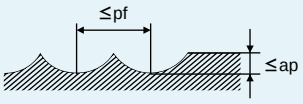
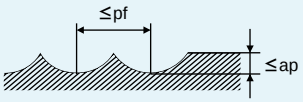
# RECOMMENDED CUTTING CONDITIONS

## Shoulder milling (grooving)

| Material | Carbon steel, Alloy steel, Mild steel, Pre-hardened steel<br>Ck45, 41CrMo4, 36CrNiMo4, X5CrNi189, X5CrNiMo1810, X2CrNiN1810, X2CrNiMoN1813 | | | | | | | | Austenitic stainless steel, Titanium alloy, Hardened stainless steels, Cobalt chromium alloy, Ferritic and Martensitic stainless steels<br>Inconel 718, NAK, X36CrMo17, X40CrMoV51, 55NiCrMoV6, X46Cr13 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R (mm) | α≤15° | | | α>15° | | | Depth of cut ap (mm) | Pick feed pf (mm) | α≤15° | | | α>15° | | | Depth of cut ap (mm) | Pick feed pf (mm) |
| | Cutting speed (m/min) | Revolution ($min^{-1}$) | Feed rate (mm/min) | Cutting speed (m/min) | Revolution ($min^{-1}$) | Feed rate (mm/min) | | | Cutting speed (m/min) | Revolution ($min^{-1}$) | Feed rate (mm/min) | Cutting speed (m/min) | Revolution ($min^{-1}$) | Feed rate (mm/min) | | |
| R 1 | 250 | 40000 | 8000 | 201 | 40000 | 8000 | 0.1 | 0.5 | 230 | 36000 | 6500 | 150 | 24000 | 2900 | 0.1 | 0.5 |
| R 1.5 | 300 | 32000 | 7700 | 198 | 32000 | 7700 | 0.2 | 0.7 | 230 | 24000 | 4800 | 150 | 16000 | 1900 | 0.2 | 0.7 |
| R 2 | 300 | 24000 | 5800 | 201 | 24000 | 5800 | 0.3 | 1 | 230 | 18000 | 4000 | 150 | 12000 | 1700 | 0.3 | 1 |
| R 2.5 | 300 | 19000 | 5300 | 199 | 19000 | 5300 | 0.4 | 1.2 | 230 | 14400 | 3500 | 150 | 9600 | 1500 | 0.4 | 1.2 |
| R 3 | 300 | 16000 | 4800 | 200 | 16000 | 4800 | 0.5 | 1.5 | 230 | 12000 | 3200 | 150 | 8000 | 1400 | 0.5 | 1.5 |
| R 4 | 300 | 12000 | 4300 | 201 | 12000 | 4300 | 0.8 | 2 | 230 | 9000 | 3200 | 150 | 6000 | 1400 | 0.8 | 2 |
| R 5 | 300 | 9600 | 4100 | 201 | 9600 | 4100 | 1 | 2.5 | 230 | 7200 | 3000 | 150 | 4800 | 1300 | 1 | 2.5 |
| R 6 | 300 | 8000 | 4000 | 200 | 8000 | 4000 | 1.2 | 3 | 230 | 6000 | 3000 | 150 | 4000 | 1300 | 1.2 | 3 |
| Depth of cut |  | | | | | | | | | | | | | | | |

R:Radius

| Material | Copper, Copper alloy | | | | | | | | Heat resistant alloys<br>Inconel etc. | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R (mm) | α≤15° | | | α>15° | | | Depth of cut ap (mm) | Pick feed pf (mm) | α≤15° | | | α>15° | | | Depth of cut ap (mm) | Pick feed pf (mm) |
| | Cutting speed (m/min) | Revolution ($min^{-1}$) | Feed rate (mm/min) | Cutting speed (m/min) | Revolution ($min^{-1}$) | Feed rate (mm/min) | | | Cutting speed (m/min) | Revolution ($min^{-1}$) | Feed rate (mm/min) | Cutting speed (m/min) | Revolution ($min^{-1}$) | Feed rate (mm/min) | | |
| R 1 | 250 | 40000 | 8000 | 240 | 38000 | 4500 | 0.1 | 0.5 | 60 | 9600 | 960 | 40 | 6400 | 510 | 0.08 | 0.2 |
| R 1.5 | 360 | 38000 | 9100 | 240 | 25000 | 3800 | 0.2 | 0.7 | 60 | 6400 | 640 | 40 | 4200 | 340 | 0.1 | 0.3 |
| R 2 | 360 | 29000 | 7000 | 240 | 19000 | 3300 | 0.3 | 1 | 60 | 4800 | 580 | 40 | 3200 | 260 | 0.1 | 0.4 |
| R 2.5 | 360 | 23000 | 6400 | 240 | 15000 | 3100 | 0.4 | 1.2 | 60 | 3800 | 530 | 39 | 2500 | 250 | 0.2 | 0.5 |
| R 3 | 360 | 19000 | 5700 | 240 | 13000 | 2600 | 0.5 | 1.5 | 60 | 3200 | 500 | 40 | 2100 | 210 | 0.2 | 0.6 |
| R 4 | 360 | 14000 | 5000 | 240 | 9600 | 2300 | 0.8 | 2 | 60 | 2400 | 430 | 40 | 1600 | 190 | 0.4 | 0.8 |
| R 5 | 360 | 12000 | 5100 | 240 | 7700 | 2200 | 1 | 2.5 | 63 | 2000 | 420 | 41 | 1300 | 180 | 0.5 | 1 |
| R 6 | 360 | 9600 | 4800 | 240 | 6400 | 2200 | 1.2 | 3 | 64 | 1700 | 350 | 41 | 1100 | 150 | 0.6 | 1.2 |
| Depth of cut |  | | | | | | | | | | | | | | | |

R:Radius

1) VQ coating has less electrical conductivity; therefore an external contact type (electrically transmitted) tool setter may not work.
   When measuring the tool length, please use an internal contact type (non-electrical type) tool setter or a laser type tool setter.
2) Effective cutting of stainless steel, titanium alloys and heat-resistant alloys etc. can be achieved with the use of emulsion coolant.
3) Chattering can still occur if the machine rigidity and clamping method are insufficient.
   In these cases the feed and speed should be reduced proportionately.
4) When the depth of cut is smaller than shown the revolution and feed rate can be increased.