

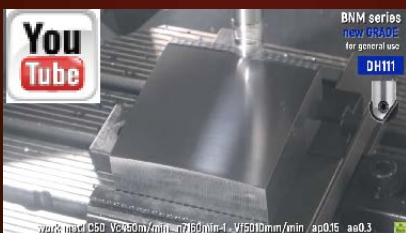
# PRODUCT NEWS

PN-E-006

Generation 2020's



## MIRROR series BNM/RNM type



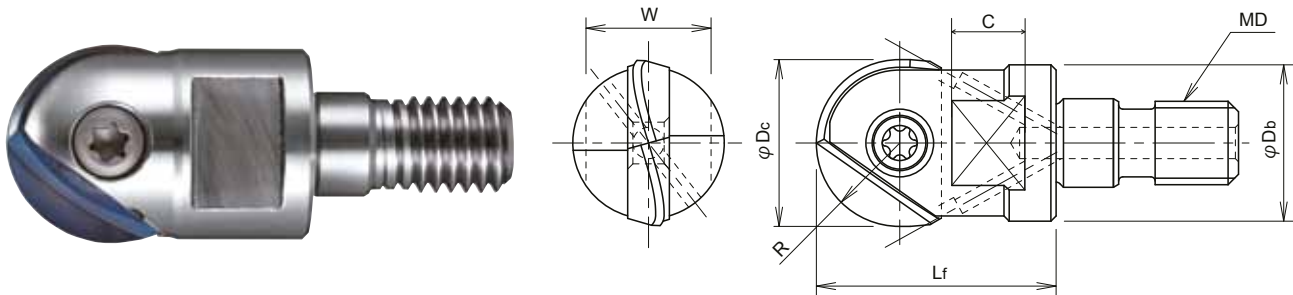
**DIJET GmbH [www.dijet.de](http://www.dijet.de)**

## Mirror Ball

## MBX<sub>TYPE</sub>

### Through Coolant Hole

Accuracy of MBX type modular head mounted on MSN carbide shank holder:  
O.D. run out **below 15μm** (Target **below 10μm**)



### BODY

| Cat. No.    | Stock | Dimensions (mm) |     |            |      |     |      |    | Inserts                    | Parts       |        |
|-------------|-------|-----------------|-----|------------|------|-----|------|----|----------------------------|-------------|--------|
|             |       | R               | φDc | Lf         | φDb  | MD  | C    | W  |                            | Clamp Screw | Wrench |
| MBX-100-M6  | ●     | 5               | 10  | 18         | 9.7  | M6  | 6.5  | 8  | BNM-100...                 | FSW-3007H   | A-08   |
| MBX-120-M6  | ●     | 6               | 12  | 20         | 11.5 | M6  | 6.5  | 8  | BNM-120...                 | FSW-3509H   | A-10   |
| MBX-160-M8  | ●     | 8               | 16  | 23         | 15   | M8  | 8    | 12 | BNM-160...                 | FSW-4013H   | A-15   |
| MBX-200-M10 | ●     | 10              | 20  | 30         | 18.5 | M10 | 8    | 14 | BNM-200...                 | FSW-5016H   | A-20W  |
| MBX-250-M12 | ●     | 12.5            | 25  | 35         | 24   | M12 | 10   | 17 | BNM-250...                 | FSW-6020    | A-30   |
| MBX-300-M16 | ●     | 15              | 30  | 43<br>(44) | 29   | M16 | 12.5 | 22 | BNM-300...<br>(BNM-320...) | FSW-8025    | A-40   |

- Note)
1. Please refer page 7-10 for recommended cutting conditions.
  2. All cutters are supplied without inserts.
  3. Please refer page 7-10 for recommended tightening torque
  4. The number in parentheses shows the dimensions when BNM-320 Type is mounted.
  5. All cutters are supplied without wrench & moly.

| Clamp Screw | Recommended Torque (N·m) |
|-------------|--------------------------|
| FSW-3007H   | 1.2                      |
| FSW-3509H   | 2.0                      |
| FSW-4013H   | 3.0                      |
| FSW-5016H   | 4.0                      |
| FSW-6020    | 5.0                      |
| FSW-8025    | 6.0                      |



# Mirror Ball



**BNM<sub>TYPE</sub>**

## Mirror Ball Carbide Shanks

1. It is possible to machine deeper mold with high quality and high accuracy at higher cutting parameters due to increased tool rigidity and minimize the vibration.
2. By adopting carbide shank, tool rigidity is equal to solid carbide ball nose end mill.
3. Compared with steel shank, the tool life is almost more than double.
4. Carbide shank can be used on shrink-fit type holders.
5. In case of super finishing application (removal stock below Dc/40), MIRROR RADIUS Insert can be mounted on MIRROR BALL Bodies.



Radius form accuracy of insert mounted on holder:  
**within  $\pm 0.010\text{mm}$**

