Cutting parameters

Calculation and practical hints

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Calculations

The basis for the calculation of speed and feed is the following table with information on cutting speeds and tooth feed. These are experimentally determined guide values for rough orientation, which can vary in practice depending on the machine and peripherals.

Guide values for milling parameters

	Cutiing Speed m/min.	Cutter Diameter								
		Ø 1 mm	Ø 2 mm	Ø 3 mm	Ø 4 mm	Ø 5 mm	Ø 6 mm	Ø 8 mm	Ø 10 mm	Ø 12 mm
		Tooth feed in mm / tooth / revolution								
Cast Aluminium > 6% Si	500	0,010	0,010	0,010	0,015	0,015	0,025	0,030	0,038	0,050
Aluminum Wrought alloy	500	0,010	0,020	0,025	0,050	0,050	0,050	0,064	0,080	0,100
Soft plastic	600	0,025	0,030	0,035	0,045	0,065	0,090	0,100	0,200	0,300
Hard plastic	550	0,015	0,020	0,025	0,050	0,060	0,080	0,089	0,100	0,150
Hard wood	450	0,020	0,025	0,030	0,035	0,045	0,055	0,065	0,080	0,090
Soft wood	500	0,025	0,030	0,035	0,040	0,050	0,060	0,070	0,085	0,100
MDF	450	0,030	0,040	0,045	0,050	0,060	0,070	0,080	0,090	0,110
Brass, Copper, Bronze	365	0,015	0,020	0,025	0,025	0,030	0,050	0,056	0,065	0,080
Steel	90	0,010	0,010	0,012	0,025	0,030	0,038	0,045	0,050	0,080

n = Speed of the milling cutter in rpm
vc = Cutting speed in m/min
d = Cutter diameter in mm
z = Number of teeth
fz = Tooth feed
vf = Feed rate in mm/min

Speed

The following formula is used to determine the speed:

n [rpm] = (vc [m/min] × 1000) / (3,14 × Ø d1 [mm])

Example:

vc = 500 m/min (from table)
d = Ø 8 mm

(500 × 1.000) / (3,14 × 8) = 19.904 U/min

Feeding rate

The following formula is used to determine the feeding rate

vf = N × z × fz

Example:
An aluminum wrought alloy and a two-flute 8 mm milling cutter are given.

n = 19.904 U/min (from speed calculation)
fz= 0,064 (from table)
z = 2

19.904 × 2 × 0,064 = 2.547,77 mm/min

Practical tips

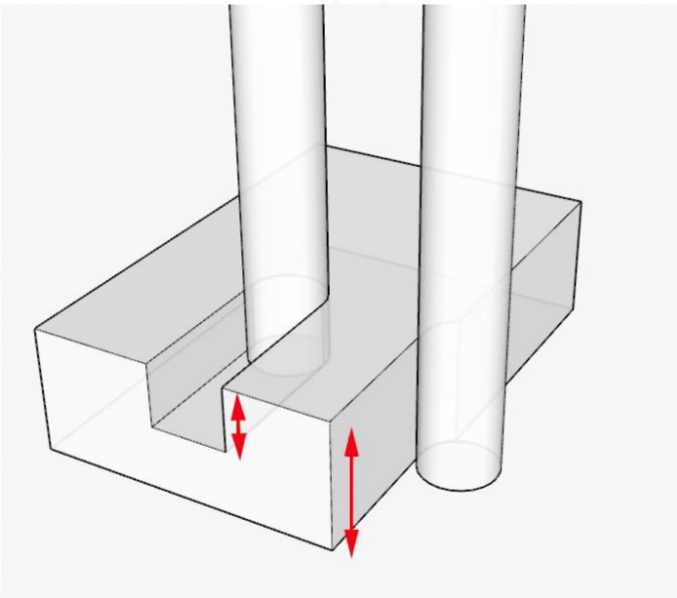
Immersion depth

When milling a groove, we recommend the following immersion depth:

- Non-ferrous metals: up to 0.5 times the diameter
- Wood, plastics: up to twice the diameter
- Hard foam: up to 5 times the diameter

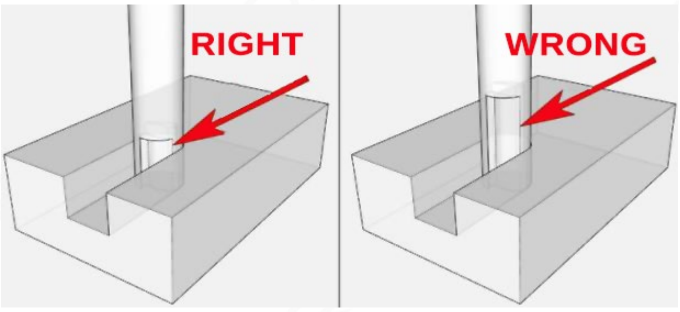
When milling contours, we recommend a lateral infeed of approx. 25% of the cutter diameter with 100% immersion depth.

