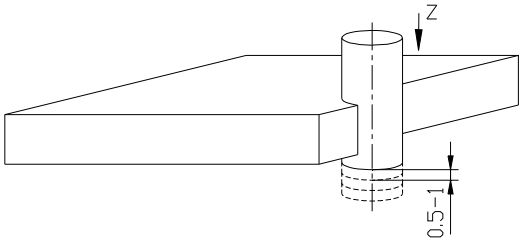
D (mm)	**SB** (mm)	**BO** (mm)	**BO max.** (mm)	**Z/V**	**ID-No.**	**T**	**Remark**
125	30,4	35	50	2/4	**024495**	•	
125	50,4	30	50	2/4	**024498**	•	
125	30,4	35	50	2/4	**162016145**	□	Reduced cutting angle
125	50,4	30	50	2/4	**162016146**	□	reduced cutting angle
Special knives:		30 x 12 x			**162016147**	□	Special TC
Special knives:		50 x 12 x			**162016148**	□	special TC

Application data: n = 1.000 min^{-1} v_f = 1 to 3 m/min

High RPM and less feed rates increase tool wear. $n_{max.}$ = 3.000 min^{-1} $v_{f\,max.}$ = 3 to 6 m/min

Machining Recommendations:

- Maximum chip release: a_e = 3 mm.
- **Double end tenoners, edging machines etc. with mechanical feed:** Working steps should be effected necessarily with feed, as the tool cutting edges wear too fast in case of cutting against feed. By stepwise axial adjustment of the tool from 0,5 to 1 mm, multiple performance times can be used at one cutting edge.
- **Spindle moulders with manual feed or roll feed device:** Work only against feed due to safety reasons!



Square trimming on CNC-machines

Tools for one-sided coating:

Spiral finishing router cutter, TC-solid, short design **WO 160-2-05**

D (mm)	**GL** (mm)	**NL** (mm)	**S** (mm)	**Z**	**Leitz-ID-No. RL**	**T**	**Remark**
16	100	40	16 x 50	3/RD	**042488**	•	stainl. steel coat. bottom
16	100	40	16 x 50	3/LD	**042489**	•	stainl. steel coat. top

Spiral finishing router cutter, TC-solid, long design **WO 160-2-05**

D (mm)	**GL** (mm)	**NL** (mm)	**S** (mm)	**Z**	**Leitz-ID-No. RL**	**T**	**Remark**
16	110	55	16 x 50	3/RD	**042464**	•	stainl. steel coat. bottom
16	110	55	16 x 50	3/LD	**042465**	•	stainl. steel coat. top
20	120	60	20 x 50	3/RD	**042466**	•	stainl. steel coat. bottom
20	120	60	20 x 50	3/LD	**042467**	•	stainl. steel coat. top

Tools for coating on both sides:

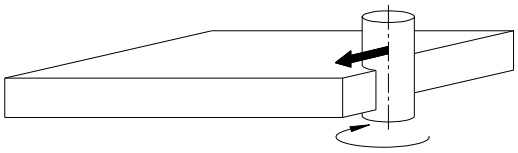
Spiral finishing cutter with reciprocal twist angle, TC-solid **WO 160-2-06**

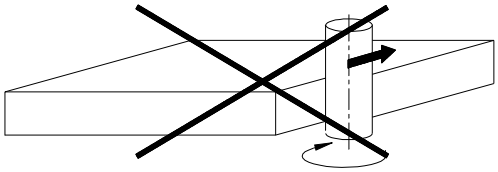
D (mm)	**GL** (mm)	**NL** (mm)	**S** (mm)	**Z**	**Leitz-ID-No. RL**	**T**	**Remark**
12	70	25	12 x 50	2 + 2	**042536**	•	stainl. steel on both sides
16	100	40	16 x 50	2 + 2	**042537**	•	stainl. steel on both sides
18	100	50	18 x 50	2 + 2	**042538**	•	stainl. steel on both sides

Application data: n = 2.000 to 3.000 min^{-1} v_f = 1,8 to 2,4 m/min

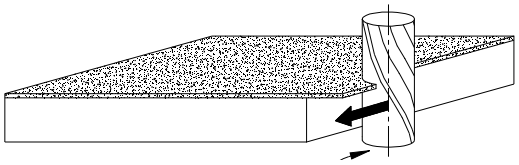
Machining Recommendations:

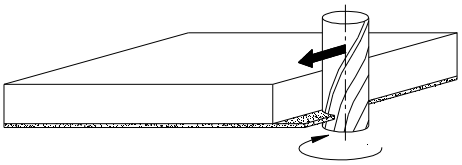
- Working should be effected necessarily with feed, as the tool cutting edges wear too fast in case of cutting against feed.