## BNM-S-C type (Straight Neck)



## BNM-T-C type (Taper Neck)



## BODY

| Cat. No.          | Stock | Fig. | Dimensions (mm) |            |       |       |     |            |            |                  |                                 |           | Parts       |        | Inserts                  |            |
|-------------------|-------|------|-----------------|------------|-------|-------|-----|------------|------------|------------------|---------------------------------|-----------|-------------|--------|--------------------------|------------|
|                   |       |      | R               | $\phi D_c$ | $l_1$ | $l_2$ | L   | $\phi D_1$ | $\phi D_s$ | $\theta_K^\circ$ | $\theta_n^\circ$<br>Taper angle |           | Clamp Screw | Wrench |                          |            |
| BNMS-060017S-S06C | ●     | 1    |                 |            | —     | 17    | 60  |            | 6          | —                | —                               |           |             |        |                          |            |
| BNMS-060030T-S10C | ●     | 2    | 3               | 6          | 15    | 30    | 80  | 5.4        | 10         | 4°14'            | 6°                              | FSW-2005H | A-06        |        | BNM-060...<br>(BNM-070)  |            |
| BNMM-060035S-S06C | ●     | 1    |                 |            | —     | 35    | 92  |            | 6          | —                | —                               |           |             |        |                          |            |
| BNML-060017S-S06C | ●     | 1    |                 |            | —     | 17    | 120 |            |            | —                | —                               |           |             |        |                          |            |
| BNMS-080025S-S08C | ●     |      |                 |            | —     | 25    | 90  |            |            | —                | —                               |           |             |        |                          |            |
| BNMM-080035S-S08C | ●     |      |                 |            | —     | 35    | 92  |            |            | —                | —                               |           |             |        |                          |            |
| BNML-080075S-S08C | ●     | 1    | 4               | 8          | —     | 75    | 140 | 7.2        | 8          | —                | —                               | FSW-2506H | A-07        |        | BNM-080...<br>RNM-080... |            |
| BNML-080095S-S08C | ●     |      |                 |            | —     | 95    | 160 |            |            | —                | —                               |           |             |        |                          |            |
| BNML-080075T-S12C | ●     | 2    |                 |            | 20    | 75    | 132 |            | 12         | 1°37'            | 2°                              |           |             |        |                          |            |
| BNMS-100030S-S10C | ●     |      |                 |            | —     | 30    | 100 |            |            | —                | —                               |           |             |        |                          |            |
| BNMM-100043S-S10C | ●     |      |                 |            | —     | 43    | 100 |            |            | —                | —                               |           |             |        |                          |            |
| BNML-100075S-S10C | ●     | 1    | 5               | 10         | —     | 75    | 140 | 9          | 10         | —                | —                               | FSW-3007H | A-08        |        | BNM-100...<br>(BNM-110)  | RNM-100... |
| BNML-100095S-S10C | ●     |      |                 |            | —     | 95    | 160 |            |            | —                | —                               |           |             |        |                          |            |
| BNML-100140S-S10C | ●     |      |                 |            | —     | 140   | 220 |            |            | —                | —                               |           |             |        |                          |            |
| BNML-100075T-S12C | ●     | 2    |                 |            | 23    | 75    | 132 |            | 12         | 0°49'            | 1°30'                           |           |             |        |                          |            |
| BNMS-120028S-S12C | ●     |      |                 |            | —     | 28    | 84  |            |            | —                | —                               |           |             |        |                          |            |
| BNMM-120053S-S12C | ●     | 1    |                 |            | —     | 53    | 110 | 11         | 12         | —                | —                               |           |             |        |                          |            |
| BNML-120095S-S12C | ●     |      | 6               | 12         | —     | 95    | 160 |            |            | —                | —                               | FSW-3509H | A-10        |        | BNM-120...<br>RNM-120... |            |
| BNML-120085T-S16C | ●     | 2    |                 |            | 27    | 85    | 145 | 10         | 16         | 1°27'            | 2°30'                           |           |             |        |                          |            |
| BNML-120150S-S12C | □     | 1    |                 |            | —     | 150   | 220 | 11         | 12         | —                | —                               |           |             |        |                          |            |
| BNMS-160033S-S16C | ●     | 1    |                 |            | —     | 33    | 93  | 15         | 16         | —                | —                               |           |             |        |                          |            |
| BNMM-160063T-S20C | ●     | 2    |                 |            | 30.5  | 63    | 123 | 14         | 20         | 2°5'             | 4°                              |           |             |        |                          |            |
| BNML-160070S-S16C | ●     |      |                 |            | —     | 70    | 140 |            |            | —                | —                               |           |             |        |                          |            |
| BNML-160090S-S16C | ●     | 1    | 8               | 16         | —     | 90    | 160 | 15         | 16         | —                | —                               | FSW-4013H | A-15        |        | BNM-160...<br>RNM-160... |            |
| BNML-160100T-S20C | ●     | 2    |                 |            | 30.5  | 100   | 166 | 14         | 20         | 1°15'            | 2°                              |           |             |        |                          |            |
| BNML-160110S-S16C | ●     |      |                 |            | —     | 110   | 180 |            |            | —                | —                               |           |             |        |                          |            |
| BNML-160150S-S16C | ●     | 1    |                 |            | —     | 150   | 220 | 15         | 16         | —                | —                               |           |             |        |                          |            |

- Note) 1. All cutters are supplied without inserts.  
2. Please refer page 13 & 14 for recommended cutting conditions.

**Please refer page 3 for ★ Caution for the mounting on shrink-fit holder**

## Mirror Ball



**BNM**TYPE

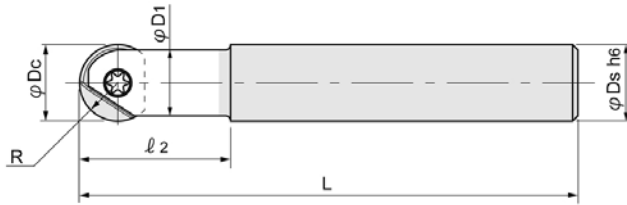


Fig.1 (Straight Neck)

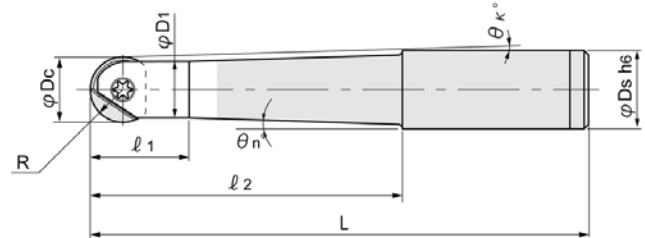
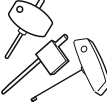


