

**Cutting Conditions (Guide) :**

● : Stable Cutting ● : General Cutting ✖ : Unstable Cutting

## RECOMMENDED CUTTING CONDITIONS

### Breaker Selection Table by Workpiece Material Cutting State

|          | Workpiece Material                              | Characteristics                                | Cutting Conditions | Breaker         |                 | Grade           |                 |
|----------|-------------------------------------------------|------------------------------------------------|--------------------|-----------------|-----------------|-----------------|-----------------|
|          |                                                 |                                                |                    | 1st Recommended | 2nd Recommended | 1st Recommended | 2nd Recommended |
| <b>P</b> | Mild Steel                                      | Hardness<br>≤180HB                             | ● ●                | L               | M               | MP6120          | VP15TF          |
|          |                                                 |                                                | ✖                  | M               | L               | MP6130          | —               |
|          | Carbon Steel<br>Alloy Steel<br>Alloy Tool Steel | Hardness<br>180-350HB<br>≤350HB<br>(Annealing) | ●                  | L               | M               | MP6120          | VP15TF          |
|          |                                                 |                                                | ●                  | M               | L               | MP6120          | VP15TF          |
|          |                                                 |                                                | ✖                  | M               | L               | MP6130          | —               |
|          | Pre-hardened Steel                              | Hardness<br>35—45HRC                           | ● ●                | M               | L               | MP6120          | VP15TF          |
|          |                                                 |                                                | ✖                  | M               | L               | MP6130          | —               |
| <b>M</b> | Austenitic Stainless Steel                      | Hardness<br>≤280HB                             | ● ●                | L               | M               | MP7130          | VP15TF          |
|          |                                                 |                                                | ✖                  | M               | L               | MP7130          | —               |
|          |                                                 | Hardness<br>>200HB                             | ● ●                | L               | M               | MP7130          | VP15TF          |
|          |                                                 |                                                | ✖                  | M               | L               | MP7130          | —               |
|          | Duplex Stainless Steel                          | Hardness<br>≤280HB                             | ● ●                | L               | M               | MP7130          | VP15TF          |
|          |                                                 |                                                | ✖                  | M               | L               | MP7130          | —               |
|          | Ferritic and Martensitic Stainless Steel        | —                                              | ● ●                | L               | M               | MP7130          | VP15TF          |
|          |                                                 |                                                | ✖                  | M               | L               | MP7130          | —               |
| <b>K</b> | Gray Cast Iron                                  | Tensile Strength<br>≤350MPa                    | ● ●                | M               | L               | MC5020          | VP15TF          |
|          |                                                 |                                                | ✖                  | M               | L               | VP15TF          | —               |
|          | Ductile Cast Iron                               | Tensile Strength<br>≤800MPa                    | ● ●                | M               | L               | MC5020          | VP15TF          |
|          |                                                 |                                                | ✖                  | M               | L               | VP15TF          | —               |
| <b>N</b> | Aluminium Alloy                                 | Content<br>Si < 5%                             | ● ●                | L               | M               | TF15            | —               |
|          |                                                 |                                                | ✖                  | M               | L               | TF15            | —               |
| <b>S</b> | Titanium Alloy<br>(Ti-6Al-4V, etc.)             | —                                              | ● ●                | L               | M               | MP9120          | VP15TF          |
|          |                                                 |                                                | ✖                  | M               | L               | MP9130          | —               |
|          | Titanium Alloy<br>(Ti-5Al-5V-5Mo-3Cr, etc.)     | —                                              | ● ●                | L               | M               | MP9120          | VP15TF          |
|          |                                                 |                                                | ✖                  | M               | L               | MP9130          | —               |
|          | Heat Resistant Alloy                            | —                                              | ● ●                | M               | L               | MP9120          | VP15TF          |
|          |                                                 |                                                | ✖                  | M               | L               | MP9130          | —               |
| <b>H</b> | Hardened Steel                                  | Hardness<br>40—55HRC                           | ● ● ✖              | M               | —               | VP15TF          | —               |

The following table shows recommended conditions for dry cutting and wet cutting accordingly.

**Cutting Conditions (Guide) :**

● : Stable Cutting ● : General Cutting ✖ : Unstable Cutting

## RECOMMENDED CUTTING CONDITIONS

### ■ Dry Cutting Cutting Speed

| Workpiece Material | Properties                                         | Cutting Conditions                       | Insert Grade   | ae (mm)        |                |                |                |
|--------------------|----------------------------------------------------|------------------------------------------|----------------|----------------|----------------|----------------|----------------|
|                    |                                                    |                                          |                | ≤0.25DC        | 0.25—0.5DC     | 0.5—0.75DC     | DC(Slot)       |
|                    |                                                    |                                          |                | vc (m/min)     |                |                |                |
| <b>P</b>           | Mild Steels                                        | Hardness ≤180HB                          | MP6120, VP15TF | 230 (180—270)  | 220 (170—260)  | 180 (140—210)  | 180 (140—210)  |
|                    |                                                    |                                          | MP6130         | 200 (150—240)  | 190 (170—260)  | 150 (110—180)  | 150 (110—180)  |
|                    | Carbon Steels<br>Alloy Steels<br>Alloy Tool Steels | Hardness 180—350HB<br>≤350HB (Annealing) | MP6120, VP15TF | 180 (140—210)  | 170 (130—200)  | 140 (110—160)  | 140 (110—180)  |
|                    |                                                    |                                          | MP6130         | 150 (110—180)  | 140 (100—170)  | 110 (80—130)   | 110 (80—130)   |
|                    | Pre-hardened Steels                                | Hardness 35—45HRC                        | MP6120, VP15TF | 120 (90—140)   | 110 (80—130)   | 100 (70—120)   | 100 (70—120)   |
|                    |                                                    |                                          | MP6130         | 100 (80—120)   | 90 (70—110)    | 80 (60—100)    | 80 (60—100)    |
| <b>M</b>           | Austenitic Stainless Steels                        | Hardness ≤200HB                          | MP7130, VP15TF | 180 (140—210)  | 170 (130—200)  | 140 (110—160)  | 140 (110—160)  |
|                    |                                                    | Hardness >200HB                          | MP7130, VP15TF | 150 (110—180)  | 140 (100—160)  | 110 (80—130)   | 110 (80—130)   |
|                    | Duplex Stainless Steels                            | Hardness ≤280HB                          | MP7130, VP15TF | 140 (110—170)  | 130 (90—150)   | 100 (70—120)   | 100 (70—120)   |
|                    | Ferritic and Martensitic Stainless Steels          | —                                        | MP7130, VP15TF | 180 (140—210)  | 170 (130—200)  | 140 (110—160)  | 140 (110—160)  |
|                    | Precipitation-Hardening Stainless Steel            | Hardness <450HB                          | MP7130, VP15TF | 130 (100—160)  | 120 (80—140)   | 90 (60—110)    | 90 (60—110)    |
| <b>K</b>           | Gray Cast Irons                                    | Tensile Strength ≤350MPa                 | MC5020         | 250 (200—300)  | 240 (190—290)  | 210 (160—260)  | 210 (160—260)  |
|                    |                                                    |                                          | VP15TF         | 200 (150—250)  | 190 (140—240)  | 160 (110—210)  | 160 (110—210)  |
|                    | Ductile Cast Irons                                 | Tensile Strength ≤800MPa                 | MC5020         | 180 (150—200)  | 170 (140—190)  | 150 (120—170)  | 150 (120—170)  |
|                    |                                                    |                                          | VP15TF         | 130 (100—150)  | 120 (90—140)   | 100 (80—120)   | 100 (80—120)   |
| <b>N</b>           | Aluminium Alloys                                   | Content Si < 5%                          | TF15           | 600 (400—1000) | 600 (400—1000) | 600 (400—1000) | 600 (400—1000) |
| <b>H</b>           | Hardened Steels                                    | Hardness 40—55HRC                        | VP15TF         | 90 (70—100)    | 85 (60—100)    | 70 (50—80)     | 70 (50—80)     |

Note 1) These cutting conditions should be referenced for standard shank types (last letter in designation is S) and arbor shank types. If there is chatter, insert chipping, etc. during machining, alter conditions accordingly.