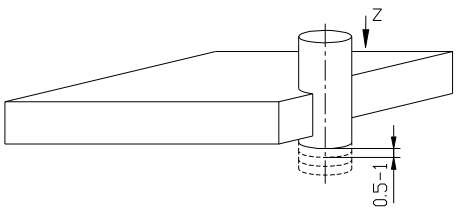


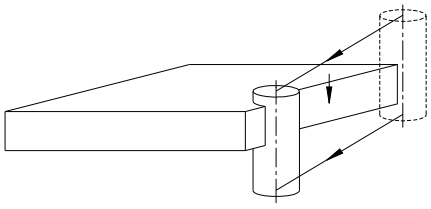
- The twist direction of the tool has to be chosen in that way, that the cutting edges always press the stainless steel coating against the carrier panel:
  Stainless steel coating top ⇒ negative twist,
  Stainless steel coating bottom ⇒ positive twist,
  Stainless steel coating on both sides ⇒ reciprocal twist.





- Gluing the stainless steel foil on the bearing board should be effected as exact as possible (max. protrusion 1 to 3 mm).
- The smaller the protrusion, the better the tool performance time.
- For increasing tool performance time, the cutter can be adjusted in Z-direction stepwise by 0,5 to 1 mm (2 D - resp. 2,5 D - steerings), or for every cutting path continually over the whole cutting length in Z-direction (3D - steerings).





Sizing / cut-outs / grooving / slotting on CNC-machines

Tools:

Spiral finishing router cutter with negative twist, TC-solid, short design **WO 160-2-03**

D (mm)	**GL** (mm)	**NL** (mm)	**S** (mm)	**Z**	**Leitz-ID-No. RL**	**T**	**Remark**
8	65	20	8 x 40	1/LD	**042732**	•	stainless steel top
10	70	20	10 x 40	1/LD	**042734**	•	stainless steel top
12	70	20	12 x 40	1/LD	**042736**	•	stainless steel top

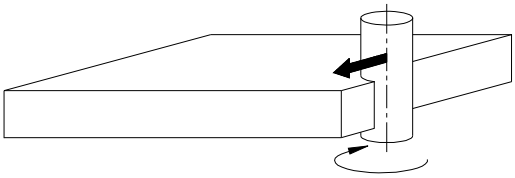
Spiral finishing router cutter with negative twist, TC-solid, long design **WO 160-2-03**

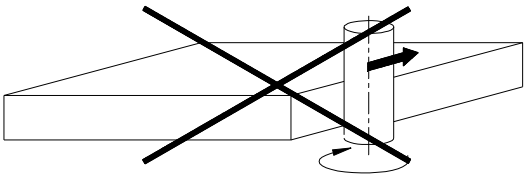
D (mm)	**GL** (mm)	**NL** (mm)	**S** (mm)	**Z**	**Leitz-ID-No. RL**	**T**	**Remark**
8	80	25	8 x 40	1/LD	**042746**	•	stainless steel top
10	90	32	10 x 40	1/LD	**042748**	•	stainless steel top
12	90	32	12 x 40	1/LD	**042750**	•	stainless steel top

Application data: **n = 2.000 to 3.000 min^{-1} v_f = 1,8 to 2,4 m/min**

Machining Recommendations:

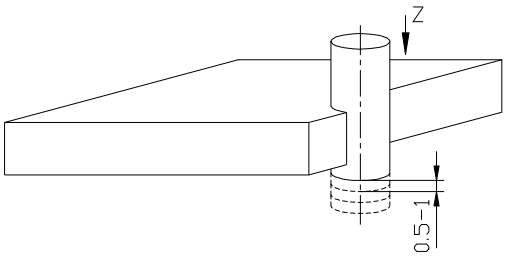
- Workpiece clamping with stainless steel coating towards the top. Working with negative twist.
- Working should be effected with feed if possible, as the tool cutting edges wear to fast in case of cutting against feed.
- Clamp the rest pieces to avoid break-outs of the cutting edges or tool breaks.