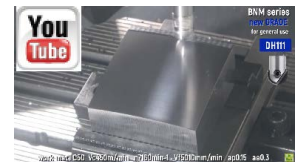
Fig.2 (Taper Neck)

### ■ BODY

| Cat. No.          | Stock | Fig. | Dimensions (mm) |               |          |          |     |               |               |                  |                                 | Parts                                                                               |                                                                                     | Inserts                                                                             |                                                                                     |
|-------------------|-------|------|-----------------|---------------|----------|----------|-----|---------------|---------------|------------------|---------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|                   |       |      |                 |               |          |          |     |               |               |                  |                                 | Clamp Screw                                                                         | Wrench                                                                              |                                                                                     |                                                                                     |
|                   |       |      | R               | $\varphi D_c$ | $\ell_1$ | $\ell_2$ | L   | $\varphi D_1$ | $\varphi D_s$ | $\theta_K^\circ$ | $\theta_n^\circ$<br>Taper angle |  |  |  |  |
| BNMS-200039S-S20C | ●     | 1    | 10              | 20            | —        | 39       | 105 | 19            | 20            | —                | —                               | FSW-5016H                                                                           | A-20W                                                                               | BNM-200...                                                                          | RNM-200...                                                                          |
| BNMM-200075S-S20C | ●     |      |                 |               | —        | 75       | 141 |               |               | —                | —                               |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| BNML-200105S-S20C | ●     |      |                 |               | —        | 105      | 180 |               |               | —                | —                               |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| BNML-200115T-S25C | ●     | 2    |                 |               | 36       | 115      | 191 | 17            | 25            | 1°22′            | 2°                              |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| BNML-200125S-S20C | ●     | 1    |                 |               | —        | 125      | 200 | 19            | 20            | —                | —                               |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| BNML-200170S-S20C | ●     |      |                 |               | —        | 170      | 250 |               |               | —                | —                               |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| BNMM-250090S-S25C | ●     | 1    | 12.5            | 25            | —        | 90       | 166 | 24            | 25            | —                | —                               | FSW-6020                                                                            | A-30                                                                                | BNM-250...                                                                          | RNM-250...                                                                          |
| BNML-250140S-S25C | ●     |      |                 |               | —        | 140      | 220 |               |               | —                | —                               |                                                                                     |                                                                                     |                                                                                     |                                                                                     |

Note) 1. All cutters are supplied without inserts.  
2. Please refer page 13 & 14 for recommended cutting conditions.

| Clamp Screw | Recommended torque (N·m) | Clamp Screw | Recommended torque (N·m) |
|-------------|--------------------------|-------------|--------------------------|
| FSW-2005H   | 0.5                      | FSW-4013H   | 3.0                      |
| FSW-2506H   | 0.9                      | FSW-5016H   | 4.0                      |
| FSW-3007H   | 1.2                      | FSW-6020    | 5.0                      |
| FSW-3509H   | 2.0                      | FSW-8025    | 6.0                      |



### ★ Caution for the mounting on shrink-fit holder (In case of BNM-C Body, RNM-C Body)

When you use a carbide shank (C Body) on the shrink-fit holder, please shrink-fit only carbide shank without putting insert and clamp screw.

**Please mount the insert and tighten the clamp screw after shrink-fit.**

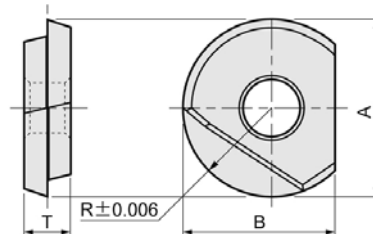
Note) If it shrink-fits with the insert and clamp screw, it will be difficult to loose the clamp screw.

# Mirror Ball

**BNM**<sub>TYPE</sub>

## Mirror Ball Insert

### ■ INSERTS



Radius form accuracy  
of inserts:  
within  $\pm 0.006\text{mm}$

| Cat. No.       | PVD coated  | Diamond coated | Uncoated  | Dimensions (mm) |    |      |     |
|----------------|-------------|----------------|-----------|-----------------|----|------|-----|
|                | DH111 (Z10) | JC10000        | KT9 (K10) | R               | A  | B    | T   |
| <b>BNM-060</b> | ●           | ●              | ●         | <b>3</b>        | 6  | 5    | 2   |
| <b>BNM-080</b> | ●           | □              | ●         | <b>4</b>        | 8  | 7    | 2.4 |
| <b>BNM-100</b> | ●           | □              | ●         | <b>5</b>        | 10 | 8.5  | 2.6 |
| <b>BNM-120</b> | ●           | ●              | ●         | <b>6</b>        | 12 | 10   | 3   |
| <b>BNM-160</b> | ●           | □              | ●         | <b>8</b>        | 16 | 12   | 4   |
| <b>BNM-200</b> | ●           | ●              | ●         | <b>10</b>       | 20 | 15   | 5   |
| <b>BNM-250</b> | ●           |                | □         | <b>12.5</b>     | 25 | 18.5 | 6   |
| <b>BNM-300</b> | ●           |                | □         | <b>15</b>       | 30 | 22.5 | 7   |
| <b>BNM-320</b> | ●           |                | □         | <b>16</b>       | 32 | 23.5 | 7   |

2 inserts per case, but in case of grade JC10000: 1 piece per case.

| Cat. No.         | Uncoated   | DLC     | Dimensions (mm) |    |      |     |     |
|------------------|------------|---------|-----------------|----|------|-----|-----|
|                  | FZ05 (Z01) | JC20003 | R               | A  | B    | C   | T   |
| <b>BNM-060-S</b> | ●          | □       | <b>3</b>        | 6  | 5    | —   | 2   |
| <b>BNM-080-S</b> | ●          | □       | <b>4</b>        | 8  | 7    | 0.5 | 2.4 |
| <b>BNM-100-S</b> | ●          | □       | <b>5</b>        | 10 | 8.5  | 1   | 2.6 |
| <b>BNM-120-S</b> | ●          | □       | <b>6</b>        | 12 | 10   | 1   | 3   |
| <b>BNM-160-S</b> | ●          | □       | <b>8</b>        | 16 | 12   | 1   | 4   |
| <b>BNM-200-S</b> | ●          | □       | <b>10</b>       | 20 | 15   | 1   | 5   |
| <b>BNM-250-S</b> | ●          | □       | <b>12.5</b>     | 25 | 18.5 | 1   | 6   |
| <b>BNM-300-S</b> | ●          | □       | <b>15</b>       | 30 | 22.5 | 1   | 7   |

2 inserts per case.