Note 2) Chattering vibration is more likely under the following circumstances. Use a cut and feed per tooth that are at minimum recommended conditions or below.

- When tool overhang is long (using a long shank, screw-in type, etc.)
- Rigidity of machine, workpiece material or attachment of workpiece material is low
- Corner radius during pocket machining

Note 3) A type with fewer teeth is recommended when the depth of cut in the radius direction (ae) is 0.5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Service life is shorter than for dry cutting.)

Note 5) When using under higher than recommended cutting conditions, or for long periods of time, the bit may become fatigued and break during machining. Please change out the bit periodically.

## RECOMMENDED CUTTING CONDITIONS

### ■ Dry Cutting

#### Depth of Cut / Feed per Tooth

| Workpiece Material                         |                                                 | Characteristics                                | ae (mm)    | Cutting Conditions | DC (mm)   |           |           |           |
|--------------------------------------------|-------------------------------------------------|------------------------------------------------|------------|--------------------|-----------|-----------|-----------|-----------|
|                                            |                                                 |                                                |            |                    | ø25       |           | ø28—ø80   |           |
|                                            |                                                 |                                                |            |                    | ap (mm)   | fz (mm/t) | ap (mm)   | fz (mm/t) |
| P                                          | Mild Steel                                      | Hardness<br>≤180HB                             | ≤0.25DC    | ● ● ● *            | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.30 |
|                                            |                                                 |                                                | 0.25—0.5DC | ● ● ● *            | ≤11       | 0.10—0.15 | ≤11       | 0.10—0.25 |
|                                            |                                                 |                                                | 0.5—0.75DC | ● ● ● *            | ≤8        | 0.08—0.12 | ≤8        | 0.10—0.20 |
|                                            |                                                 |                                                | DC(Slot)   | ● ● ● *            | ≤5        | 0.06—0.10 | ≤5        | 0.08—0.15 |
|                                            | Carbon Steel<br>Alloy Steel<br>Alloy Tool Steel | Hardness<br>180—280HB                          | ≤0.25DC    | ● ● ● *            | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.30 |
|                                            |                                                 |                                                | 0.25—0.5DC | ● ● ● *            | ≤11       | 0.10—0.15 | ≤11       | 0.10—0.25 |
|                                            |                                                 |                                                | 0.5—0.75DC | ● ● ● *            | ≤8        | 0.08—0.12 | ≤8        | 0.10—0.20 |
|                                            |                                                 |                                                | DC(Slot)   | ● ● ● *            | ≤5        | 0.06—0.10 | ≤5        | 0.08—0.15 |
|                                            | Carbon Steel<br>Alloy Steel<br>Alloy Tool Steel | Hardness<br>280—350HB<br>≤350HB<br>(Annealing) | ≤0.25DC    | ● ● ● *            | ≤11       | 0.10—0.15 | ≤11       | 0.10—0.25 |
|                                            |                                                 |                                                | 0.25—0.5DC | ● ● ● *            | ≤11       | 0.08—0.12 | ≤11       | 0.10—0.20 |
|                                            |                                                 |                                                | 0.5—0.75DC | ● ● ● *            | ≤8        | 0.06—0.10 | ≤8        | 0.10—0.15 |
|                                            |                                                 |                                                | DC(Slot)   | ● ● ● *            | ≤5        | 0.06—0.10 | ≤5        | 0.08—0.12 |
|                                            | Pre-hardened Steel                              | Hardness<br>35—45HRC                           | ≤0.25DC    | ● ● ● *            | ≤11       | 0.10—0.15 | ≤11       | 0.10—0.25 |
|                                            |                                                 |                                                | 0.25—0.5DC | ● ● ● *            | ≤11       | 0.08—0.12 | ≤11       | 0.10—0.20 |
|                                            |                                                 |                                                | 0.5—0.75DC | ● ● ● *            | ≤8        | 0.06—0.10 | ≤8        | 0.10—0.15 |
|                                            |                                                 |                                                | DC(Slot)   | ● ● ● *            | ≤5        | 0.06—0.10 | ≤5        | 0.08—0.12 |
| M                                          | Austenitic Stainless Steel                      | —                                              | ≤0.25DC    | ● ● ● *            | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.20 |
|                                            |                                                 |                                                |            |                    | ≤11       | 0.08—0.15 | ≤11       | 0.08—0.15 |
|                                            |                                                 |                                                | 0.25—0.5DC | ● ● ● *            | ≤11       | 0.08—0.15 | ≤11       | 0.08—0.15 |
|                                            |                                                 |                                                |            |                    | ≤11       | 0.08—0.12 | ≤11       | 0.08—0.12 |
|                                            |                                                 |                                                | 0.5—0.75DC | ● ● ● *            | ≤8        | 0.08—0.12 | ≤8        | 0.08—0.12 |
|                                            |                                                 |                                                |            |                    | ≤8        | 0.06—0.10 | ≤8        | 0.06—0.10 |
|                                            |                                                 |                                                | DC(Slot)   | ● ● ● *            | ≤5        | 0.06—0.10 | ≤5        | 0.06—0.10 |
|                                            |                                                 |                                                |            |                    | ≤5        | 0.06—0.08 | ≤5        | 0.06—0.08 |
|                                            | Duplex Stainless Steel                          | Hardness<br>≤280HB                             | ≤0.25DC    | ● ● ● *            | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.20 |
|                                            |                                                 |                                                |            |                    | ≤11       | 0.08—0.15 | ≤11       | 0.08—0.15 |
|                                            |                                                 |                                                | 0.25—0.5DC | ● ● ● *            | ≤11       | 0.08—0.15 | ≤11       | 0.08—0.15 |
|                                            |                                                 |                                                |            |                    | ≤11       | 0.08—0.12 | ≤11       | 0.08—0.12 |
|                                            |                                                 |                                                | 0.5—0.75DC | ● ● ● *            | ≤8        | 0.08—0.12 | ≤8        | 0.08—0.12 |
|                                            |                                                 |                                                |            |                    | ≤8        | 0.06—0.10 | ≤8        | 0.06—0.10 |
|                                            |                                                 |                                                | DC(Slot)   | ● ● ● *            | ≤5        | 0.06—0.10 | ≤5        | 0.06—0.10 |
|                                            |                                                 |                                                |            |                    | ≤5        | 0.06—0.08 | ≤5        | 0.06—0.08 |
|                                            | Ferritic and Martensitic<br>Stainless Steel     | —                                              | ≤0.25DC    | ● ● ● *            | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.20 |
|                                            |                                                 |                                                |            |                    | ≤11       | 0.08—0.15 | ≤11       | 0.08—0.15 |
|                                            |                                                 |                                                | 0.25—0.5DC | ● ● ● *            | ≤11       | 0.08—0.15 | ≤11       | 0.08—0.15 |
|                                            |                                                 |                                                |            |                    | ≤11       | 0.08—0.12 | ≤11       | 0.08—0.12 |
|                                            |                                                 |                                                | 0.5—0.75DC | ● ● ● *            | ≤8        | 0.08—0.12 | ≤8        | 0.08—0.12 |
|                                            |                                                 |                                                |            |                    | ≤8        | 0.06—0.10 | ≤8        | 0.06—0.10 |
|                                            |                                                 |                                                | DC(Slot)   | ● ● ● *            | ≤5        | 0.06—0.10 | ≤5        | 0.06—0.10 |
|                                            |                                                 |                                                |            |                    | ≤5        | 0.06—0.08 | ≤5        | 0.06—0.08 |
| Precipitation-Hardening<br>Stainless Steel | Hardness<br><450HB                              | ≤0.25DC                                        | ● ● ● *    | ≤11                | 0.10—0.15 | ≤11       | 0.10—0.15 |           |
|                                            |                                                 |                                                |            | ≤11                | 0.08—0.12 | ≤11       | 0.08—0.12 |           |
|                                            |                                                 | 0.25—0.5DC                                     | ● ● ● *    | ≤11                | 0.08—0.12 | ≤11       | 0.08—0.12 |           |
|                                            |                                                 |                                                |            | ≤11                | 0.08—0.12 | ≤11       | 0.06—0.10 |           |
|                                            |                                                 | 0.5—0.75DC                                     | ● ● ● *    | ≤8                 | 0.06—0.10 | ≤8        | 0.06—0.10 |           |
|                                            |                                                 |                                                |            | ≤8                 | 0.06—0.08 | ≤8        | 0.06—0.08 |           |
|                                            |                                                 | DC(Slot)                                       | ● ● ● *    | ≤5                 | 0.06—0.10 | ≤5        | 0.06—0.10 |           |
|                                            |                                                 |                                                |            | ≤5                 | 0.06—0.08 | ≤5        | 0.06—0.08 |           |