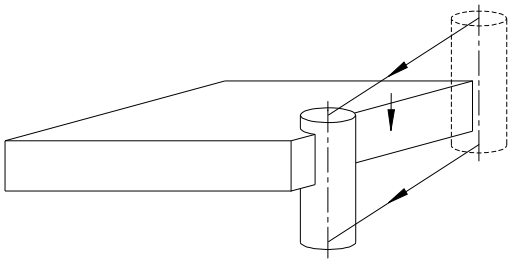




Cutting strategies for sizing:

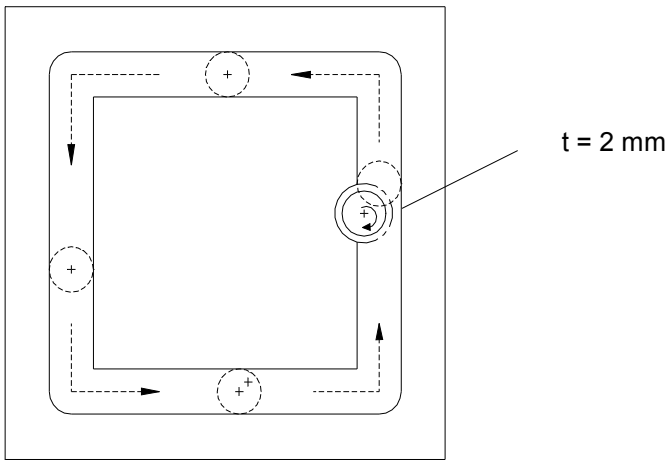
- During sizing (full cut) the good side of the workpiece should be worked with feed, because less burrs are created.
- As the wear is mainly caused by the stainless steel coating, multiple performance times can be reached by a stepwise adjustment of the cutter by 0,5 to 1 mm in Z-direction towards the bottom.





Cutting strategies for cutting cut-outs:

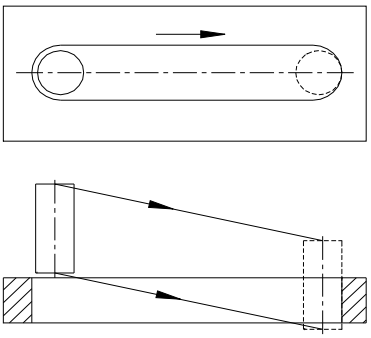
- First cut: Cut to the cut-out contour from inwards circularly and plunge to approx. 2 mm. – Good side with feed. With righthand rotation tools, cut anticlockwise circularly.
- Pre-cutting: Pre-cut the cut-out contour with feed with approx. 2 mm depth (Z-dimension) to finish dimension.

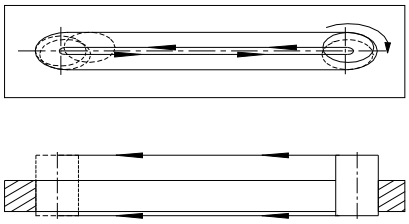


- Finish cutting: Adjustment in Z-direction to full cutting depth and finish cutting the cut-out.
- As the wear is mainly caused by the stainless steel coating, multiple performance times can be reached by stepwise adjustment of the cutter by 0,5 to 1 mm in Z-direction towards the bottom during pre- and finish cutting.

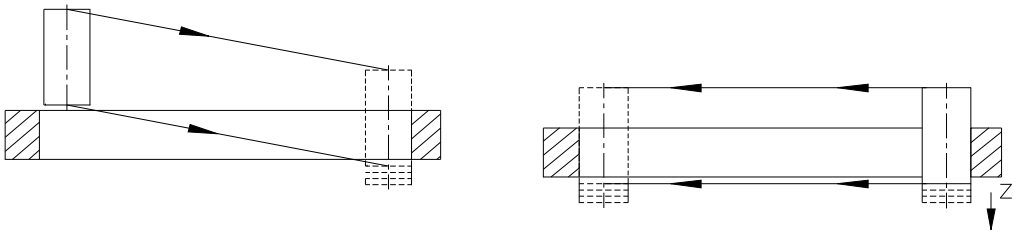
Cutting strategies for grooving / slotting:

- The tool diameter should be smaller than the groove resp. slotting width. First plunge to the complete cutting depth with the cutter along the groove resp. slotting middle. Then the groove resp. slot is cut to nominal size.
- In case of right-hand rotating tools the feed direction has to be anticlockwise.





- In case of bluntness of the cutter (creation of burrs at the plate edge), the plunging depth can be increased by 0,5 to 1 mm, as far as the cutting length allows.