### ★ Instructions for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Do not tighten the clamp screw too hard.

**Refer the right table for recommended tightening torque.**

| Dimensions (mm) | Recommended torque |
|-----------------|--------------------|
| $\varphi D_c$   | (N·m)              |
| 6               | 0.5                |
| 8               | 0.9                |
| 10              | 1.2                |
| 12              | 2.0                |
| 16              | 3.0                |
| 20              | 4.0                |
| 25              | 5.0                |
| 30              | 6.0                |
| 32              | 6.0                |

## Mirror Ball

**BNM**TYPE

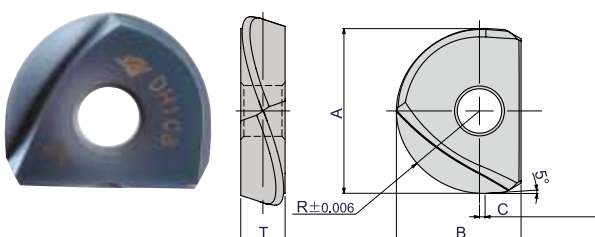
### ■ INSERT (S type, TG type) **MirrorS**

#### BNM-S: Standard type

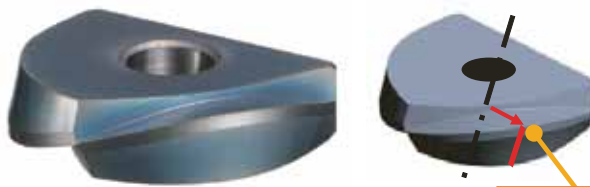


#### BNM-SS Type

Fig. 1 Below R8  
(Tool dia. Below 16mm)

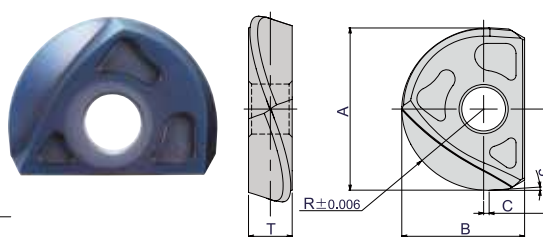


#### BNM-TG: Stronger cutting edge type



**Negative rake**

Fig. 2 Above R10  
(Tool dia. Above 20mm)



**Radius form  
accuracy of inserts:  
within  $\pm 0.006\text{mm}$**



| Cat. No.          | PVD coated             | Dimensions (mm) |    |      |     |     |
|-------------------|------------------------|-----------------|----|------|-----|-----|
|                   | <b>DH108<br/>(Z10)</b> | R               | A  | B    | C   | T   |
| <b>BNM-060-SS</b> | ●                      | <b>3</b>        | 6  | 5    | —   | 2   |
| <b>BNM-080-SS</b> | ●                      | <b>4</b>        | 8  | 7    | 0.5 | 2.4 |
| <b>BNM-100-SS</b> | ●                      | <b>5</b>        | 10 | 8.5  | 1   | 2.6 |
| <b>BNM-120-SS</b> | ●                      | <b>6</b>        | 12 | 10   | 1   | 3   |
| <b>BNM-160-SS</b> | ●                      | <b>8</b>        | 16 | 12   | 1   | 4   |
| <b>BNM-200-SS</b> | ●                      | <b>10</b>       | 20 | 15   | 1   | 5   |
| <b>BNM-250-SS</b> | ●                      | <b>12.5</b>     | 25 | 18.5 | 1   | 6   |
| <b>BNM-300-SS</b> | □                      | <b>15</b>       | 30 | 22.5 | 1   | 7   |
| <b>BNM-320-SS</b> | ●                      | <b>16</b>       | 32 | 23.5 | 1   | 7   |

| Cat. No.          | PVD coated             | Dimensions (mm) |    |      |     |     |
|-------------------|------------------------|-----------------|----|------|-----|-----|
|                   | <b>DH102<br/>(Z01)</b> | R               | A  | B    | C   | T   |
| <b>BNM-060-TG</b> | ●                      | <b>3</b>        | 6  | 5    | —   | 2   |
| <b>BNM-080-TG</b> | ●                      | <b>4</b>        | 8  | 7    | 0.5 | 2.4 |
| <b>BNM-100-TG</b> | ●                      | <b>5</b>        | 10 | 8.5  | 1   | 2.6 |
| <b>BNM-120-TG</b> | ●                      | <b>6</b>        | 12 | 10   | 1.5 | 3   |
| <b>BNM-160-TG</b> | ●                      | <b>8</b>        | 16 | 12   | 1.5 | 4   |
| <b>BNM-200-TG</b> | ●                      | <b>10</b>       | 20 | 15   | 2   | 5   |
| <b>BNM-250-TG</b> | ●                      | <b>12.5</b>     | 25 | 18.5 | 2   | 6   |
| <b>BNM-300-TG</b> | ●                      | <b>15</b>       | 30 | 22.5 | 2   | 7   |
| <b>BNM-320-TG</b> | □                      | <b>16</b>       | 32 | 23.5 | 2   | 7   |

2 inserts per case.

