

#### **Technical information**

#### VHM - Schaftfräser

Art.-Nr. 414

**Flutes** 4



**INOTECH** Data sheets

















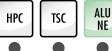








Tool recommendation

















## Areas of application and special features

HPC mill especially for harder short chipping aluminium and non-ferrous materials. Uneven partition, uneven helix. cutting edge and coating are polished.

#### Competitive advantages and profitability

competition to Hoffmann, GW and Ceratizit

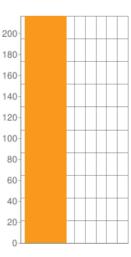
### **Example application**

Art.-Nr.: 414.160.10

Material: Aluminium alloyed over >8% S

|      | Inov         | vatools - | Finishing                 |
|------|--------------|-----------|---------------------------|
| D1   | 16,00        | mm        | Diameter                  |
| z    | 4            |           | Flutes                    |
| ae   | 8,000        | mm        | Row pitch                 |
| ар   | 16,000       | mm        | Cutting depth             |
| vc   | 250,00       | m/min     | Cutting speed             |
| n    | 4974         | U/min     | Rotation speed            |
| fz   | 0,08500      | mm        | Feed per tooth            |
| vf   | 1691,02      | mm/min    | Feed rate                 |
| Q    | 216,45072260 | cm³/min   | Material removal rate     |
| hm   | 0,05411      | mm        | Middle chipping thickness |
| K/M  |              | €/std     | Machine hourly cost       |
| K/W  |              | €         | Tool cost                 |
| Т    |              | min       | Tool life                 |
| ٧    |              | cm³       | Processing volume         |
| Tb   |              | min       | Process time              |
| €/Ws |              | €         | Cost workpiece            |





#### Competitor: Art.-Nr.:

|      | Calcula | ator                      |
|------|---------|---------------------------|
| D1   | mm      | Diameter                  |
| z    |         | Flutes                    |
| ae   | mm      | Row pitch                 |
| ар   | mm      | Cutting depth             |
| vc   | m/min   | Cutting speed             |
| n    | U/min   | Rotation speed            |
| fz   | mm      | Feed per tooth            |
| vf   | mm/min  | Feed rate                 |
| Q    | cm³/min | Material removal rate     |
| hm   | mm      | Middle chipping thickness |
| K/M  | €/std   | Machine hourly cost       |
| K/W  | €       | Tool cost                 |
| Т    | min     | Tool life                 |
| V    | cm³     | Processing volume         |
| Tb   | min     | Process time              |
| €/Ws | €       | Cost workpiece            |