Cutting spy-and keyholes / cutting hinges on CNC-machines

Tools:

Spiral finishing router cutter with negative twist, TC-solid, short design **WO 160-2-03**

D (mm)	**GL** (mm)	**NL** (mm)	**S** (mm)	**Z**	**Leitz-ID-No. RL**	**T**	**Remark**
8	65	20	8 x 40	1/LD	**042732**	•	stainless steel top
10	70	20	10 x 40	1/LD	**042734**	•	stainless steel top
12	70	20	12 x 40	1/LD	**042736**	•	stainless steel top

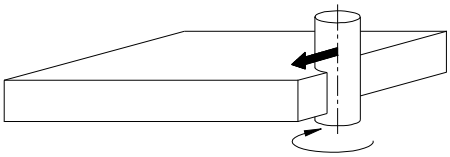
Spiral roughing cutter, TC-solid, for spy and keyholes **WO 160-2**

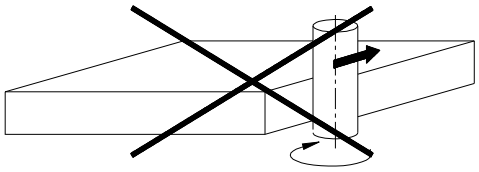
D (mm)	**GL** (mm)	**NL/AL** (mm)	**S** (mm)	**Z**	**Leitz-ID-No. RL**	**T**	**Remark**
10	95	45	1 0x 40	3	**042522**	•	stainless steel below
11,3	105	15/55	12 x 45	2	**042523**	•	stainless steel below
12	120	15/75	12 x 40	2	**042524**	•	stainless steel below
14	110	47/55	14 x 50	3	**042525**	•	stainless steel below
14	130	50/75	14 x 50	3	**042530**	•	stainless steel below
16	130	75	16 x 50	3	**042526**	•	stainless steel below

Application data: **n = 2.000 to 3.000 min^{-1} v_f = 1,8 to 2,4 m/min**

Machining Recommendations:

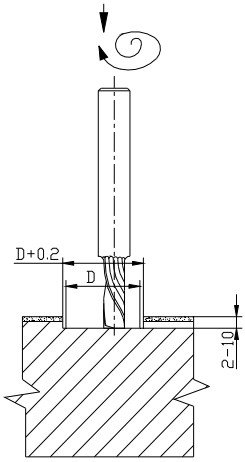
- In case of one-sided stainless steel coating, the workpiece clamping has to be effected with stainless steel side towards the top. Working with negative twist. If possible, the working step should be carried out with feed, as the tool cutting edges wear too fast in case of cutting against feed.



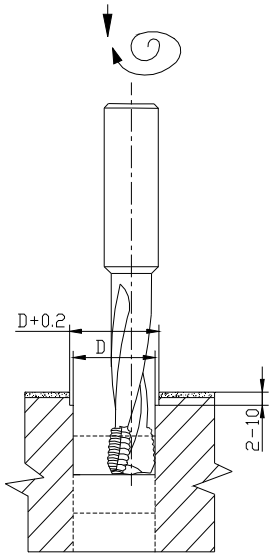


Cutting strategies for producing spy-resp. keyholes

- The tool diameter should be lower than the boring diameter
- Cut out circularly the bore with a spiral finishing router cutter WO 160-2-03 from the inner side with feed up to a depth of approx. 2 mm. The bore diameter should then be 0,2 mm larger than the nominal diameter.



- In case of bluntness of the cutter (creation of burrs at the boring edge), the cutting depth can be increased stepwise by approx. 0,5 to 1 mm from 2 mm to approx. 10 mm, to be able to use multiple running times of the cutter.
- Drill through centrically the remaining boring depth with the “spyhole” cutter WO 160-2 and then cut it out circularly with feed until the nominal diameter is reached (if the cutter diameter is smaller than the nominal diameter of the bore).



- This procedure can also be applied for boards coated with stainless steel on both sides.

Cutting strategies for producing hinge bores

- The tool diameter should be smaller than the boring diameter.
- Pre-cutting: Cut out the bore from the inner side with feed with spiral finishing router WO 160-2-03, until a depth of approx. 2 mm (Z-dimension) and the nominal diameter are reached.
- Finish cutting: Cut out the bore with spiral finishing router WO 160-2-03 from the inner side with feed, until the boring depth wanted and the nominal diameter are reached.
- As the wear is mainly caused by stainless steel coating, multiple running times can be reached by increasing stepwise the cutting depth during pre-cutting (adjusting the cutter by 0,5 to 1 mm in Z-direction towards below).

See figures production of spyholes.