- Note) 1. "Mirror S, Mirror TG" inserts are exclusive use of MIRROR BALL.  
Please use only in MIRROR BALL body and modular head.  
2. BNM-060-SS and BNM-060-TG don't have straight cutting edge.

**Please refer page 4 for "Instructions for mounting insert"**

## Mirror Ball

**BNM<sub>TYPE</sub>**

### ■ CONTROLLED TORQUE WRENCH (WITH REPLACEABLE BLADE)

#### ● Tightening a screw is controlled with proper torque wrench

Wrenches are pre-set to protect screws and tools against damage during tightening and loosening processes. This wrench is recommended to use especially with Mirror ball.

#### ● Size: T6, T7, T8, T10

#### ● Replaceable blades



#### ● Controlled torque wrench (with replaceable blade)

| Cat. No.      | Torx No. | Torque value | Applicable blades | Applicable holders               |
|---------------|----------|--------------|-------------------|----------------------------------|
| <b>TQC-06</b> | T6       | 0.5Nm        | B-06              | BNM○-06...type<br>RNM○-06...type |
| <b>TQC-07</b> | T7       | 0.9Nm        | B-07              | BNM○-08...type<br>RNM○-08...type |
| <b>TQC-08</b> | T8       | 1.2Nm        | B-08              | BNM○-10...type<br>RNM○-10...type |
| <b>TQC-10</b> | T10      | 2.0Nm        | B-10              | BNM○-12...type<br>RNM○-12...type |

#### ● Blades

| Cat. No.    | Torx No. | Applicable torque control wrench |
|-------------|----------|----------------------------------|
| <b>B-06</b> | T6       | TQC-06                           |
| <b>B-07</b> | T7       | TQC-07                           |
| <b>B-08</b> | T8       | TQC-08                           |
| <b>B-10</b> | T10      | TQC-10                           |



## Mirror Ball

**MBX**TYPE

### RECOMMENDED CUTTING CONDITIONS / HIGH SPEED MACHINING

● **MBX type** + MSN Carbide Shank Holder

| Work Materials               | Insert Grades |                  | Cutting speed<br>Vc<br>(m/min) | Tool dia. (mm)            |                |                           |                |                           |                | Max. Depth of cut<br>ap<br>(mm) | Max. Pick feed<br>ae<br>(mm) |
|------------------------------|---------------|------------------|--------------------------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|---------------------------------|------------------------------|
|                              | BNM           | BNM-SS<br>BNM-TG |                                | 10                        |                | 12                        |                | 16                        |                |                                 |                              |
|                              |               |                  |                                | n<br>(min <sup>-1</sup> ) | Vf<br>(mm/min) | n<br>(min <sup>-1</sup> ) | Vf<br>(mm/min) | n<br>(min <sup>-1</sup> ) | Vf<br>(mm/min) |                                 |                              |
| Grey cast iron 160-260 HB    | DH111         | DH102<br>DH108   | 750                            | 24,000                    | 9,600          | 20,000                    | 10,000         | 15,000                    | 10,000         | 0.1-0.3                         | 0.02Dc                       |
| Nodular cast iron 170-300 HB |               | DH102<br>DH108   | 600                            | 19,000                    | 7,000          | 16,000                    | 7,000          | 12,000                    | 7,000          | 0.1-0.3                         | 0.02Dc                       |
| Carbon steel 180-280 HB      | DH111         | DH108            | 600                            | 19,000                    | 7,000          | 16,000                    | 7,000          | 12,000                    | 7,000          | 0.1-0.3                         | 0.02Dc                       |
| Low alloy steel 180-280 HB   |               | DH108            | 600                            | 19,000                    | 7,000          | 16,000                    | 7,000          | 12,000                    | 7,000          | 0.1-0.2                         | 0.015Dc                      |
| Tool & Die steel 180-255 HB  |               | DH108            | 600                            | 19,000                    | 7,000          | 16,000                    | 7,000          | 12,000                    | 7,000          | 0.1-0.2                         | 0.015Dc                      |
| Hardened die steel 40-55 HRC | DH111         | DH102<br>DH108   | 450                            | 14,500                    | 4,300          | 12,000                    | 4,800          | 9,000                     | 4,500          | 0.1-0.2                         | 0.015Dc                      |
| Hardened die steel 56-63 HRC |               | DH102<br>DH108   | 300                            | 9,500                     | 2,800          | 8,000                     | 3,200          | 6,000                     | 3,000          | 0.05-0.1                        | 0.015Dc                      |
| Stainless steel 150-250 HB   | DH111         | DH108            | 500                            | 16,000                    | 6,000          | 13,500                    | 6,000          | 10,000                    | 6,000          | 0.1-0.2                         | 0.015Dc                      |
| Copper alloy 80-150 HB       | KT9           | FZ05             | 600                            | 19,000                    | 9,000          | 16,000                    | 9,600          | 12,000                    | 8,400          | 0.1-0.3                         | 0.02Dc                       |
| Aluminium alloy 30-100 HB    |               |                  | 800                            | 25,000                    | 12,500         | 21,000                    | 12,600         | 16,000                    | 11,200         | 0.1-0.5                         | 0.02Dc                       |

n: Spindlespeed, Vf: Feedspeed

### ★ Instruction for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Do not tighten the clamp screw too hard.

**Recommend to use Torque control wrenches (Page 6)**  
**Refer the right table for recommended tightening torque.**

| Dimensions | Recommended Torque |
|------------|--------------------|
| φDc        | N~m                |
| 10         | 1.2                |
| 12         | 2.0                |
| 16         | 3.0                |
| 20         | 4.0                |
| 25         | 5.0                |
| 30         | 6.0                |
| 32         | 6.0                |