# **Cutting data and application recommendations**

# Art.-Nr. 414 / 1 - example aluminium

|   | aption:  | _                           | D1                      | D1                       | D1  | D1                                  | D1                                     | D1   | D1       | D1       | D1       | D1       | D1       | D1       | D1       | D1       |
|---|--|-----------------------------|-------------------------|--------------------------|---|-------------------------------------|--|--|----------|----------|----------|----------|----------|----------|----------|----------|
| ap: 1,00 Good   |  |                             | 3,00                    | 5,00                     | 10,00   | 16,00                               | 18,00                                  | 25,00  |          |          |          |          |          |          |          |          |
| - Ap  | pplicable<br>mited applica   | able                        | 4,00                    | 6,00<br>8,00             | 12,00   |                                     | 20,00                                  |  |          |          |          |          |          |          |          |          |
| Material  | vc<br>m/mir  | φ<br>n Grad                 | fz<br>mm                | fz<br>mm                 | fz<br>mm                                      | fz<br>mm                            | fz<br>mm                               | fz<br>mm                                     | fz<br>mm | fz<br>mm | fz<br>mm | fz<br>mm | fz<br>mm | fz<br>mm | fz<br>mm | fz<br>mm |
| General steels <500 N/mm² (<150 HB)   | )  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| General steels <700 N/mm² (<205 HB)   | )  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| General steels <850 N/mm² (<25 HRC  | )  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Tempering steel <850 N/mm² (<25 HR  | RC)  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Tempering steel <1000 N/mm² (<32 H  |  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Tempering steel <1400 N/mm² (<44 HF   | RC)  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Tempered steels 45-55 HRC (1400-2000  | N/mr   |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Tempered steels 55-60 HRC (>2000 N/m  | nm²)   |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Tempered steels 60-65 HRC   |  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Cast iron <180HB  |  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Malleable cast iron   |  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Cast iron with nodular graphite   |  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Aluminium long-chipping   | 283  | 70                          | 0,021                   | 0,046                    | 0,055   | 0,071                               | 0,092                                  | 0,109  |          |          |          |          |          |          |          |          |
| Aluminium short-chipping  | 318  | 65                          | 0,021                   | 0,046                    | 0,055   | 0,071                               | 0,092                                  | 0,109  |          |          |          |          |          |          |          |          |
| Aluminium alloyed over >8% S  | 177  | 45                          | 0,021                   | 0,046                    | 0,055   | 0,071                               | 0,092                                  | 0,109  |          |          |          |          |          |          |          |          |
| Copper, brass, bronze, red brass  | 177  | 55                          | 0,017                   | 0,029                    | 0,042   | 0,063                               |  | 0,101  |          |          |          |          |          |          |          |          |
| Plastics - thermoplast  | 283  | 90                          | 0,017                   | 0,029                    | 0,042   | 0,063                               | 0,076                                  | 0,101  |          |          |          |          |          |          |          |          |
| Plastics - duroplast  |  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| GFK/CFK (fibreglass/carbon fibre plastics)  | )  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Graphite  |  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Rust and acid constant steels <700 N/mm   | n² (<2(  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Rust and acid constant steels >700 N/mm   |  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Inconel, Hastelloy, Nimonic, Monel  | (* 2)  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Titanium  |  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