Note 1) These cutting conditions should be referenced for standard shank types (last letter in designation is S) and arbor shank types. If there is chatter, insert chipping, etc. during machining, alter conditions accordingly.

Note 2) Chattering vibration is more likely under the following circumstances. Use a cut and feed per tooth that are at minimum recommended conditions or below.

- When tool overhang is long (using a long shank, screw-in type, etc.)
- Rigidity of machine, workpiece material or attachment of workpiece material is low
- Corner radius during pocket machining

Note 3) A type with fewer teeth is recommended when the depth of cut in the radius direction (ae) is 0.5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Service life is shorter than for dry cutting.)

Note 5) When using under higher than recommended cutting conditions, or for long periods of time, the bit may become fatigued and break during machining. Please change out the bit periodically.

**Cutting Conditions (Guide) :**

● : Stable Cutting ● : General Cutting ✖ : Unstable Cutting

| Workpiece Material |                   | Characteristics             | ae (mm)              | Cutting Conditions | DC (mm)   |           |           |           |           |
|--------------------|-------------------|-----------------------------|----------------------|--------------------|-----------|-----------|-----------|-----------|-----------|
|                    |                   |                             |                      |                    | ø25       |           | ø28—ø80   |           |           |
|                    |                   |                             |                      |                    | ap (mm)   | fz (mm/t) | ap (mm)   | fz (mm/t) |           |
| K                  | Gray Cast Iron    | Tensile Strength<br>≤350MPa | ≤0.25DC              | ● ● ✖              | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.30 |           |
|                    |                   |                             |                      | ● ● ✖              | ≤11       | 0.08—0.15 | ≤11       | 0.10—0.25 |           |
|                    |                   |                             | 0.25—0.5DC           | ● ● ✖              | ≤11       | 0.08—0.15 | ≤11       | 0.10—0.25 |           |
|                    |                   |                             |                      | ● ● ✖              | ≤11       | 0.08—0.12 | ≤11       | 0.10—0.20 |           |
|                    |                   |                             | 0.5—0.75DC           | ● ● ✖              | ≤8        | 0.08—0.12 | ≤8        | 0.10—0.20 |           |
|                    |                   |                             |                      | ● ● ✖              | ≤8        | 0.06—0.10 | ≤8        | 0.08—0.15 |           |
|                    | Ductile Cast Iron | Tensile Strength<br>≤800MPa | DC(Slot)             | ● ● ✖              | ≤5        | 0.06—0.10 | ≤5        | 0.08—0.15 |           |
|                    |                   |                             |                      | ● ● ✖              | ≤5        | 0.06—0.08 | ≤5        | 0.08—0.12 |           |
|                    |                   |                             | ≤0.25DC              | ● ● ✖              | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.25 |           |
|                    |                   |                             |                      | ● ● ✖              | ≤11       | 0.10—0.15 | ≤11       | 0.10—0.20 |           |
|                    |                   |                             | 0.25—0.5DC           | ● ● ✖              | ≤11       | 0.10—0.15 | ≤11       | 0.10—0.20 |           |
|                    |                   |                             |                      | ● ● ✖              | ≤11       | 0.08—0.12 | ≤11       | 0.10—0.15 |           |
| N                  | Aluminium Alloy   | Content<br>Si < 5%          | ≤0.25DC              | ● ● ✖              | ≤11       | 0.10—0.25 | ≤11       | 0.10—0.25 |           |
|                    |                   |                             |                      | ● ● ✖              | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.20 |           |
|                    |                   |                             | 0.25—0.5DC           | ● ● ✖              | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.20 |           |
|                    |                   |                             |                      | ● ● ✖              | ≤11       | 0.10—0.15 | ≤11       | 0.10—0.15 |           |
|                    |                   |                             | 0.5—0.75DC           | ● ● ✖              | ≤8        | 0.06—0.15 | ≤8        | 0.08—0.15 |           |
|                    |                   |                             |                      | ● ● ✖              | ≤8        | 0.06—0.15 | ≤8        | 0.08—0.15 |           |
|                    | H                 | Hardened Steel              | Hardness<br>40—55HRC | ≤0.25DC            | ● ● ✖     | ≤5        | 0.08—0.15 | ≤5        | 0.08—0.15 |
|                    |                   |                             |                      |                    | ● ● ✖     | ≤5        | 0.08—0.12 | ≤5        | 0.08—0.12 |
|                    |                   |                             |                      | 0.25—0.5DC         | ● ● ✖     | ≤4        | 0.08—0.12 | ≤4        | 0.08—0.12 |
|                    |                   |                             |                      |                    | ● ● ✖     | ≤4        | 0.06—0.10 | ≤4        | 0.06—0.10 |
|                    |                   |                             |                      | 0.5—0.75DC         | ● ● ✖     | ≤3        | 0.06—0.10 | ≤3        | 0.06—0.10 |
|                    |                   |                             |                      |                    | ● ● ✖     | ≤3        | 0.06—0.08 | ≤3        | 0.06—0.08 |
| DC(Slot)           | ● ● ✖             | ≤2                          | 0.06—0.10            | ≤2                 | 0.06—0.10 |           |           |           |           |
|                    | ● ● ✖             | ≤2                          | 0.06—0.08            | ≤2                 | 0.06—0.08 |           |           |           |           |

Note 1) These cutting conditions should be referenced for standard shank types (last letter in designation is S) and arbor shank types. If there is chatter, insert chipping, etc. during machining, alter conditions accordingly.

Note 2) Chattering vibration is more likely under the following circumstances. Use a cut and feed per tooth that are at minimum recommended conditions or below.

- When tool overhang is long (using a long shank, screw-in type, etc.)
- Rigidity of machine, workpiece material or attachment of workpiece material is low
- Corner radius during pocket machining

Note 3) A type with fewer teeth is recommended when the depth of cut in the radius direction (ae) is 0.5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Service life is shorter than for dry cutting.)

Note 5) When using under higher than recommended cutting conditions, or for long periods of time, the bit may become fatigued and break during machining. Please change out the bit periodically.

