

Cutting Conditions (Guide)

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

Recommended Cutting Conditions

■ Dry Cutting Cutting Speed

(mm)

| Workpiece Material | Properties | Cutting Conditions | Grade | ae | | | | |
|--------------------|--|--|--------------------------|---------------|--------------|--------------|--------------|--------------|
| | | | | 0.5DC≥ | 0.8DC≥ | DC(Slot) | | |
| | | | | vc (m/min) | | | | |
| P | Mild Steels | Hardness ≤180HB | ● | MP6120 | 240(200–280) | 220(180–260) | 200(160–240) | |
| | | | ● | MP6130 | 230(190–270) | 210(170–250) | 190(150–230) | |
| | | | ✖ | MP6130,VP15TF | 210(170–250) | 190(150–230) | 170(130–210) | |
| | Carbon Steels Alloy Steels | Hardness 180–280HB | ● | MP6120 | 210(170–250) | 190(150–230) | 170(130–210) | |
| | | | ● | MP6130 | 200(160–240) | 180(140–220) | 160(120–200) | |
| | | | ✖ | MP6130,VP15TF | 180(140–220) | 160(120–200) | 140(100–180) | |
| | Carbon Steels Alloy Steels Alloy Tool Steels | Hardness 280–350HB ≤350HB (Annealing) | ● | MP6120 | 200(160–240) | 180(140–220) | 160(120–200) | |
| | | | ● | MP6130 | 190(150–230) | 170(130–210) | 150(110–190) | |
| | | | ✖ | MP6130,VP15TF | 170(130–210) | 150(110–190) | 130(90–170) | |
| | Pre-hardened Steels | Hardness 35–45HRC | ● | MP6120 | 140(120–160) | – | – | |
| | | | ● | MP6130 | 120(100–140) | – | – | |
| | | | ✖ | MP6130,VP15TF | 110(90–130) | – | – | |
| M | Austenitic Stainless Steels | Hardness ≤200HB | ● | MP7130 | 180(160–200) | 160(140–180) | – | |
| | | | ● | MP7130,VP15TF | 170(150–190) | 150(130–170) | – | |
| | | | ✖ | MP7130,VP15TF | 150(130–170) | 130(110–150) | – | |
| | Austenitic Stainless Steels | Hardness >200HB | ● | MP7130 | 170(150–190) | 150(130–170) | – | |
| | | | ● | MP7130,VP15TF | 160(140–180) | 140(120–160) | – | |
| | | | ✖ | MP7130,VP15TF | 140(120–160) | 120(100–140) | – | |
| | Ferritic and Martensitic Stainless Steels | Hardness ≤200HB | ● | MP7130 | 180(160–200) | 160(140–180) | – | |
| | | | ● | MP7130,VP15TF | 170(150–190) | 150(130–170) | – | |
| | | | ✖ | MP7130,VP15TF | 150(130–170) | 130(110–150) | – | |
| | Duplex Stainless Steels | Hardness ≤280HB | ● | MP7130 | 160(140–180) | 140(120–160) | – | |
| | | | ● | MP7130,VP15TF | 150(130–170) | 130(110–150) | – | |
| | | | ✖ | MP7130,VP15TF | 130(110–150) | 110(90–130) | – | |
| | Precipitation Hardening Stainless Steels | Hardness <450HB | ● | MP7130 | 140(120–160) | – | – | |
| | | | ● | MP7130,VP15TF | 130(110–150) | – | – | |
| | | | ✖ | MP7130,VP15TF | 110(90–130) | – | – | |
| | K | Gray Cast Irons | Tensile Strength ≤350MPa | ● | MC5020 | 250(210–290) | 230(190–270) | 210(170–250) |
| | | | | ● | MC5020 | 240(200–280) | 220(180–260) | 200(160–240) |
| | | | | ● | VP15TF | 240(200–280) | 220(180–260) | – |
| ✖ | | | | MC5020,VP15TF | 220(180–260) | 200(160–240) | 180(140–220) | |
| Ductile Cast Irons | | Tensile Strength ≤450MPa | ● | MC5020 | 220(180–260) | 200(160–240) | 180(140–220) | |
| | | | ● | MC5020 | 210(170–250) | 190(150–230) | 170(130–210) | |
| | | | ● | VP15TF | 210(170–250) | 190(150–230) | – | |
| | | | ✖ | MC5020,VP15TF | 190(150–230) | 170(130–210) | 150(110–190) | |
| Ductile Cast Irons | | Tensile Strength ≤800MPa | ● | MC5020 | 180(140–220) | 160(120–200) | 140(100–180) | |
| | | | ● | MC5020 | 170(130–210) | 150(110–190) | 130(90–170) | |
| | | | ● | VP15TF | 170(130–210) | 150(110–190) | – | |
| | | | ✖ | MC5020,VP15TF | 150(110–190) | 130(90–170) | 110(70–150) | |
| H | Hardened Steels | Hardness 40–55HRC | ● | VP15TF | 50(30–70) | – | – | |
| | | | ● | VP15TF | 50(30–70) | – | – | |