|   |  |                             |                         |                          |   |                                     |  |  |          |          |          |          |          |          |          |          |
| Finishing Caption:  |  |                             | D1                      | D1                       | D1  | D1                                  | D1                                     | D1   | D1       | D1       | D1       | D1       | D1       | D1       | D1       | D:       |
| Id  | leal   |                             |                         |                          |   |                                     | 18,00                                  | 25,00  |          |          |          |          |          |          |          |          |
| ap: 1,00 Go   | ood  |                             | 3,00                    | 5,00                     | 10,00   | 16,00                               |  | ,  |          |          |          |          |          |          |          |          |
| ap: 1,00 Go<br>ae: 0,50 Ap  |  | able                        | 3,00<br>4,00            | 5,00<br>6,00<br>8,00     | 10,00   | 16,00                               | 20,00                                  |  |          |          |          |          |          |          |          |          |
| ap: 1,00 Go<br>ae: 0,50 Ap  | ood<br>pplicable<br>mited applica<br>vc  | able<br>φ<br>n Grad         | 4,00<br>fz              | 6,00                     |   | fz<br>mm                            |  | fz<br>mm                                     | fz<br>mm | fz<br>mm | fz<br>mm | fz<br>mm | fz<br>mm | fz<br>mm | fz<br>mm | fz<br>mr |
| ap: 1,00 Go<br>ae:0,50 Ap<br>Lin  | pplicable<br>mited applica<br>vc<br>m/mii  | φ                           | 4,00<br>fz              | 6,00<br>8,00<br>fz       | 12,00<br>fz                                   | fz                                  | 20,00<br>fz                            | fz   |          |          |          |          |          |          |          |          |
| ap: 1,00  | pplicable<br>mited applica<br>vc<br>m/mii  | φ                           | 4,00<br>fz              | 6,00<br>8,00<br>fz       | 12,00<br>fz                                   | fz                                  | 20,00<br>fz                            | fz   |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50 Ap  Material  General steels < 500 N/mm² (<150 HB)  General steels < 700 N/mm² (<205 HB)  | ood pplicable mited applica vc m/mii )   | φ                           | 4,00<br>fz              | 6,00<br>8,00<br>fz       | 12,00<br>fz                                   | fz                                  | 20,00<br>fz                            | fz   |          |          |          |          |          |          |          |          |
| ap: 1,00  | ood pplicable mited applica m/min )  | φ                           | 4,00<br>fz              | 6,00<br>8,00<br>fz       | 12,00<br>fz                                   | fz                                  | 20,00<br>fz                            | fz   |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50 Ap  Material  General steels <500 N/mm² (<150 HB)  General steels <700 N/mm² (<205 HB)  General steels <850 N/mm² (<25 HRC)  Tempering steel <850 N/mm² (<25 HRC)   | pplicable pplicable mited applica m/c m/min ) ) ) RC)  | φ                           | 4,00<br>fz              | 6,00<br>8,00<br>fz       | 12,00<br>fz                                   | fz                                  | 20,00<br>fz                            | fz   |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50 Ap Lit  Material  General steels <500 N/mm² (<150 HB) General steels <700 N/mm² (<205 HB) General steels <850 N/mm² (<25 HRC) Tempering steel <850 N/mm² (<25 HRC)  | pplicable mited applica mited m/min ) ) ) RC)  | φ                           | 4,00<br>fz              | 6,00<br>8,00<br>fz       | 12,00<br>fz                                   | fz                                  | 20,00<br>fz                            | fz   |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50 Ap  Material  General steels < 500 N/mm² (<150 HB) General steels < 700 N/mm² (<205 HB) General steels < 850 N/mm² (<25 HRC) Tempering steel < 850 N/mm² (<32 HRC) Tempering steel < 1000 N/mm² (<32 HRC) Tempering