## RECOMMENDED CUTTING CONDITIONS

### Wet Cutting Cutting Speed

| Workpiece Material | Properties                                         | Cutting Conditions                       | Insert Grade | ae (mm)                    |                |                |                |
|--------------------|----------------------------------------------------|------------------------------------------|--------------|----------------------------|----------------|----------------|----------------|
|                    |                                                    |                                          |              | ≤0.25DC                    | 0.25—0.5DC     | 0.5—0.75DC     | DC(Slot)       |
|                    |                                                    |                                          |              | vc (m/min)                 |                |                |                |
| <b>P</b>           | Mild Steels                                        | Hardness ≤180HB                          | ● ● ✱        | MP6120<br>MP6130<br>VP15TF | 140 (100—190)  | 130 (90—180)   | 100 (70—120)   |
|                    | Carbon Steels<br>Alloy Steels<br>Alloy Tool Steels | Hardness 180—350HB<br>≤350HB (Annealing) | ● ● ✱        | MP6120<br>MP6130<br>VP15TF | 120 (90—140)   | 110 (80—130)   | 100 (70—120)   |
|                    | Pre-hardened Steels                                | Hardness 35—45HRC                        | ● ● ✱        | MP6120<br>MP6130<br>VP15TF | 100 (80—120)   | 90 (70—110)    | 80 (60—100)    |
| <b>M</b>           | Austenitic Stainless Steels                        | Hardness ≤200HB                          | ● ● ✱        | MP7130, VP15TF             | 120 (100—150)  | 110 (90—140)   | 90 (70—120)    |
|                    |                                                    | Hardness >200HB                          | ● ● ✱        | MP7130, VP15TF             | 100 (80—130)   | 90 (70—120)    | 70 (50—100)    |
|                    | Duplex Stainless Steels                            | Hardness ≤280HB                          | ● ● ✱        | MP7130, VP15TF             | 100 (80—130)   | 90 (70—120)    | 70 (50—100)    |
|                    | Ferritic and Martensitic Stainless Steels          | —                                        | ● ● ✱        | MP7130, VP15TF             | 120 (100—150)  | 110 (90—140)   | 90 (70—120)    |
|                    | Precipitation-Hardening Stainless Steel            | Hardness <450HB                          | ● ● ✱        | MP7130, VP15TF             | 90 (70—120)    | 80 (60—110)    | 60 (40—90)     |
| <b>K</b>           | Gray Cast Irons                                    | Tensile Strength ≤350MPa                 | ● ●          | MC5020                     | 180 (160—220)  | 170 (150—210)  | 150 (130—190)  |
|                    |                                                    |                                          | ● ● ✱        | VP15TF                     | 130 (100—150)  | 120 (90—140)   | 100 (80—120)   |
|                    | Ductile Cast Irons                                 | Tensile Strength ≤800MPa                 | ● ●          | MC5020                     | 160 (140—180)  | 150 (130—170)  | 130 (110—150)  |
|                    |                                                    |                                          | ● ● ✱        | VP15TF                     | 110 (80—140)   | 100 (70—130)   | 80 (60—120)    |
| <b>N</b>           | Aluminium Alloys                                   | Content Si <5%                           | ● ● ✱        | TF15                       | 600 (400—1000) | 600 (400—1000) | 600 (400—1000) |
| <b>S</b>           | Titanium Alloys (Ti-6Al-4V, etc.)                  | —                                        | ● ●          | MP9120, VP15TF             | 50 (40—70)     | 50 (40—70)     | 50 (40—70)     |
|                    |                                                    |                                          | ● ✱          | MP9130                     | 40 (30—60)     | 40 (30—60)     | 40 (30—60)     |
|                    | Titanium Alloys (Ti-5Al-5V-5Mo-3Cr, etc.)          | —                                        | ● ●          | MP9120, VP15TF             | 30 (20—40)     | 30 (20—40)     | 30 (20—40)     |
|                    |                                                    |                                          | ● ✱          | MP9130                     | 30 (20—40)     | 30 (20—40)     | 30 (20—40)     |
|                    | Heat Resistant Alloys                              | —                                        | ● ●          | MP9120, VP15TF             | 40 (30—60)     | 40 (30—60)     | 40 (30—60)     |
|                    |                                                    |                                          | ● ✱          | MP9130                     | 30 (20—40)     | 30 (20—40)     | 30 (20—40)     |
| <b>H</b>           | Hardened Steels                                    | Hardness 40—55HRC                        | ● ● ✱        | VP15TF                     | 90 (70—100)    | 85 (60—100)    | 70 (50—80)     |

Note 1) These cutting conditions should be referenced for standard shank types (last letter in designation is S) and arbor shank types. If there is chatter, insert chipping, etc. during machining, alter conditions accordingly.

Note 2) Chattering vibration is more likely under the following circumstances. Use a cut and feed per tooth that are at minimum recommended conditions or below.

- When tool overhang is long (using a long shank, screw-in type, etc.)
- Rigidity of machine, workpiece material or attachment of workpiece material is low
- Corner radius during pocket machining

Note 3) A type with fewer teeth is recommended when the depth of cut in the radius direction (ae) is 0.5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Service life is shorter than for dry cutting.)

Note 5) When using under higher than recommended cutting conditions, or for long periods of time, the bit may become fatigued and break during machining. Please change out the bit periodically.