Note 1) The recommended cutting speed has been calculated for a depth of cut 2mm. Please reduce the cutting speed by an appropriate amount corresponding to the increase in cutting depth.

Cutting Conditions (Guide)

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

Recommended Cutting Conditions

**Wet Cutting
Cutting Speed**

(mm)

| Workpiece Material | Properties | Cutting Conditions | Grade | ae | | | |
|---|--|--|---------------|---------------|--------------|--------------|--------------|
| | | | | 0.5DC≥ | 0.8DC≥ | DC(Slot) | |
| | | | | vc (m/min) | | | |
| P | Mild Steels Hardness ≤180HB | ● | MP6120 | 150(140–160) | 130(120–140) | 120(110–130) | |
| | | ● | MP6130 | 140(130–150) | 120(110–130) | 110(100–120) | |
| | | ✖ | MP6130,VP15TF | 120(110–130) | 100(90–110) | 90(80–100) | |
| | Carbon Steels Alloy Steels | Hardness 180–280HB | ● | MP6120 | 150(140–160) | 130(120–140) | 120(110–130) |
| | | | ● | MP6130 | 140(130–150) | 120(110–130) | 110(100–120) |
| | | | ✖ | MP6130,VP15TF | 120(110–130) | 100(90–110) | 90(80–100) |
| | Carbon Steels Alloy Steels Alloy Tool Steels | Hardness 280–350HB ≤350HB (Annealing) | ● | MP6120 | 140(130–150) | 120(110–130) | 110(100–120) |
| | | | ● | MP6130 | 130(120–140) | 110(100–120) | 100(90–110) |
| | | | ✖ | MP6130,VP15TF | 110(100–120) | 90(80–100) | 80(70–90) |
| | Pre-hardened Steels | Hardness 35–45HRC | ● | MP6120 | 110(100–120) | — | — |
| | | | ● | MP6130 | 100(90–110) | — | — |
| | | | ✖ | MP6130,VP15TF | 80(70–90) | — | — |
| M | Austenitic Stainless Steels | ● | MP7130 | 130(120–140) | 110(100–120) | — | |
| | | ● | MP7130,VP15TF | 120(110–130) | 100(90–110) | — | |
| | | ✖ | MP7130,VP15TF | 100(90–110) | 80(70–90) | — | |
| | Austenitic Stainless Steels | Hardness >200HB | ● | MP7130 | 130(120–140) | 110(100–120) | — |
| | | | ● | MP7130,VP15TF | 120(110–130) | 100(90–110) | — |
| | | | ✖ | MP7130,VP15TF | 100(90–110) | 80(70–90) | — |
| | Ferritic and Martensitic Stainless Steels | Hardness ≤200HB | ● | MP7130 | 130(120–140) | 110(100–120) | — |
| | | | ● | MP7130,VP15TF | 120(110–130) | 100(90–110) | — |
| | | | ✖ | MP7130,VP15TF | 100(90–110) | 80(70–90) | — |
| | Duplex Stainless Steels | Hardness ≤280HB | ● | MP7130 | 120(110–130) | 100(90–110) | — |
| | | | ● | MP7130,VP15TF | 110(100–120) | 90(80–100) | — |
| | | | ✖ | MP7130,VP15TF | 90(80–100) | 70(60–80) | — |
| Precipitation Hardening Stainless Steels | Hardness <450HB | ● | MP7130 | 120(110–130) | — | — | |
| | | ● | MP7130,VP15TF | 110(100–120) | — | — | |
| | | ✖ | MP7130,VP15TF | 90(80–100) | — | — | |
| K | Gray Cast Irons | ● | MC5020 | 170(150–190) | 150(130–170) | 130(110–150) | |
| | | ● | MC5020 | 160(140–180) | 140(120–160) | 120(100–140) | |
| | | ● | VP15TF | 160(140–180) | 140(120–160) | — | |
| | | ✖ | MC5020,VP15TF | 140(120–160) | 120(100–140) | 100(80–120) | |
| | Ductile Cast Irons | Tensile Strength ≤450MPa | ● | MC5020 | 170(150–190) | 150(130–170) | 130(110–150) |
| | | | ● | MC5020 | 160(140–180) | 140(120–160) | 120(100–140) |
| | | | ● | VP15TF | 160(140–180) | 140(120–160) | — |
| | | | ✖ | MC5020,VP15TF | 140(120–160) | 120(100–140) | 100(80–120) |
| | Ductile Cast Irons | Tensile Strength ≤800MPa | ● | MC5020 | 160(150–170) | 140(130–150) | 120(110–130) |
| | | | ● | MC5020 | 150(140–160) | 130(120–140) | 110(100–120) |
| | | | ● | VP15TF | 150(140–160) | 130(120–140) | — |
| | | | ✖ | MC5020,VP15TF | 130(120–140) | 110(100–120) | 90(80–100) |
| N | Aluminium Alloys Content Si <5% | ● | TF15 | 500(300–900) | 500(300–900) | 500(300–900) | |
| | | ● | TF15 | 500(300–900) | 500(300–900) | 500(300–900) | |
| | | ✖ | TF15 | 400(200–800) | 400(200–800) | 400(200–800) | |
| S | Titanium Alloys | ● | MP9120 | 80(60–100) | — | — | |
| | | ● | MP9120 | 70(50–90) | — | — | |
| | | ✖ | MP9130 | 60(40–80) | — | — | |
| | Heat Resistant Alloys | — | ● | MP9120 | 60(50–70) | — | — |
| | | | ● | MP9120 | 50(30–60) | — | — |
| | | | ✖ | MP9130 | 40(20–40) | — | — |
| H | Hardened Steels Hardness 40–55HRC | ● | VP15TF | 50(30–70) | — | — | |
| | | ● | VP15TF | 50(30–70) | — | — | |