steel < 1400 N/mm² (<44 HRC)  | pplicable mited applica mited m/min ) ) ) ) RC) RC)  | φ                           | 4,00<br>fz              | 6,00<br>8,00<br>fz       | 12,00<br>fz                                   | fz                                  | 20,00<br>fz                            | fz   |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50 Ap  Material  General steels < 500 N/mm² (<150 HB)  General steels < 700 N/mm² (<205 HB)  General steels < 850 N/mm² (<25 HRC)  Tempering steel < 850 N/mm² (<32 HRC)  Tempering steel < 1000 N/mm² (<34 HRC)  Tempering steel < 1400 N/mm² (<44 HRC)  Tempered steels 45-55 HRC (1400-2000)  | pplicable pplicable mited applica pplicable pm/mit pplicable property pplicable pplica | φ                           | 4,00<br>fz              | 6,00<br>8,00<br>fz       | 12,00<br>fz                                   | fz                                  | 20,00<br>fz                            | fz   |          |          |          |          |          |          |          |          |
| ap: 1,00  | pplicable pplicable mited applica pplicable pm/mit pplicable property pplicable pplica | φ                           | 4,00<br>fz              | 6,00<br>8,00<br>fz       | 12,00<br>fz                                   | fz                                  | 20,00<br>fz                            | fz   |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  General steels < 500 N/mm² (<150 HB) General steels < 700 N/mm² (<205 HB) General steels < 850 N/mm² (<25 HRC) Tempering steel < 850 N/mm² (<25 HRC) Tempering steel < 1000 N/mm² (<32 HB) Tempering steel < 1400 N/mm² (<44 HB) Tempered steels 45-55 HRC (1400-2000) Tempered steels 55-60 HRC (>2000 N/m) Tempered steels 60-65 HRC   | pplicable pplicable mited applica pplicable pm/mit pplicable property pplicable pplica | φ                           | 4,00<br>fz              | 6,00<br>8,00<br>fz       | 12,00<br>fz                                   | fz                                  | 20,00<br>fz                            | fz   |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  General steels <500 N/mm² (<150 HB, General steels <700 N/mm² (<205 HB, General steels <850 N/mm² (<25 HRC Tempering steel <850 N/mm² (<25 HRC Tempering steel <1000 N/mm² (<32 H Tempering steel <1400 N/mm² (<44 H Tempered steels 45-55 HRC (1400-2000 Tempered steels 55-60 HRC (>2000 N/m Tempered steels 60-65 HRC Cast iron <180 HB   | pplicable pplicable mited applica pplicable pm/mit pplicable property pplicable pplica | φ                           | 4,00<br>fz              | 6,00<br>8,00<br>fz       | 12,00<br>fz                                   | fz                                  | 20,00<br>fz                            | fz   |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  General steels <500 N/mm² (<150 HB, General steels <700 N/mm² (<205 HB, General steels <850 N/mm² (<25 HRC Tempering steel <850 N/mm² (<25 HRC Tempering steel <1000 N/mm² (<32 HT) Tempering steel <1400 N/mm² (<44 HT) Tempered steels 45-55 HRC (1400-2000 Tempered steels 55-60 HRC (>2000 N/m Tempered steels 60-65 HRC Cast iron <180 HB Malleable cast iron   | pplicable pplicable mited applica pplicable pm/mit pplicable property pplicable pplica | φ                           | 4,00<br>fz              | 6,00<br>8,00<br>fz       | 12,00<br>fz                                   | fz                                  | 20,00<br>fz                            | fz   |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  General steels <500 N/mm² (<150 HB) General steels <700 N/mm² (<205 HB) General steels <850 N/mm² (<25 HB) General steels <850 N/mm² (<25 HB) Tempering steel <850 N/mm² (<25 HB) Tempering steel <1000 N/mm² (<32 HB) Tempering steel <1000 N/mm² (<44 HB) Tempered steels 45-55 HBC (1400-2000 N/m) Tempered steels 60-65 HBC Cast iron <180 HB Malleable cast iron Cast iron with nodular graphite  | pplicable pplicable mited applica pplicable pm/mit pplicable property pplicable pplica | φ                           | fz mm                   | 6,00<br>8,00<br>fz<br>mm | fz mm   | fz<br>mm                            | fz mm                                  | fz<br>mm                                     |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  General steels <500 N/mm² (<150 HB) General steels <700 N/mm² (<205 HB) General steels <850 N/mm² (<25 HB) General steels <850 N/mm² (<25 HB) Tempering steel <850 N/mm² (<32 HB) Tempering steel <1000 N/mm² (<32 HB) Tempering steel <1000 N/mm² (<44 HB) Tempered steels 45-55 HBC (1400-2000) Tempered steels 