**Cutting Conditions (Guide) :**

● : Stable Cutting ● : General Cutting ✖ : Unstable Cutting

## Wet Cutting

### Depth of Cut / Feed per Tooth

| Workpiece Material                      | Characteristics                                 | ae (mm)                                        | Cutting Conditions | DC (mm) |           |           |           |           |
|-----------------------------------------|-------------------------------------------------|------------------------------------------------|--------------------|---------|-----------|-----------|-----------|-----------|
|                                         |                                                 |                                                |                    | ø25     |           | ø28—ø80   |           |           |
|                                         |                                                 |                                                |                    | ap (mm) | fz (mm/t) | ap (mm)   | fz (mm/t) |           |
| P                                       | Mild Steel                                      | Hardness<br>≤180HB                             | ≤0.25DC            | ● ● ✖   | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.30 |
|                                         |                                                 |                                                | 0.25—0.5DC         | ● ● ✖   | ≤11       | 0.10—0.15 | ≤11       | 0.10—0.25 |
|                                         |                                                 |                                                | 0.5—0.75DC         | ● ● ✖   | ≤8        | 0.08—0.12 | ≤8        | 0.10—0.20 |
|                                         |                                                 |                                                | DC(Slot)           | ● ● ✖   | ≤5        | 0.06—0.10 | ≤5        | 0.08—0.15 |
|                                         | Carbon Steel<br>Alloy Steel<br>Alloy Tool Steel | Hardness<br>180—280HB                          | ≤0.25DC            | ● ● ✖   | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.30 |
|                                         |                                                 |                                                | 0.25—0.5DC         | ● ● ✖   | ≤11       | 0.10—0.15 | ≤11       | 0.10—0.25 |
|                                         |                                                 |                                                | 0.5—0.75DC         | ● ● ✖   | ≤8        | 0.08—0.12 | ≤8        | 0.10—0.20 |
|                                         |                                                 |                                                | DC(Slot)           | ● ● ✖   | ≤5        | 0.06—0.10 | ≤5        | 0.08—0.15 |
|                                         | Carbon Steel<br>Alloy Steel<br>Alloy Tool Steel | Hardness<br>280—350HB<br>≤350HB<br>(Annealing) | ≤0.25DC            | ● ● ✖   | ≤11       | 0.10—0.15 | ≤11       | 0.10—0.25 |
|                                         |                                                 |                                                | 0.25—0.5DC         | ● ● ✖   | ≤11       | 0.08—0.12 | ≤11       | 0.10—0.20 |
|                                         |                                                 |                                                | 0.5—0.75DC         | ● ● ✖   | ≤8        | 0.06—0.10 | ≤8        | 0.10—0.15 |
|                                         |                                                 |                                                | DC(Slot)           | ● ● ✖   | ≤5        | 0.06—0.10 | ≤5        | 0.08—0.12 |
|                                         | Pre-hardened Steel                              | Hardness<br>35—45HRC                           | ≤0.25DC            | ● ● ✖   | ≤11       | 0.10—0.15 | ≤11       | 0.10—0.25 |
|                                         |                                                 |                                                | 0.25—0.5DC         | ● ● ✖   | ≤11       | 0.08—0.12 | ≤11       | 0.10—0.20 |
|                                         |                                                 |                                                | 0.5—0.75DC         | ● ● ✖   | ≤8        | 0.06—0.10 | ≤8        | 0.10—0.15 |
|                                         |                                                 |                                                | DC(Slot)           | ● ● ✖   | ≤5        | 0.06—0.10 | ≤5        | 0.08—0.12 |
| M                                       | Austenitic Stainless Steel                      | —                                              | ≤0.25DC            | ● ● ✖   | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.20 |
|                                         |                                                 |                                                |                    | ● ● ✖   | ≤11       | 0.08—0.15 | ≤11       | 0.08—0.15 |
|                                         |                                                 |                                                | 0.25—0.5DC         | ● ● ✖   | ≤11       | 0.08—0.12 | ≤11       | 0.08—0.15 |
|                                         |                                                 |                                                |                    | ● ● ✖   | ≤11       | 0.06—0.10 | ≤11       | 0.08—0.12 |
|                                         |                                                 |                                                | 0.5—0.75DC         | ● ● ✖   | ≤8        | 0.06—0.10 | ≤8        | 0.08—0.12 |
|                                         |                                                 |                                                |                    | ● ● ✖   | ≤8        | 0.06—0.10 | ≤8        | 0.06—0.10 |
|                                         |                                                 |                                                | DC(Slot)           | ● ● ✖   | ≤5        | 0.06—0.10 | ≤5        | 0.06—0.10 |
|                                         |                                                 |                                                |                    | ● ● ✖   | ≤5        | 0.06—0.08 | ≤5        | 0.06—0.08 |
|                                         | Duplex Stainless Steel                          | Hardness<br>≤280HB                             | ≤0.25DC            | ● ● ✖   | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.20 |
|                                         |                                                 |                                                |                    | ● ● ✖   | ≤11       | 0.08—0.15 | ≤11       | 0.08—0.15 |
|                                         |                                                 |                                                | 0.25—0.5DC         | ● ● ✖   | ≤11       | 0.08—0.15 | ≤11       | 0.08—0.15 |
|                                         |                                                 |                                                |                    | ● ● ✖   | ≤11       | 0.08—0.12 | ≤11       | 0.08—0.12 |
|                                         |                                                 |                                                | 0.5—0.75DC         | ● ● ✖   | ≤8        | 0.08—0.12 | ≤8        | 0.08—0.12 |
|                                         |                                                 |                                                |                    | ● ● ✖   | ≤8        | 0.06—0.10 | ≤8        | 0.06—0.10 |
|                                         |                                                 |                                                | DC(Slot)           | ● ● ✖   | ≤5        | 0.06—0.10 | ≤5        | 0.06—0.10 |
|                                         |                                                 |                                                |                    | ● ● ✖   | ≤5        | 0.06—0.08 | ≤5        | 0.06—0.08 |
|                                         | Ferritic and Martensitic Stainless Steel        | —                                              | ≤0.25DC            | ● ● ✖   | ≤11       | 0.10—0.20 | ≤11       | 0.10—0.20 |
|                                         |                                                 |                                                |                    | ● ● ✖   | ≤11       | 0.08—0.15 | ≤11       | 0.08—0.15 |
|                                         |                                                 |                                                | 0.25—0.5DC         | ● ● ✖   | ≤11       | 0.08—0.15 | ≤11       | 0.08—0.15 |
|                                         |                                                 |                                                |                    | ● ● ✖   | ≤11       | 0.08—0.12 | ≤11       | 0.08—0.12 |
|                                         |                                                 |                                                | 0.5—0.75DC         | ● ● ✖   | ≤8        | 0.08—0.12 | ≤8        | 0.08—0.12 |
|                                         |                                                 |                                                |                    | ● ● ✖   | ≤8        | 0.06—0.10 | ≤8        | 0.06—0.10 |
|                                         |                                                 |                                                | DC(Slot)           | ● ● ✖   | ≤5        | 0.06—0.10 | ≤5        | 0.06—0.10 |
|                                         |                                                 |                                                |                    | ● ● ✖   | ≤5        | 0.06—0.08 | ≤5        | 0.06—0.08 |
| Precipitation-Hardening Stainless Steel | Hardness<br><450HB                              | ≤0.25DC                                        | ● ● ✖              | ≤11     | 0.10—0.15 | ≤11       | 0.10—0.15 |           |
|                                         |                                                 |                                                | ● ● ✖              | ≤11     | 0.08—0.12 | ≤11       | 0.08—0.12 |           |
|                                         |                                                 | 0.25—0.5DC                                     | ● ● ✖              | ≤11     | 0.08—0.12 | ≤11       | 0.08—0.12 |           |
|                                         |                                                 |                                                | ● ● ✖              | ≤11     | 0.08—0.12 | ≤11       | 0.08—0.12 |           |
|                                         |                                                 | 0.5—0.75DC                                     | ● ● ✖              | ≤8      | 0.06—0.10 | ≤8        | 0.06—0.10 |           |
|                                         |                                                 |                                                | ● ● ✖              | ≤8      | 0.06—0.08 | ≤8        | 0.06—0.08 |           |
|                                         |                                                 | DC(Slot)                                       | ● ● ✖              | ≤5      | 0.06—0.10 | ≤5        | 0.06—0.10 |           |
|                                         |                                                 |                                                | ● ● ✖              | ≤5      | 0.06—0.08 | ≤5        | 0.06—0.08 |           |