Note 1) Refer to the above table and set up cutting conditions according to cutting applications.

Recommended Cutting Conditions

Depth of Cut / Feed per Tooth

| Workpiece Material | Properties | Cutting Conditions | Grade | ae | | | |
|---------------------|--|---------------------------------------|---------------|---------------|------|-----------------|-----------------|
| | | | | 0.5DC ≥ | | | |
| | | | | Breaker | ap | fz (mm/t.) | |
| P | Mild Steels | Hardness ≤180HB | ● | MP6120 | L,M | ≤4.0 | 0.13(0.10—0.15) |
| | | | ● | MP6130 | L,M | ≤4.0 | 0.13(0.10—0.15) |
| | | | ● | MP6130,VP15TF | M,R | ≤4.0 | 0.16(0.10—0.20) |
| | | | ⚙ | | M,R | ≤4.0 | 0.13(0.10—0.15) |
| | Carbon Steels Alloy Steels | Hardness 180—280HB | ● | MP6120 | L,M | ≤4.0 | 0.13(0.10—0.15) |
| | | | ● | MP6130 | L,M | ≤4.0 | 0.13(0.10—0.15) |
| | | | ● | MP6130,VP15TF | M,R | ≤4.0 | 0.16(0.10—0.20) |
| | | | ⚙ | | M,R | ≤4.0 | 0.13(0.10—0.15) |
| | Carbon Steels Alloy Steels Alloy Tool Steels | Hardness 280—350HB ≤350HB (Annealing) | ● | MP6120 | L,M | ≤3.0 | 0.13(0.10—0.15) |
| | | | ● | MP6130 | L,M | ≤3.0 | 0.13(0.10—0.15) |
| | | | ● | MP6130,VP15TF | M,R | ≤3.0 | 0.16(0.10—0.20) |
| | | | ⚙ | | M,R | ≤3.0 | 0.13(0.10—0.15) |
| Pre-hardened Steels | Hardness 35—45HRC | ● | MP6120 | L,M | ≤2.0 | 0.13(0.10—0.15) | |
| | | ● | MP6130 | L,M | ≤2.0 | 0.13(0.10—0.15) | |
| | | ● | MP6130,VP15TF | M,R | ≤2.0 | 0.16(0.10—0.20) | |
| | | ⚙ | | M,R | ≤2.0 | 0.13(0.10—0.15) | |
| M | Austenitic Stainless Steels | Hardness ≤200HB | ● ● | MP7130 | L,M | ≤4.0 | 0.13(0.10—0.15) |
| | | | ● | VP15TF | M | ≤4.0 | 0.16(0.10—0.20) |
| | | | ⚙ | MP7130,VP15TF | M | ≤4.0 | 0.13(0.10—0.15) |
| | Austenitic Stainless Steels | Hardness >200HB | ● | MP7130 | L,M | ≤4.0 | 0.13(0.10—0.15) |
| | | | ● | MP7130 | L,M | ≤3.0 | 0.13(0.10—0.15) |
| | | | ● | VP15TF | M | ≤3.0 | 0.16(0.10—0.20) |