55-60 HBC (>2000 N/m) Tempered steels 60-65 HBC Cast iron <180 HB Malleable cast iron Cast iron with nodular graphite Aluminium long-chipping  | pplicable mited applica  (m/min ) ) ) (C) (RC) (HRC) (RC) (D N/mr (mm²) (400)  | φ<br>Grad                   | 4,00<br>fz<br>mm        | 6,00<br>8,00<br>fz<br>mm | 12,00<br>fz<br>mm                             | fz<br>mm                            | 20,00<br>fz<br>mm                      | f <sub>2</sub> mm                            |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  Material  General steels < 500 N/mm² (<150 HB) General steels < 700 N/mm² (<205 HB) General steels < 850 N/mm² (<25 HRC) Tempering steel < 850 N/mm² (<25 HRC) Tempering steel < 1000 N/mm² (<32 HC) Tempering steel < 1400 N/mm² (<44 HC) Tempered steels 45-55 HRC (1400-2000) Tempered steels 55-60 HRC (>2000 N/m) Tempered steels 60-65 HRC Cast iron < 180 HB Malleable cast iron Cast iron with nodular graphite Aluminium long-chipping  | pplicable mited applica  yc m/min  ) ) ) C) RC) HRC) RC) O N/mr  | φ<br>Grad                   | 4,00<br>fz<br>mm        | 6,00<br>8,00<br>fz<br>mm | fz mm   | fz<br>mm                            | 20,00<br>fz<br>mm                      | f2<br>mm                                     |          |          |          |          |          |          |          |          |
| ap: 1,00 ae:0,50  Material  Material  General steels <500 N/mm² (<150 HB) General steels <700 N/mm² (<205 HB) General steels <850 N/mm² (<25 HRC) Tempering steel <850 N/mm² (<25 HRC) Tempering steel <1000 N/mm² (<32 HTC) Tempering steel <1000 N/mm² (<44 HFC) Tempered steels 45-55 HRC (1400-2000) Tempered steels 60-65 HRC Cast iron <180 HB Malleable cast iron Cast iron with nodular graphite Aluminium long-chipping Aluminium alloyed over >8% S   | pplicable mited applica  yc m/mii  ) ) ) RC) RC) HRC) D N/mr mm²)  400  450  | φ<br>Grad                   | 4,00<br>fz<br>mm        | 6,00<br>8,00<br>fz<br>mm | 12,00<br>fz<br>mm                             | fz<br>mm<br>0,085<br>0,085          | 20,000  fz mm  0,110 0,110 0,110       | f <sub>2</sub> mm  0,130 0,130 0,130         |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  Material  General steels <500 N/mm² (<150 HB) General steels <700 N/mm² (<205 HB) General steels <850 N/mm² (<25 HB) General steels <850 N/mm² (<25 HB) Tempering steel <850 N/mm² (<25 HB) Tempering steel <1000 N/mm² (<32 HB) Tempering steel <1400 N/mm² (<44 HB) Tempered steels 45-55 HRC (1400-2000) Tempered steels 55-60 HRC (>2000 N/m) Tempered steels 60-65 HRC Cast iron <180 HB Malleable cast iron Cast iron with nodular graphite Aluminium long-chipping Aluminium short-chipping Aluminium alloyed over >8% S Copper, brass, bronze, red brass   | pplicable mited applica  vc m/mii  ) ) ) RC) RC) HRC) RC) O N/mr nm²)  400  450  | φ<br>Grad<br>70<br>65<br>45 | 0,025<br>0,025<br>0,025 | 0,055<br>0,055<br>0,055  | 12,00<br>fz<br>mm<br>0,065<br>0,065           | fz<br>mm<br>0,085<br>0,085<br>0,085 | 20,000  fz mm  0,110 0,110 0,110 0,090 | fz<br>mm<br>0,130<br>0,130<br>0,130<br>0,130 |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  Material  General steels <500 N/mm² (<150 HB) General steels <700 N/mm² (<205 HB) General steels <850 N/mm² (<25 HB) General steels <850 N/mm² (<25 HB) Tempering steel <850 N/mm² (<25 HB) Tempering steel <1000 N/mm² (<32 HB) Tempering steel <1400 N/mm² (<44 HB) Tempered steels 45-55 HRC (1400-2000) Tempered steels 55-60 HRC (>2000 N/m) Tempered steels 60-65 HRC Cast iron <180 HB Malleable cast iron Cast iron with nodular graphite Aluminium long-chipping Aluminium short-chipping Aluminium short-chipping Aluminium alloyed over >8% S Copper, brass, bronze, red brass Plastics - thermoplast   | pplicable mited applica  vc m/mii  )  )  RC)  HRC)  RC)  D N/mr  mm²)  400  450  250   | φ<br>Grad<br>70<br>65<br>45 | 0,025<br>0,025<br>0,025 | 0,055<br>0,055<br>0,055  | 12,000<br>fz<br>mm<br>0,065<br>0,065<br>0,065 | fz<br>mm<br>0,085<br>0,085<br>0,085 | 20,000  fz mm  0,110 0,110 0,110 0,090 | fz<br>mm<br>0,130<br>0,130<br>0,130<br>0,130 |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  Material  General steels <500 N/mm² (<150 HB) General steels <700 N/mm² (<205 HB) General steels <850 N/mm² (<25 HBC) General steels <850 N/mm² (<25 HBC) Tempering steel <850 N/mm² (<32 HBC) Tempering steel <1000 N/mm² (<32 HBC) Tempering steel <1400 N/mm² (<44 HBC) Tempered steels 45-55 HBC (1400-2000 N/m) Tempered steels 55-60 HBC (>2000 N/m) Tempered steels 60-65 HBC Cast iron <180 HB Malleable cast iron Cast iron with nodular graphite Aluminium