**Cutting Conditions (Guide) :**

● : Stable Cutting ● : General Cutting ✖ : Unstable Cutting

## RECOMMENDED CUTTING CONDITIONS

### Wet Cutting

#### Depth of Cut / Feed per Tooth

| Workpiece Material | Characteristics                             | ae (mm)                     | Cutting Conditions | DC (mm) |           |         |           |
|--------------------|---------------------------------------------|-----------------------------|--------------------|---------|-----------|---------|-----------|
|                    |                                             |                             |                    | ø25     |           | ø28—ø80 |           |
|                    |                                             |                             |                    | ap (mm) | fz (mm/t) | ap (mm) | fz (mm/t) |
| K                  | Gray Cast Iron                              | Tensile Strength<br>≤350MPa | ● ●                | ≤11     | 0.10—0.20 | ≤11     | 0.10—0.30 |
|                    |                                             |                             |                    | ● ✖     | 0.08—0.15 | ≤11     | 0.10—0.25 |
|                    |                                             |                             | ● ●                | ≤11     | 0.08—0.15 | ≤11     | 0.10—0.25 |
|                    |                                             |                             |                    | ● ✖     | 0.08—0.12 | ≤11     | 0.10—0.20 |
|                    |                                             |                             | ● ●                | ≤8      | 0.08—0.12 | ≤8      | 0.10—0.20 |
|                    |                                             |                             |                    | ● ✖     | 0.06—0.10 | ≤8      | 0.08—0.15 |
|                    |                                             |                             | ● ●                | ≤5      | 0.06—0.10 | ≤5      | 0.08—0.15 |
|                    |                                             |                             |                    | ● ✖     | 0.06—0.08 | ≤5      | 0.08—0.12 |
|                    |                                             |                             | ● ●                | ≤11     | 0.10—0.20 | ≤11     | 0.10—0.25 |
|                    |                                             |                             |                    | ● ✖     | 0.10—0.15 | ≤11     | 0.10—0.20 |
|                    | Ductile Cast Iron                           | Tensile Strength<br>≤800MPa | ● ●                | ≤11     | 0.10—0.15 | ≤11     | 0.10—0.20 |
|                    |                                             |                             |                    | ● ✖     | 0.08—0.12 | ≤11     | 0.10—0.15 |
|                    |                                             |                             | ● ●                | ≤8      | 0.08—0.12 | ≤8      | 0.10—0.15 |
|                    |                                             |                             |                    | ● ✖     | 0.06—0.10 | ≤8      | 0.08—0.12 |
|                    |                                             |                             | ● ●                | ≤5      | 0.06—0.10 | ≤5      | 0.08—0.12 |
|                    |                                             |                             |                    | ● ✖     | 0.06—0.08 | ≤5      | 0.06—0.10 |
| N                  | Aluminium Alloy                             | Content<br>Si<5%            | ● ●                | ≤11     | 0.10—0.25 | ≤11     | 0.10—0.25 |
|                    |                                             |                             |                    | ● ✖     | 0.10—0.20 | ≤11     | 0.10—0.20 |
|                    |                                             |                             | ● ●                | ≤11     | 0.10—0.20 | ≤11     | 0.10—0.20 |
|                    |                                             |                             |                    | ● ✖     | 0.10—0.15 | ≤11     | 0.10—0.15 |
|                    |                                             |                             | ● ●                | ≤8      | 0.06—0.15 | ≤8      | 0.08—0.15 |
|                    |                                             |                             |                    | ● ✖     | 0.06—0.15 | ≤8      | 0.08—0.15 |
|                    |                                             |                             | ● ●                | ≤5      | 0.06—0.15 | ≤5      | 0.08—0.15 |
|                    |                                             |                             |                    | ● ✖     | 0.06—0.15 | ≤5      | 0.08—0.12 |
| S                  | Titanium Alloy<br>(Ti-6Al-4V, etc.)         | —                           | ● ● ✖              | ≤11     | 0.08—0.15 | ≤11     | 0.08—0.15 |
|                    |                                             |                             |                    | ● ● ✖   | 0.08—0.12 | ≤11     | 0.08—0.12 |
|                    |                                             |                             | ● ● ✖              | ≤8      | 0.06—0.10 | ≤8      | 0.06—0.10 |
|                    |                                             |                             |                    | ● ● ✖   | 0.06—0.10 | ≤5      | 0.06—0.10 |
|                    | Titanium Alloy<br>(Ti-5Al-5V-5Mo-3Cr, etc.) | —                           | ● ● ✖              | ≤11     | 0.08—0.12 | ≤11     | 0.08—0.12 |
|                    |                                             |                             |                    | ● ● ✖   | 0.08—0.12 | ≤11     | 0.08—0.12 |
|                    |                                             |                             | ● ● ✖              | ≤8      | 0.06—0.10 | ≤8      | 0.06—0.10 |
|                    |                                             |                             |                    | ● ● ✖   | 0.06—0.10 | ≤5      | 0.06—0.10 |
|                    | Heat Resistant Alloy                        | —                           | ● ● ✖              | ≤11     | 0.08—0.12 | ≤11     | 0.08—0.12 |
|                    |                                             |                             |                    | ● ● ✖   | 0.08—0.12 | ≤11     | 0.08—0.12 |
|                    |                                             |                             | ● ● ✖              | ≤8      | 0.06—0.10 | ≤8      | 0.06—0.10 |
|                    |                                             |                             |                    | ● ● ✖   | 0.06—0.10 | ≤5      | 0.06—0.10 |
| H                  | Hardened Steel                              | Hardness<br>40—55HRC        | ● ●                | ≤5      | 0.08—0.15 | ≤5      | 0.08—0.15 |
|                    |                                             |                             |                    | ● ✖     | 0.08—0.12 | ≤5      | 0.08—0.12 |
|                    |                                             |                             | ● ●                | ≤4      | 0.08—0.12 | ≤4      | 0.08—0.12 |
|                    |                                             |                             |                    | ● ✖     | 0.06—0.10 | ≤4      | 0.06—0.10 |
|                    |                                             |                             | ● ●                | ≤3      | 0.06—0.10 | ≤3      | 0.06—0.10 |
|                    |                                             |                             |                    | ● ✖     | 0.06—0.10 | ≤3      | 0.06—0.08 |
|                    |                                             |                             | ● ●                | ≤2      | 0.06—0.10 | ≤2      | 0.06—0.10 |
|                    |                                             |                             |                    | ● ✖     | 0.06—0.10 | ≤2      | 0.06—0.08 |

Note 1) These cutting conditions should be referenced for standard shank types (last letter in designation is S) and arbor shank types. If there is chatter, insert chipping, etc. during machining, alter conditions accordingly.

Note 2) Chattering vibration is more likely under the following circumstances. Use a cut and feed per tooth that are at minimum recommended conditions or below.

- When tool overhang is long (using a long shank, screw-in type, etc.)
- Rigidity of machine, workpiece material or attachment of workpiece material is low
- Corner radius during pocket machining

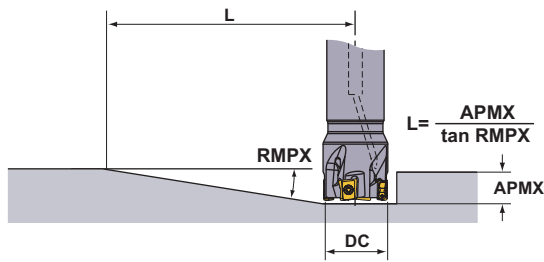
Note 3) A type with fewer teeth is recommended when the depth of cut in the radius direction (ae) is 0.5 DC or more.

Note 4) Wet cutting is recommended, when focusing on the surface finish. (Service life is shorter than for dry cutting.)

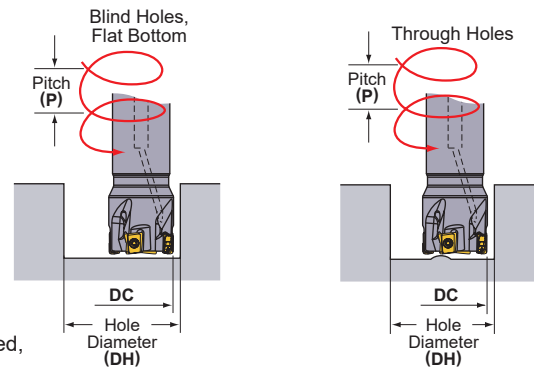
Note 5) When using under higher than recommended cutting conditions, or for long periods of time, the bit may become fatigued and break during machining. Please change out the bit periodically.

## ■ Ramping / Helical Milling

### ● Ramping



### ● Helical Milling



Refer to the table below for cutting conditions. For feed per tooth and cutting speed, follow the cutting conditions for slot milling.