# Mirror Ball

# MBX<sub>TYPE</sub>

## RECOMMENDED CUTTING CONDITIONS / HIGH SPEED MACHINING

● **MBX type** + MSN Carbide Shank Holder

| Work Materials                  | Insert Grades |                  | Cutting speed<br>Vc<br>(m/min) | Tool dia. (mm)            |                |                           |                |                           |                | Max. Depth<br>of cut<br>ap<br>(mm) | Max. Pick<br>feed<br>ae<br>(mm) |
|---------------------------------|---------------|------------------|--------------------------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|------------------------------------|---------------------------------|
|                                 | BNM           | BNM-SS<br>BNM-TG |                                | 20                        |                | 25                        |                | 30/32                     |                |                                    |                                 |
|                                 |               |                  |                                | n<br>(min <sup>-1</sup> ) | Vf<br>(mm/min) | n<br>(min <sup>-1</sup> ) | Vf<br>(mm/min) | n<br>(min <sup>-1</sup> ) | Vf<br>(mm/min) |                                    |                                 |
| Grey cast iron<br>160-260 HB    | DH111         | DH102<br>DH108   | 750                            | 12,000                    | 9,000          | 9,600                     | 8,000          | 8,000                     | 8,000          | 0.1-0.3                            | 0.02Dc                          |
| Nodular cast iron<br>170-300 HB |               | DH102<br>DH108   | 600                            | 9,600                     | 6,700          | 7,700                     | 6,000          | 6,500                     | 6,000          | 0.1-0.3                            | 0.02Dc                          |
| Carbon steel<br>180-280 HB      | DH111         | DH108            | 600                            | 9,600                     | 6,700          | 7,700                     | 6,000          | 6,500                     | 6,000          | 0.1-0.3                            | 0.02Dc                          |
| Low alloy steel<br>180-280 HB   |               | DH108            | 600                            | 9,600                     | 6,700          | 7,700                     | 6,000          | 6,500                     | 6,000          | 0.1-0.2                            | 0.015Dc                         |
| Tool & Die steel<br>180-255 HB  |               | DH108            | 600                            | 9,600                     | 6,700          | 7,700                     | 6,000          | 6,500                     | 6,000          | 0.1-0.2                            | 0.015Dc                         |
| Hardened die steel<br>40-55 HRC | DH111         | DH102<br>DH108   | 450                            | 7,200                     | 3,600          | 5,750                     | 3,450          | 4,800                     | 3,360          | 0.1-0.2                            | 0.015Dc                         |
| Hardened die steel<br>56-63 HRC |               | DH102<br>DH108   | 300                            | 4,800                     | 2,400          | 3,850                     | 2,300          | 3,200                     | 2,200          | 0.05-0.1                           | 0.015Dc                         |
| Stainless steel<br>150-250 HB   | DH111         | DH108            | 500                            | 8,000                     | 4,800          | 6,400                     | 4,500          | 5,300                     | 4,200          | 0.1-0.2                            | 0.015Dc                         |
| Copper alloy<br>80-150 HB       | KT9           | FZ05             | 600                            | 9,600                     | 7,600          | 7,700                     | 6,200          | 6,500                     | 6,500          | 0.1-0.3                            | 0.02Dc                          |
| Aluminium alloy<br>30-100 HB    |               |                  | 800                            | 12,700                    | 10,000         | 10,200                    | 8,200          | 8,500                     | 8,500          | 0.1-0.5                            | 0.02Dc                          |

n: Spindle speed, Vf: Feed speed

## ★ Instruction for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Do not tighten the clamp screw too hard.

**Recommend to use Torque control wrenches (Page 6)**

**Refer the right table for recommended tightening torque.**

| Dimensions | Recommended Torque |
|------------|--------------------|
| φ Dc       | N~m                |
| 10         | 1.2                |
| 12         | 2.0                |
| 16         | 3.0                |
| 20         | 4.0                |
| 25         | 5.0                |
| 30         | 6.0                |
| 32         | 6.0                |

## Mirror Ball

## MBX<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS

● **MBX type** + MSN Carbide Shank Holder

| Work<br>Materials               | Insert Grades |                  | Cutting<br>speed<br>Vc<br>(m/min) | Tool dia. (mm)            |                |                           |                |                           |                | Max. Depth<br>of cut<br>ap<br>(mm) | Max. Pick<br>feed<br>ae<br>(mm) |
|---------------------------------|---------------|------------------|-----------------------------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|------------------------------------|---------------------------------|
|                                 | BNM           | BNM-SS<br>BNM-TG |                                   | 10                        |                | 12                        |                | 16                        |                |                                    |                                 |
|                                 |               |                  |                                   | n<br>(min <sup>-1</sup> ) | Vf<br>(mm/min) | n<br>(min <sup>-1</sup> ) | Vf<br>(mm/min) | n<br>(min <sup>-1</sup> ) | Vf<br>(mm/min) |                                    |                                 |
| Grey cast iron<br>160-260 HB    | DH111         | DH102<br>DH108   | 450                               | 14,500                    | 4,400          | 12,000                    | 4,800          | 9,000                     | 4,500          | 0.02Dc                             | 0.025Dc                         |
| Nodular cast iron<br>170-300 HB |               | DH102<br>DH108   | 350                               | 11,000                    | 3,300          | 9,200                     | 3,700          | 7,000                     | 3,500          | 0.02Dc                             | 0.025Dc                         |
| Carbonsteel<br>180-280HB        | DH111         | DH108            | 350                               | 11,000                    | 3,300          | 9,200                     | 3,700          | 7,000                     | 3,500          | 0.02Dc                             | 0.02Dc                          |
| Low alloy steel<br>180-280 HB   |               | DH108            | 350                               | 11,000                    | 3,300          | 9,200                     | 3,700          | 7,000                     | 3,500          | 0.02Dc                             | 0.02Dc                          |
| Tool & Die steel<br>180-255 HB  |               | JC8008           | 350                               | 11,000                    | 3,300          | 9,200                     | 3,700          | 7,000                     | 3,500          | 0.02Dc                             | 0.02Dc                          |
| Hardened die steel<br>40-55 HRC | DH111         | DH102<br>DH108   | 250                               | 8,000                     | 2,000          | 6,700                     | 2,000          | 5,000                     | 2,000          | 0.015Dc                            | 0.02Dc                          |
| Hardened die steel<br>56-63 HRC |               | DH102<br>DH108   | 200                               | 6,400                     | 1,300          | 5,300                     | 1,500          | 4,000                     | 1,400          | 0.01Dc                             | 0.02Dc                          |
| Stainless steel<br>150-250HB    | DH111         | DH108            | 300                               | 9,600                     | 3,000          | 8,000                     | 3,200          | 6,000                     | 3,000          | 0.02Dc                             | 0.02Dc                          |
| Copperalloy<br>80-150HB         | KT9           | FZ05             | 350                               | 11,000                    | 3,800          | 9,200                     | 4,000          | 7,000                     | 3,850          | 0.02Dc                             | 0.025Dc                         |
| Aluminium alloy<br>30-100 HB    |               |                  | 500                               | 16,000                    | 6,400          | 13,500                    | 6,800          | 10,000                    | 6,000          | 0.03Dc                             | 0.03Dc                          |