long-chipping Aluminium short-chipping Aluminium alloyed over >8% S Copper, brass, bronze, red brass Plastics - thermoplast Plastics - duroplast  | pplicable mited applica  wc m/min  ) ) ) C) RC) HRC) O N/mr  mm²  400  450  250  400   | φ<br>Grad<br>70<br>65<br>45 | 0,025<br>0,025<br>0,025 | 0,055<br>0,055<br>0,055  | 12,000<br>fz<br>mm<br>0,065<br>0,065<br>0,065 | fz<br>mm<br>0,085<br>0,085<br>0,085 | 20,000  fz mm  0,110 0,110 0,110 0,090 | fz<br>mm<br>0,130<br>0,130<br>0,130<br>0,130 |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  General steels <500 N/mm² (<150 HB) General steels <700 N/mm² (<205 HB) General steels <850 N/mm² (<25 HB) General steels <850 N/mm² (<25 HB) Tempering steel <850 N/mm² (<25 HB) Tempering steel <1000 N/mm² (<32 HB) Tempering steel <1400 N/mm² (<44 HB) Tempered steels 45-55 HBC (1400-2000 N/m) Tempered steels 60-65 HBC Cast iron <180 HB Malleable cast iron Cast iron with nodular graphite Aluminium long-chipping Aluminium short-chipping Aluminium alloyed over >8% S Copper, brass, bronze, red brass Plastics - thermoplast Plastics - duroplast GFK/CFK (fibreglass/carbon fibre plastics)  | pplicable mited applica  wc m/min  ) ) ) C) RC) HRC) O N/mr  mm²  400  450  250  400   | φ<br>Grad<br>70<br>65<br>45 | 0,025<br>0,025<br>0,025 | 0,055<br>0,055<br>0,055  | 12,000<br>fz<br>mm<br>0,065<br>0,065<br>0,065 | fz<br>mm<br>0,085<br>0,085<br>0,085 | 20,000  fz mm  0,110 0,110 0,110 0,090 | fz<br>mm<br>0,130<br>0,130<br>0,130<br>0,130 |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  General steels <500 N/mm² (<150 HB) General steels <700 N/mm² (<205 HB) General steels <850 N/mm² (<25 HB) General steels <850 N/mm² (<25 HB) Tempering steel <850 N/mm² (<25 HB) Tempering steel <1000 N/mm² (<32 HB) Tempering steel <1400 N/mm² (<44 HB) Tempered steels 45-55 HBC (1400-2000 N/m) Tempered steels 60-65 HBC Cast iron <180 HB Malleable cast iron Cast iron with nodular graphite Aluminium long-chipping Aluminium short-chipping Aluminium alloyed over >8% S Copper, brass, bronze, red brass Plastics - thermoplast Plastics - duroplast GFK/CFK (fibreglass/carbon fibre plastics) Graphite   | wc m/min    | φ<br>Grad<br>70<br>65<br>45 | 0,025<br>0,025<br>0,025 | 0,055<br>0,055<br>0,055  | 12,000<br>fz<br>mm<br>0,065<br>0,065<br>0,065 | fz<br>mm<br>0,085<br>0,085<br>0,085 | 20,000  fz mm  0,110 0,110 0,110 0,090 | fz<br>mm<br>0,130<br>0,130<br>0,130<br>0,130 |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  General steels < 500 N/mm² (<150 HB) General steels < 700 N/mm² (<205 HB) General steels < 850 N/mm² (<25 HRC) Tempering steel < 850 N/mm² (<25 HRC) Tempering steel < 1000 N/mm² (<32 HC) Tempering steel < 1400 N/mm² (<44 HB) Tempered steels 45-55 HRC (1400-2000 N/m) Tempered steels 45-55 HRC (1400-2000 N/m) Tempered steels 60-65 HRC Cast iron < 180 HB Malleable cast iron Cast iron with nodular graphite Aluminium long-chipping Aluminium short-chipping Aluminium alloyed over > 8% S Copper, brass, bronze, red brass Plastics - thermoplast Plastics - duroplast GFK/CFK (fibreglass/carbon fibre plastics) Graphite Rust and acid constant steels < 700 N/mm | vc   vc   vc   vc   vc   vc   vc   vc  | φ<br>Grad<br>70<br>65<br>45 | 0,025<br>0,025<br>0,025 | 0,055<br>0,055<br>0,055  | 12,000<br>fz<br>mm<br>0,065<br>0,065<br>0,065 | fz<br>mm<br>0,085<br>0,085<br>0,085 | 20,000  fz mm  0,110 0,110 0,110 0,090 | fz<br>mm<br>0,130<br>0,130<br>0,130<br>0,130 |          |          |          |          |          |          |          |          |
| ap: 1,00 ae: 0,50  Material  General steels < 500 N/mm² (<150 HB) General steels < 700 N/mm² (<205 HB) General steels < 850 N/mm² (<25 HB) General steels < 850 N/mm² (<25 HB) Tempering steel < 850 N/mm² (<25 HB) Tempering steel < 1000 N/mm² (<32 HB) Tempering steel < 1400 N/mm² (<34 HB) Tempered steels 45-55 HBC (1400-2000 N/m) Tempered steels 55-60 HBC (>2000 N/m) Tempered steels 60-65 HBC Cast iron < 180 HB Malleable cast iron Cast iron with nodular graphite Aluminium long-chipping Aluminium short-chipping Aluminium alloyed over > 8% S Copper, brass, bronze, red brass Plastics - thermoplast Plastics - duroplast GFK/CFK (fibreglass/carbon fibre plastics) Graphite            | vc   vc   vc   vc   vc   vc   vc   vc  | φ<br>Grad<br>70<br>65<br>45 | 0,025<br>0,025<br>0,025 | 0,055<br>0,055<br>0,055  | 12,000<br>fz<br>mm<br>0,065<br>0,065<br>0,065 | fz<br>mm<br>0,085<br>0,085<br>0,085 | 20,000  fz mm  0,110 0,110 0,110 0,090 | fz<br>mm<br>0,130<br>0,130<br>0,130<br>0,130 |          |          |          |          |          |          |          |          |