| | | | ⚙ | MP7130,VP15TF | M | ≤3.0 | 0.13(0.10—0.15) |
| | Ferritic and Martensitic Stainless Steels | Hardness ≤200HB | ● ● | MP7130 | L,M | ≤4.0 | 0.13(0.10—0.15) |
| | | | ● | VP15TF | M | ≤4.0 | 0.16(0.10—0.20) |
| | | | ⚙ | MP7130,VP15TF | M | ≤3.0 | 0.13(0.10—0.15) |
| | Duplex Stainless Steels | Hardness ≤280HB | ● ● | MP7130 | L,M | ≤3.0 | 0.13(0.10—0.15) |
| | | | ● ● | MP7130 | L,M | ≤4.0 | 0.13(0.10—0.15) |
| | | | ● | VP15TF | M | ≤3.0 | 0.16(0.10—0.20) |
| | | | ● | VP15TF | M | ≤4.0 | 0.16(0.10—0.20) |
| | | | ⚙ | MP7130,VP15TF | M | ≤3.0 | 0.13(0.10—0.15) |
| | | | ⚙ | MP7130,VP15TF | M | ≤4.0 | 0.13(0.10—0.15) |
| | Precipitation Hardening Stainless Steels | Hardness <450HB | ● | MP7130 | L,M | ≤2.0 | 0.13(0.10—0.15) |
| | | | ● | MP7130 | L,M | ≤2.0 | 0.13(0.10—0.15) |
| ● | | | VP15TF | M | ≤2.0 | 0.16(0.10—0.20) | |
| ⚙ | | | MP7130,VP15TF | M | ≤2.0 | 0.13(0.10—0.15) | |
| K | Gray Cast Irons | Tensile Strength ≤350MPa | ● ● | MC5020 | L,M | ≤4.0 | 0.13(0.10—0.15) |
| | | | ● | VP15TF | M,R | ≤4.0 | 0.16(0.10—0.20) |
| | | | ⚙ | MC5020,VP15TF | M,R | ≤4.0 | 0.13(0.10—0.15) |
| | Ductile Cast Irons | Tensile Strength ≤800MPa | ● ● | MC5020 | L,M | ≤4.0 | 0.13(0.10—0.15) |
| | | | ● | VP15TF | M,R | ≤4.0 | 0.16(0.10—0.20) |
| | | | ⚙ | MC5020,VP15TF | M,R | ≤4.0 | 0.13(0.10—0.15) |
| N | Aluminium Alloys | Content Si <5% | ● ● ⚙ | TF15 | L | ≤4.0 | 0.13(0.10—0.15) |
| S | Titanium Alloys | — | ● ● | MP9120 | L,M | ≤2.0 | 0.10(0.05—0.13) |
| | | | ⚙ | MP9130 | L,M | ≤2.0 | 0.10(0.05—0.13) |
| | Heat Resistant Alloys | — | ● ● | MP9120 | L,M | ≤2.0 | 0.10(0.05—0.13) |
| | | | ⚙ | MP9130 | L,M | ≤2.0 | 0.10(0.05—0.13) |
| H | Hardened Steels | Hardness 40—55HRC | ● | VP15TF | M | ≤2.0 | 0.05(0.05—0.10) |
| | | | ● | VP15TF | M,R | ≤2.0 | 0.05(0.05—0.10) |

Note 1) Refer to the above table and set up cutting conditions according to cutting applications.