n: Spindle speed, Vf: Feed speed

### ★ Instruction for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Do not tighten the clamp screw too hard.

**Recommend to use Torque control wrenches (Page 6)**

**Refer the right table for recommended tightening torque.**

| Dimensions | Recommended Torque |
|------------|--------------------|
| φ Dc       | N~m                |
| 10         | 1.2                |
| 12         | 2.0                |
| 16         | 3.0                |
| 20         | 4.0                |
| 25         | 5.0                |
| 30         | 6.0                |
| 32         | 6.0                |

# Mirror Ball

# MBX<sub>TYPE</sub>

## RECOMMENDED CUTTING CONDITIONS

● **MBX type** + MSN Carbide Shank Holder

| Work<br>Materials               | Insert Grades |                  | Cutting<br>speed<br>Vc<br>(m/min) | Tool dia. (mm)            |                |                           |                |                           |                | Max. Depth<br>of cut<br>ap<br>(mm) | Max. Pick<br>feed<br>ae<br>(mm) |
|---------------------------------|---------------|------------------|-----------------------------------|---------------------------|----------------|---------------------------|----------------|---------------------------|----------------|------------------------------------|---------------------------------|
|                                 | BNM           | BNM-SS<br>BNM-TG |                                   | 20                        |                | 25                        |                | 30/32                     |                |                                    |                                 |
|                                 |               |                  |                                   | n<br>(min <sup>-1</sup> ) | Vf<br>(mm/min) | n<br>(min <sup>-1</sup> ) | Vf<br>(mm/min) | n<br>(min <sup>-1</sup> ) | Vf<br>(mm/min) |                                    |                                 |
| Grey cast iron<br>160-260 HB    | DH111         | DH102<br>DH108   | 450                               | 7,200                     | 4,300          | 6,000                     | 4,000          | 5,000                     | 4,000          | 0.02Dc                             | 0.025Dc                         |
| Nodular cast iron<br>170-300 HB |               | DH102<br>DH108   | 350                               | 5,600                     | 3,000          | 4,500                     | 2,700          | 4,000                     | 2,800          | 0.02Dc                             | 0.025Dc                         |
| Carbon steel<br>180-280 HB      | DH111         | DH108            | 350                               | 5,600                     | 3,000          | 4,500                     | 2,700          | 4,000                     | 2,800          | 0.02Dc                             | 0.02Dc                          |
| Low alloy steel<br>180-280 HB   |               | DH108            | 350                               | 5,600                     | 3,000          | 4,500                     | 2,700          | 4,000                     | 2,800          | 0.02Dc                             | 0.02Dc                          |
| Tool & Die steel<br>180-255 HB  |               | DH108            | 350                               | 5,600                     | 3,000          | 4,500                     | 2,700          | 4,000                     | 2,800          | 0.02Dc                             | 0.02Dc                          |
| Hardened die steel<br>40-55HRC  | DH111         | DH102<br>DH108   | 250                               | 4,000                     | 1,800          | 3,200                     | 1,600          | 2,700                     | 1,400          | 0.015Dc                            | 0.02Dc                          |
| Hardened die steel<br>56-63 HRC |               | DH102<br>DH108   | 200                               | 3,200                     | 1,300          | 2,600                     | 1,300          | 2,000                     | 1,000          | 0.01Dc                             | 0.02Dc                          |
| Stainless steel<br>150-250 HB   | DH111         | DH108            | 300                               | 4,800                     | 2,400          | 3,850                     | 2,100          | 3,200                     | 2,000          | 0.02Dc                             | 0.02Dc                          |
| Copper alloy<br>80-150 HB       | KT9           | FZ05             | 350                               | 5,600                     | 3,400          | 4,500                     | 3,150          | 4,000                     | 3,200          | 0.02Dc                             | 0.025Dc                         |
| Aluminium alloy<br>30-100 HB    |               |                  | 500                               | 8,000                     | 5,600          | 6,400                     | 4,500          | 5,300                     | 4,800          | 0.03Dc                             | 0.03Dc                          |

n: Spindle speed, Vf: Feed speed

## ★ Instruction for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Do not tighten the clamp screw too hard.

**Recommend to use Torque control wrenches (Page 6)**

**Refer the right table for recommended tightening torque.**

| Dimensions | Recommended Torque |
|------------|--------------------|
| φ Dc       | N~m                |
| 10         | 1.2                |
| 12         | 2.0                |
| 16         | 3.0                |
| 20         | 4.0                |
| 25         | 5.0                |
| 30         | 6.0                |
| 32         | 6.0                |