| DC<br>(mm) | RE<br>(mm) | Ramping |          | Helical Milling (Blind Hole, Flat Bottom) |                |                 |                | Helical Milling (Through Hole) |                |
|------------|------------|---------|----------|-------------------------------------------|----------------|-----------------|----------------|--------------------------------|----------------|
|            |            | RMPX    | L (mm) * | DH max.<br>(mm)                           | P max.<br>(mm) | DH min.<br>(mm) | P max.<br>(mm) | DH min.<br>(mm)                | P max.<br>(mm) |
| 25         | 0.2        | 2.13°   | 296      | 49                                        | 2.8            | 42.7            | 2.1            | 36.9                           | 1.4            |
|            | 0.4        | 2.13°   | 296      | 48.6                                      | 2.8            | 42.7            | 2.1            | 36.9                           | 1.4            |
|            | 0.8        | 2.13°   | 296      | 47.8                                      | 2.7            | 42.7            | 2.1            | 36.9                           | 1.4            |
|            | 1          | 2.13°   | 296      | 47.4                                      | 2.6            | 42.7            | 2.1            | 36.9                           | 1.4            |
|            | 1.2        | 2.13°   | 296      | 47                                        | 2.6            | 42.7            | 2.1            | 36.9                           | 1.4            |
|            | 1.6        | 2.13°   | 296      | 46.2                                      | 2.5            | 42.7            | 2.1            | 36.9                           | 1.4            |
|            | 2          | 2.13°   | 296      | 45.4                                      | 2.4            | 42.7            | 2.1            | 36.9                           | 1.4            |
|            | 2.4        | 2.13°   | 296      | 44.6                                      | 2.3            | 42.7            | 2.1            | 36.9                           | 1.4            |
|            | 3          | 2.13°   | 296      | 43.4                                      | 2.2            | 42.7            | 2.1            | 36.9                           | 1.4            |
|            | 3.2        | 2.13°   | 296      | 43                                        | 2.1            | 42.7            | 2.1            | 36.9                           | 1.4            |
| 28         | 0.2        | 1.77°   | 356      | 55                                        | 2.6            | 48.7            | 2              | 42.7                           | 1.4            |
|            | 0.4        | 1.77°   | 356      | 54.6                                      | 2.6            | 48.7            | 2              | 42.7                           | 1.4            |
|            | 0.8        | 1.77°   | 356      | 53.8                                      | 2.5            | 48.7            | 2              | 42.7                           | 1.4            |
|            | 1          | 1.77°   | 356      | 53.4                                      | 2.5            | 48.7            | 2              | 42.7                           | 1.4            |
|            | 1.2        | 1.77°   | 356      | 53                                        | 2.4            | 48.7            | 2              | 42.7                           | 1.4            |
|            | 1.6        | 1.77°   | 356      | 52.2                                      | 2.4            | 48.7            | 2              | 42.7                           | 1.4            |
|            | 2          | 1.77°   | 356      | 51.4                                      | 2.3            | 48.7            | 2              | 42.7                           | 1.4            |
|            | 2.4        | 1.77°   | 356      | 50.6                                      | 2.2            | 48.7            | 2              | 42.7                           | 1.4            |
|            | 3          | 1.77°   | 356      | 49.4                                      | 2.1            | 48.7            | 2              | 42.7                           | 1.4            |
|            | 3.2        | 1.77°   | 356      | 49                                        | 2              | 48.7            | 2              | 42.7                           | 1.4            |
| 30         | 0.2        | 1.61°   | 392      | 59                                        | 2.6            | 52.7            | 2              | 46.6                           | 1.5            |
|            | 0.4        | 1.61°   | 392      | 58.6                                      | 2.5            | 52.7            | 2              | 46.6                           | 1.5            |
|            | 0.8        | 1.61°   | 392      | 57.8                                      | 2.5            | 52.7            | 2              | 46.6                           | 1.5            |
|            | 1          | 1.61°   | 392      | 57.4                                      | 2.4            | 52.7            | 2              | 46.6                           | 1.5            |
|            | 1.2        | 1.61°   | 392      | 57                                        | 2.4            | 52.7            | 2              | 46.6                           | 1.5            |
|            | 1.6        | 1.61°   | 392      | 56.2                                      | 2.3            | 52.7            | 2              | 46.6                           | 1.5            |
|            | 2          | 1.61°   | 392      | 55.4                                      | 2.2            | 52.7            | 2              | 46.6                           | 1.5            |
|            | 2.4        | 1.61°   | 392      | 54.6                                      | 2.2            | 52.7            | 2              | 46.6                           | 1.5            |
|            | 3          | 1.61°   | 392      | 53.4                                      | 2.1            | 52.7            | 2              | 46.6                           | 1.5            |
|            | 3.2        | 1.61°   | 392      | 53                                        | 2              | 52.7            | 2              | 46.6                           | 1.5            |
| 32         | 0.2        | 1.47°   | 429      | 63                                        | 2.5            | 56.7            | 2              | 50.6                           | 1.5            |
|            | 0.4        | 1.47°   | 429      | 62.6                                      | 2.5            | 56.7            | 2              | 50.6                           | 1.5            |
|            | 0.8        | 1.47°   | 429      | 61.8                                      | 2.4            | 56.7            | 2              | 50.6                           | 1.5            |
|            | 1          | 1.47°   | 429      | 61.4                                      | 2.4            | 56.7            | 2              | 50.6                           | 1.5            |
|            | 1.2        | 1.47°   | 429      | 61                                        | 2.3            | 56.7            | 2              | 50.6                           | 1.5            |
|            | 1.6        | 1.47°   | 429      | 60.2                                      | 2.3            | 56.7            | 2              | 50.6                           | 1.5            |
|            | 2          | 1.47°   | 429      | 59.4                                      | 2.2            | 56.7            | 2              | 50.6                           | 1.5            |
|            | 2.4        | 1.47°   | 429      | 58.6                                      | 2.1            | 56.7            | 2              | 50.6                           | 1.5            |
|            | 3          | 1.47°   | 429      | 57.4                                      | 2.1            | 56.7            | 2              | 50.6                           | 1.5            |
|            | 3.2        | 1.47°   | 429      | 57                                        | 2              | 56.7            | 2              | 50.6                           | 1.5            |

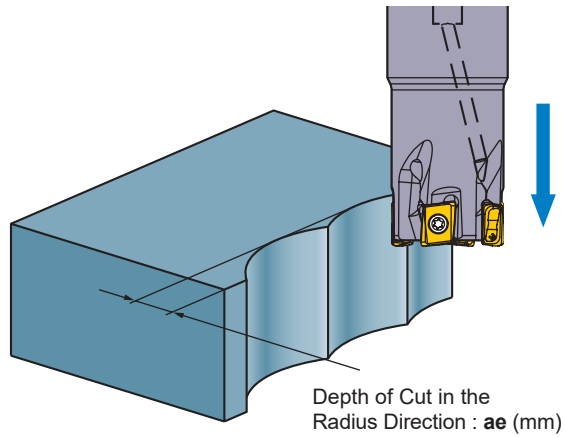
Note 1) When machining a highly ductile workpiece material with the ramping angles in the table above, chips can become long.  
 \* Shows the distance until a maximum depth of cut of 11 mm is achieved at the maximum ramping angle  $L (= 11/\tan RMPX)$ .