Cutting Conditions (Guide)

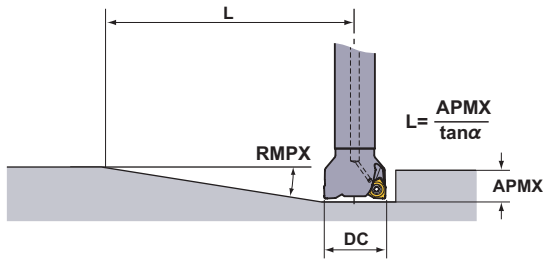
● : Stable Cutting ● : General Cutting ✖ : Unstable Cutting

(mm)

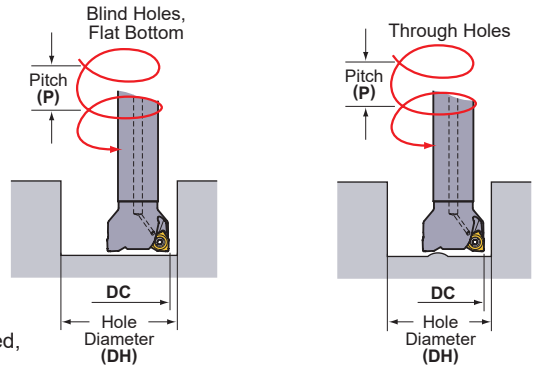
| ae | | | | | | | Cutting Mode |
|---------|------|-----------------|----------|------|-----------------|----------|--------------|
| 0.8DC≥ | | | DC(Slot) | | | | |
| Breaker | ap | fz (mm/t.) | Breaker | ap | fz (mm/t.) | | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | L,M | ≤2.0 | 0.13(0.10-0.15) | Dry, Wet | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | L,M | ≤2.0 | 0.13(0.10-0.15) | Dry, Wet | |
| M,R | ≤3.0 | 0.16(0.10-0.20) | - | - | - | Dry, Wet | |
| M,R | ≤3.0 | 0.13(0.10-0.15) | M | ≤2.0 | 0.13(0.10-0.15) | Dry, Wet | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | L,M | ≤2.0 | 0.13(0.10-0.15) | Dry, Wet | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | L,M | ≤2.0 | 0.13(0.10-0.15) | Dry, Wet | |
| M,R | ≤3.0 | 0.16(0.10-0.20) | - | - | - | Dry, Wet | |
| M,R | ≤3.0 | 0.13(0.10-0.15) | M | ≤2.0 | 0.13(0.10-0.15) | Dry, Wet | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | L,M | ≤3.0 | 0.13(0.10-0.15) | Dry, Wet | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | L,M | ≤2.0 | 0.13(0.10-0.15) | Dry, Wet | |
| M,R | ≤3.0 | 0.16(0.10-0.20) | - | - | - | Dry, Wet | |
| M,R | ≤3.0 | 0.13(0.10-0.15) | M | ≤2.0 | 0.13(0.10-0.15) | Dry, Wet | |
| - | - | - | - | - | - | Dry, Wet | |
| - | - | - | - | - | - | Dry, Wet | |
| - | - | - | - | - | - | Dry, Wet | |
| - | - | - | - | - | - | Dry, Wet | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | - | - | - | Dry, Wet | |
| M | ≤3.0 | 0.16(0.10-0.20) | - | - | - | Dry, Wet | |
| M | ≤3.0 | 0.13(0.10-0.15) | - | - | - | Dry, Wet | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | - | - | - | Dry, Wet | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | - | - | - | Dry, Wet | |
| M | ≤3.0 | 0.16(0.10-0.20) | - | - | - | Dry, Wet | |
| M | ≤3.0 | 0.13(0.10-0.15) | - | - | - | Dry, Wet | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | - | - | - | Dry, Wet | |
| M | ≤3.0 | 0.16(0.10-0.20) | - | - | - | Dry, Wet | |
| M | ≤3.0 | 0.13(0.10-0.15) | - | - | - | Dry, Wet | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | - | - | - | Dry | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | - | - | - | Wet | |
| M | ≤3.0 | 0.16(0.10-0.20) | - | - | - | Dry | |
| M | ≤3.0 | 0.16(0.10-0.20) | - | - | - | Wet | |
| M | ≤3.0 | 0.16(0.10-0.20) | - | - | - | Dry | |
| M | ≤3.0 | 0.13(0.10-0.15) | - | - | - | Wet | |
| - | - | - | - | - | - | Dry, Wet | |
| - | - | - | - | - | - | Dry, Wet | |
| - | - | - | - | - | - | Dry, Wet | |
| - | - | - | - | - | - | Dry, Wet | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | L,M | ≤2.0 | 0.13(0.10-0.15) | Dry, Wet | |
| M,R | ≤3.0 | 0.16(0.10-0.20) | - | - | - | Dry, Wet | |
| M,R | ≤3.0 | 0.13(0.10-0.15) | M,R | ≤2.0 | 0.13(0.10-0.15) | Dry, Wet | |
| L,M | ≤3.0 | 0.13(0.10-0.15) | L,M | ≤2.0 | 0.13(0.10-0.15) | Dry, Wet | |
| M,R | ≤3.0 | 0.16(0.10-0.20) | - | - | - | Dry, Wet | |
| M,R | ≤3.0 | 0.13(0.10-0.15) | M,R | ≤2.0 | 0.13(0.10-0.15) | Dry, Wet | |
| L | ≤3.0 | 0.13(0.10-0.15) | L | ≤2.0 | 0.13(0.10-0.15) | Wet | |
| - | - | - | - | - | 0.10(0.05-0.13) | Wet | |
| - | - | - | - | - | 0.10(0.05-0.13) | Wet | |
| - | - | - | - | - | 0.10(0.05-0.13) | Wet | |
| - | - | - | - | - | 0.10(0.05-0.13) | Wet | |
| - | - | - | - | - | 0.05(0.05-0.10) | Dry, Wet | |
| - | - | - | - | - | 0.05(0.05-0.10) | Dry, Wet | |