Note:
Here, too, the information depends heavily on the structure and stability of the machine.



Choice of length of cutter

In order to prevent the cutter from vibrating and swinging open, we recommend that the cutter is always as short as possible or only as long as necessary.



Drawings: ZenziWerken

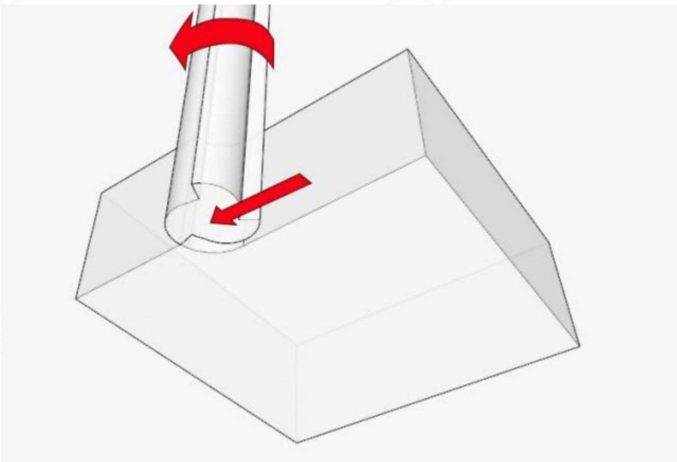
Cooling / lubricating

In the case of non-ferrous metals, cooling takes place in the best case with minimum quantity lubrication in conjunction with a lubricant. Furthermore, the lubrication improves the surface quality and the service life of the tool.
With acrylic glass, a very good surface can be achieved by lubricating it with soapy water.

Down-cut / up-cut milling

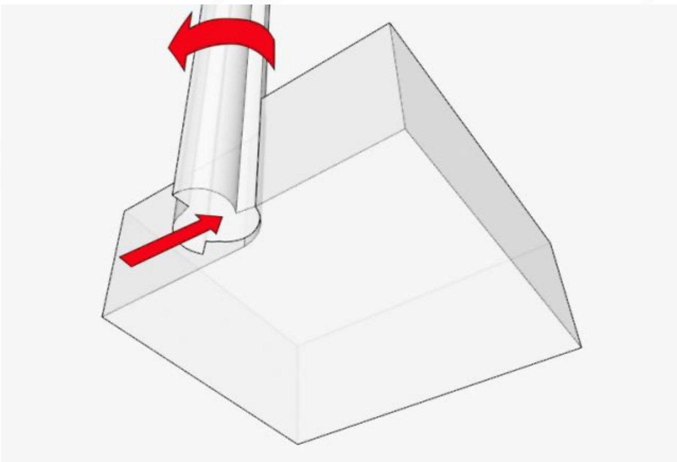
Down-cut milling
With down-cut milling, the milling cutter pulls itself into the workpiece, which can lead to the portal or the Z-axis being pulled in an uncontrolled manner in the direction of the workpiece due to reverse play of the spindle. This leads to a very unclean milling pattern and can even lead to the cutter breaking if the chip is too large at that moment.

If backlash-free recirculating ball spindles are installed without backlash, down-cut is preferred over up-cut milling.



Up-cut milling
In up-cut milling, the milling cutter pushes itself away from the workpiece, which quickly leads to the cutting edge being pushed out of the workpiece with very little chip removal. This creates chatter marks that are neither useful for a beautiful surface nor for the service life of the cutter.

Up-cut milling is favored on machines with backlash in the threaded spindles.



Drawings: ZenziWerken

Mill with reduced neck

The maximum possible depth infeed is usually limited to the spiral length of the milling cutter, otherwise the shaft will rub against the workpiece.
The reduced neck enables milling depths over several infeeds up to the maximum usable length that exceeds the spiral length.