| DC<br>(mm) | RE<br>(mm) | Ramping |          | Helical Milling (Blind Hole, Flat Bottom) |                |                 |                | Helical Milling (Through Hole) |                |
|------------|------------|---------|----------|-------------------------------------------|----------------|-----------------|----------------|--------------------------------|----------------|
|            |            | RMPX    | L (mm) * | DH max.<br>(mm)                           | P max.<br>(mm) | DH min.<br>(mm) | P max.<br>(mm) | DH min.<br>(mm)                | P max.<br>(mm) |
| 35         | 0.2        | 1.28°   | 493      | 69                                        | 2.4            | 62.8            | 1.9            | 56.6                           | 1.5            |
|            | 0.4        | 1.28°   | 493      | 68.6                                      | 2.4            | 62.8            | 1.9            | 56.6                           | 1.5            |
|            | 0.8        | 1.28°   | 493      | 67.8                                      | 2.3            | 62.8            | 1.9            | 56.6                           | 1.5            |
|            | 1          | 1.28°   | 493      | 67.4                                      | 2.3            | 62.8            | 1.9            | 56.6                           | 1.5            |
|            | 1.2        | 1.28°   | 493      | 67                                        | 2.2            | 62.8            | 1.9            | 56.6                           | 1.5            |
|            | 1.6        | 1.28°   | 493      | 66.2                                      | 2.2            | 62.8            | 1.9            | 56.6                           | 1.5            |
|            | 2          | 1.28°   | 493      | 65.4                                      | 2.1            | 62.8            | 1.9            | 56.6                           | 1.5            |
|            | 2.4        | 1.28°   | 493      | 64.6                                      | 2.1            | 62.8            | 1.9            | 56.6                           | 1.5            |
|            | 3          | 1.28°   | 493      | 63.4                                      | 2              | 62.8            | 1.9            | 56.6                           | 1.5            |
|            | 3.2        | 1.28°   | 493      | 63                                        | 2              | 62.8            | 1.9            | 56.6                           | 1.5            |
| 40         | 0.2        | 1.06°   | 595      | 78.8                                      | 2.3            | 72.7            | 1.9            | 66.5                           | 1.5            |
|            | 0.4        | 1.06°   | 595      | 78.4                                      | 2.2            | 72.7            | 1.9            | 66.5                           | 1.5            |
|            | 0.8        | 1.06°   | 595      | 77.6                                      | 2.2            | 72.7            | 1.9            | 66.5                           | 1.5            |
|            | 1          | 1.06°   | 595      | 77.2                                      | 2.2            | 72.7            | 1.9            | 66.5                           | 1.5            |
|            | 1.2        | 1.06°   | 595      | 76.8                                      | 2.1            | 72.7            | 1.9            | 66.5                           | 1.5            |
|            | 1.6        | 1.06°   | 595      | 76                                        | 2.1            | 72.7            | 1.9            | 66.5                           | 1.5            |
|            | 2          | 1.06°   | 595      | 75.2                                      | 2              | 72.7            | 1.9            | 66.5                           | 1.5            |
|            | 2.4        | 1.06°   | 595      | 74.4                                      | 2              | 72.7            | 1.9            | 66.5                           | 1.5            |
|            | 3          | 1.06°   | 595      | 73.2                                      | 1.9            | 72.7            | 1.9            | 66.5                           | 1.5            |
|            | 3.2        | 1.06°   | 595      | 72.8                                      | 1.9            | 72.7            | 1.9            | 66.5                           | 1.5            |
| 50         | 0.2        | 0.79°   | 798      | 98.8                                      | 2.1            | 92.7            | 1.8            | 86.5                           | 1.6            |
|            | 0.4        | 0.79°   | 798      | 98.4                                      | 2.1            | 92.7            | 1.8            | 86.5                           | 1.6            |
|            | 0.8        | 0.79°   | 798      | 97.6                                      | 2.1            | 92.7            | 1.8            | 86.5                           | 1.6            |
|            | 1          | 0.79°   | 798      | 97.2                                      | 2              | 92.7            | 1.8            | 86.5                           | 1.6            |
|            | 1.2        | 0.79°   | 798      | 96.8                                      | 2              | 92.7            | 1.8            | 86.5                           | 1.6            |
|            | 1.6        | 0.79°   | 798      | 96                                        | 2              | 92.7            | 1.8            | 86.5                           | 1.6            |
|            | 2          | 0.79°   | 798      | 95.2                                      | 2              | 92.7            | 1.8            | 86.5                           | 1.6            |
|            | 2.4        | 0.79°   | 798      | 94.4                                      | 1.9            | 92.7            | 1.8            | 86.5                           | 1.6            |
|            | 3          | 0.79°   | 798      | 93.2                                      | 1.9            | 92.7            | 1.8            | 86.5                           | 1.6            |
|            | 3.2        | 0.79°   | 798      | 92.8                                      | 1.9            | 92.7            | 1.8            | 86.5                           | 1.6            |
| 63         | 0.2        | 0.6°    | 1051     | 124.8                                     | 2              | 118.7           | 1.8            | 112.5                          | 1.6            |
|            | 0.4        | 0.6°    | 1051     | 124.4                                     | 2              | 118.7           | 1.8            | 112.5                          | 1.6            |
|            | 0.8        | 0.6°    | 1051     | 123.6                                     | 2              | 118.7           | 1.8            | 112.5                          | 1.6            |
|            | 1          | 0.6°    | 1051     | 123.2                                     | 2              | 118.7           | 1.8            | 112.5                          | 1.6            |
|            | 1.2        | 0.6°    | 1051     | 122.8                                     | 2              | 118.7           | 1.8            | 112.5                          | 1.6            |
|            | 1.6        | 0.6°    | 1051     | 122                                       | 1.9            | 118.7           | 1.8            | 112.5                          | 1.6            |
|            | 2          | 0.6°    | 1051     | 121.2                                     | 1.9            | 118.7           | 1.8            | 112.5                          | 1.6            |
|            | 2.4        | 0.6°    | 1051     | 120.4                                     | 1.9            | 118.7           | 1.8            | 112.5                          | 1.6            |
|            | 3          | 0.6°    | 1051     | 119.2                                     | 1.9            | 118.7           | 1.8            | 112.5                          | 1.6            |
|            | 3.2        | 0.6°    | 1051     | 118.8                                     | 1.8            | 118.7           | 1.8            | 112.5                          | 1.6            |
| 80         | 0.2        | 0.45°   | 1401     | 158.8                                     | 1.9            | 152.6           | 1.8            | 146.5                          | 1.6            |
|            | 0.4        | 0.45°   | 1401     | 158.4                                     | 1.9            | 152.7           | 1.8            | 146.5                          | 1.6            |
|            | 0.8        | 0.45°   | 1401     | 157.6                                     | 1.9            | 152.7           | 1.8            | 146.5                          | 1.6            |
|            | 1          | 0.45°   | 1401     | 157.2                                     | 1.9            | 152.7           | 1.8            | 146.5                          | 1.6            |
|            | 1.2        | 0.45°   | 1401     | 156.8                                     | 1.9            | 152.7           | 1.8            | 146.5                          | 1.6            |
|            | 1.6        | 0.45°   | 1401     | 156                                       | 1.9            | 152.7           | 1.8            | 146.5                          | 1.6            |
|            | 2          | 0.45°   | 1401     | 155.2                                     | 1.9            | 152.7           | 1.8            | 146.5                          | 1.6            |
|            | 2.4        | 0.45°   | 1401     | 154.4                                     | 1.8            | 152.7           | 1.8            | 146.5                          | 1.6            |
|            | 3          | 0.45°   | 1401     | 153.2                                     | 1.8            | 152.7           | 1.8            | 146.5                          | 1.6            |
|            | 3.2        | 0.45°   | 1401     | 152.8                                     | 1.8            | 152.7           | 1.8            | 146.5                          | 1.6            |

## ■ For Plunging and Drilling

See the tables to the right for cutting conditions. Follow the cutting conditions for slot milling regarding feed per tooth and cutting speed.

### ● Plunging



#### VPX200

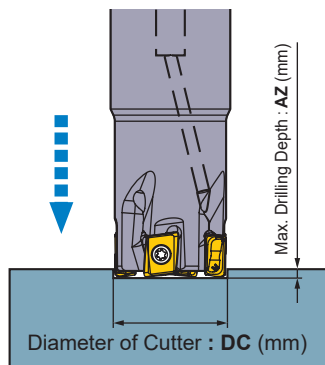
| DC (mm) | ae max. (mm) |
|---------|--------------|
| 16      | 3.9          |
| 18      | 3.9          |
| 20      | 3.9          |
| 22      | 4.0          |
| 25      | 4.0          |
| 28      | 4.0          |
| 30      | 4.0          |
| 32      | 4.0          |
| 35      | 4.0          |
| 40      | 4.0          |
| 50      | 4.0          |
| 63      | 4.0          |

#### VPX300

| DC (mm) | ae max. (mm) |
|---------|--------------|
| 25      | 6.5          |
| 28      | 6.6          |
| 30      | 6.6          |
| 32      | 6.6          |
| 35      | 6.7          |
| 40      | 6.7          |
| 50      | 6.7          |
| 63      | 6.7          |
| 80      | 6.7          |

Note 1) No step feed necessary.

### ● Drilling



#### VPX200

| DC (mm) | AZ max. (mm) |
|---------|--------------|
| 16      | 0.3          |
| 18      | 0.3          |
| 20      | 0.3          |
| 22      | 0.3          |
| 25      | 0.3          |
| 28      | 0.3          |
| 30      | 0.3          |
| 32      | 0.3          |
| 35      | 0.3          |
| 40      | 0.3          |
| 50      | 0.3          |
| 63      | 0.3          |

#### VPX300

| DC (mm) | AZ max. (mm) |
|---------|--------------|
| 25      | 0.55         |
| 28      | 0.55         |
| 30      | 0.55         |
| 32      | 0.55         |
| 35      | 0.55         |
| 40      | 0.55         |
| 50      | 0.55         |
| 63      | 0.55         |
| 80      | 0.55         |

Note 1) Exercise due caution as chips scatter easily.

Note 2) Use compressed air to eliminate chips (or coolant for when machining aluminium alloy).