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 | RE | APMX | Ramping | | Helical Milling (Blind Hole, Flat Bottom) | | | | Helical Milling (Through Hole) | |
|----|-----|------|---------|------|---|--------|---------|--------|--------------------------------|--------|
| | | | RMPX | L | DH max. | P max. | DH min. | P max. | DH min. | P max. |
| 50 | 0.4 | 8 | 0.40° | 1175 | 98.5 | 1.06 | 95.2 | 0.99 | 82.5 | 0.7 |
| 50 | 0.8 | 8 | 0.40° | 1175 | 97.7 | 1.05 | 95.2 | 0.99 | 82.5 | 0.7 |
| 63 | 0.4 | 8 | 0.26° | 1807 | 124.5 | 0.88 | 121.2 | 0.83 | 108.6 | 0.6 |
| 63 | 0.8 | 8 | 0.26° | 1807 | 123.7 | 0.87 | 121.2 | 0.83 | 108.6 | 0.6 |
| 80 | 0.4 | 8 | 0.16° | 2936 | 158.5 | 0.69 | 155.2 | 0.66 | 142.6 | 0.5 |
| 80 | 0.8 | 8 | 0.16° | 2936 | 157.7 | 0.68 | 155.3 | 0.66 | 142.6 | 0.5 |

(mm)

DC = Cutting Diameter

APMX = Depth of Cut Max.

Note 1) When ramping and helical milling, it is recommended to reduce the feed per tooth.

Note 2) When ramping and helical milling, long continuous chips may be scattered so please be careful.

<Helical Milling>

To obtain a flat bottom surface when helical milling, it requires to remove "the uncut part" in the centre of the workpiece material at a final pass. When helical milling, make sure that the depth of cut per helical pass doesn't exceed the maximum depth of cut (APMX).

Plunging