Through-hole boring

Tools:

Through-hole boring bit „Marathon“

D (mm)	**GL** (mm)	**NL/AL** (mm)	**S** (mm)	**Z**	**ID-No. LL**	**T**	**ID-No. RL**	**T**	**Remark**
5	57,5	25	10 x 25	2	**033960**	•	**033961**	•	stainl. steel both sides
5	70	35	10 x 25	2	**033964**	•	**033965**	•	stainl. steel both sides
8	57.5	25	10 x 25	2	**033962**	•	**033963**	•	stainl. steel both sides
8	70	35	10 x 25	2	**033966**	•	**033967**	•	stainl. steel both sides

Application data: n = 3.000 to 4.500 min^{-1} v_f = 0,7 to 1 m/min

Machining Recommendations:

- The situation of the stainless steel coating (top / bottom) does not influence the boring quality.

Hinge boring

Tools:

D (mm)	**GL** (mm)	**L** (mm)	**S** (mm)	**Z**	**Leitz-ID-No. RL**		**Remark**
35	57	54.5	10 x 26	2	130040142	□	Special boring bit

Application data: n = 1.400 to 1.500 min^{-1} v_f = 0,7 to 1 m/min, in foil area approx. 0,2 m/min

Machining Recommendations:

- Careful plunging until the stainless steel foil is cut, than cut out with normal feed until the full boring depth is reached.

Square trimming / bevelling with portable routers

Tools:

Square trimmer turnblade design with ball bearing guide ring D15.88mm WL 220-1

D (mm)	**GL** (mm)	**NL** (mm)	**S** (mm)	**Z**	**Leitz-ID-No. RL**	**T**	**Remark**
15.88	60	6.35	8 x 35	2	40776	•	plate protrusion 0,5 mm

Bevelling cutter turnblade design 22° with ball bearing guide ring D15.88mm WL 320-1

D (mm)	**GL** (mm)	**NL** (mm)	**S** (mm)	**Z**	**Leitz-ID-No. RL**	**T**	**Remark**
20	60	5.5	8 x 35	2	40775	•	square trimming before

Square trimmer turnblade design without ball bearing guide ring **WL 200-1**

D (mm)	**GL** (mm)	**NL** (mm)	**S** (mm)	**Z**	**Leitz-ID-No. RL**	**T**	**Remark**
15.88	60	6.35	8 x 35	2	**40776**	□	plate protrusion 0,5 mm

Bevelling cutter turnblade design 22° without ball bearing guide ring **WL 300-1**

D (mm)	**GL** (mm)	**NL** (mm)	**S** (mm)	**Z**	**Leitz-ID-No. RL**	**T**	**Remark**
20	60	5.5	8 x 35	2	**40775**	□	square trimming before

Replacement parts :

Description:	ABM				**T**	
Turnblades	6.4/2.38			**9526**	•	
Clamping screw	M2.5			**6092**	•	
Ball bearing:	15.88 x 5 x 6.35			**8081**	•	

Application data: **n = 3.000 to 8.000 min^{-1} v_f = 2 to 5 m/min**

Machining Recommendations:

- Apply a portable router with adjustable RPM and adjust it to the minimum step. RPM of n = 3.000 min^{-1} and a feed speed v_f = 2 m/min are most favourable. In case of adjustable portable routers, the minimum RPM is n = 7000-8.000 min^{-1}. In this case the feed speed has to be increased to $v_f \approx$ 5 m/min (quick manual feed).
- The stainless steel foil has to lay on the top.
- The guide ring (ball bearing) has to be permanently in contact with the contracted area of the panel material.
- The blank of the coating should be effected as exact as possible, so that the coating protrusion is as low as possible (approx. 0,5 mm).
- In case of square trimming, approx. 2 to 3 running times per cutting edge can be used by axial adjustment of the cutting depth in the area of the cutting edge length.
- The turnblades can be turned 4 times.
- A variation of the cutting depth leads to a variation of the bevel width.

ABM	dimension	**LL**	lefthand rotation
a_e	cutting thickness radial	**M**	metric thread
AL	working length	**min^{-1}**	per minute
BO	bore diameter	**n**	RPM
CNC	Computerized Numerical Control	**NL**	cutting length
D	cutting circle diameter	**RD**	righthand twist
FLD	flange diameter	**RL**	righthand rotation
FZ	flat tooth	**S**	shank dimension
GL	total length	**SB**	cutting width
HW	tungsten carbide	**TDI**	thickness of tool
ID No. LL	ident number lefthand rotation	**TZ**	trapeze tooth
ID No. RL	ident number righthand rotation	**V**	no. of spurs
L	length	**v_f**	feed speed
LD	lefthand twist	**Z**	no. of teeth