### GENERAL RECOMMENDED CUTTING CONDITIONS

#### ● Calculation of cutting conditions

##### 1. Spindle speed

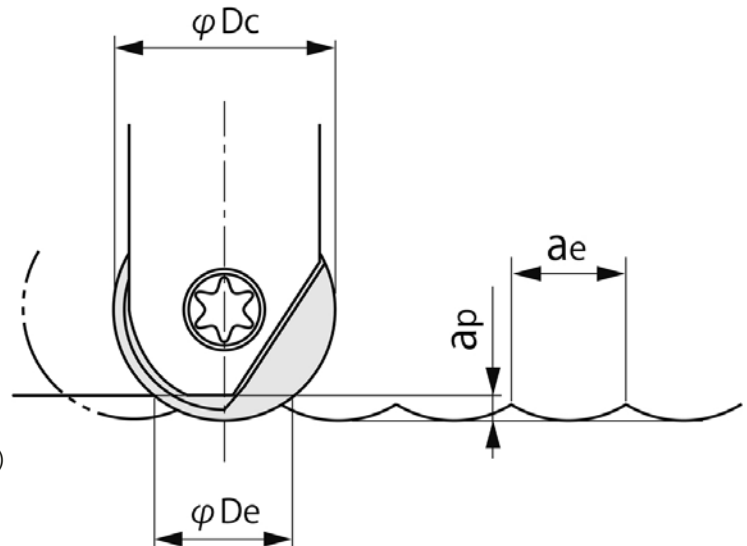
$$n = \frac{V_c \times 1000}{\pi \times D_e} \text{ (min}^{-1}\text{)}$$

$$D_e = 2 \times \sqrt{a_p \times (D_c - a_p)} \text{ (mm)}$$

##### 2. Feed speed

$$V_f = n \times f \text{ (mm/min)}$$

$$f = h_{\text{max.}} \times \frac{D_c}{\sqrt{a_p \times (D_c - a_p)}} \text{ (mm/rev)}$$



- $n$  = Spindle speed (min<sup>-1</sup>)
- $V_c$  = Cutting speed (m/min), refer Table 1.
- $D_e$  = Effective tool diameter (mm), refer Table 2.
- $a_p$  = Axial depth of cut (mm)
- $a_e$  = Pick feed, radial depth of cut (mm)
- $V_f$  = Feed speed (mm/min)
- $f$  = feed per revolution (mm/rev), refer Table 1.
- $h_{\text{max.}}$  = Max. chip thickness (mm), refer Table 3.

**Table 1. Nominal cutting speed and feed values**

| Work Materials                        | Hardness  | Insert Grades |         |     | Cutting speed<br>Vc<br>(m/min) | Nominal feed rate: f (mm/rev) |      |     |     |     |     |     |     |     |       | Max depth of cut<br>ap (mm) | Max pick feed<br>ae (mm) |
|---------------------------------------|-----------|---------------|---------|-----|--------------------------------|-------------------------------|------|-----|-----|-----|-----|-----|-----|-----|-------|-----------------------------|--------------------------|
|                                       |           | DH11          | JC10000 | KT9 |                                | Tool dia. Dc (mm)             |      |     |     |     |     |     |     |     |       |                             |                          |
|                                       |           |               |         |     |                                | 6                             | 8    | 10  | 12  | 16  | 20  | 25  | 30  | 32  |       |                             |                          |
| Grey cast iron<br>(FC250, FC300)      | 160~260HB | ◎             |         |     | 200~400                        | 0.2                           | 0.3  | 0.4 | 0.5 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | Dc/10 | Dc/10                       |                          |
| Nodular cast iron<br>(FCD600, FCD700) | 170~300HB | ◎             |         |     | 150~350                        | 0.2                           | 0.3  | 0.4 | 0.5 | 0.6 | 0.6 | 0.7 | 0.7 | 0.7 | Dc/15 | Dc/15                       |                          |
| Carbon steel<br>(S50C, S55C)          | 180~280HB | ○             |         |     | 180~230                        | 0.2                           | 0.3  | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | Dc/15 | Dc/15                       |                          |
| Low alloy steel<br>(SCM440)           | 180~280HB | ○             |         |     | 150~200                        | 0.2                           | 0.3  | 0.4 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | Dc/15 | Dc/15                       |                          |
| Mold steel<br>(HPM, NAK)              | 280~400HB | ◎             |         |     | 110~170                        | 0.15                          | 0.25 | 0.3 | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | Dc/20 | Dc/20                       |                          |
| Tool & Die steel<br>(SKD61, SKD11)    | 180~255HB | ○             |         |     | 130~180                        | 0.15                          | 0.25 | 0.3 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | Dc/20 | Dc/20                       |                          |
| Hardened steel<br>(SKD61, SKD11)      | 40~55HRC  | ◎             |         |     | 70~ 90                         | 0.15                          | 0.25 | 0.3 | 0.4 | 0.5 | 0.5 | 0.6 | 0.6 | 0.6 | Dc/30 | Dc/30                       |                          |
| Stainless steel<br>(SUS304, SUS316)   | 150~250HB | ○             |         |     | 90~130                         | 0.15                          | 0.25 | 0.3 | 0.4 | 0.4 | 0.4 | 0.5 | 0.5 | 0.5 | Dc/20 | Dc/20                       |                          |
| Copper alloy                          | 80~150HB  |               |         | ◎   | 150~200                        | 0.25                          | 0.4  | 0.5 | 0.6 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | Dc/10 | Dc/10                       |                          |
| Aluminium alloy                       | 30~100HB  |               |         | ◎   | 200~300                        | 0.25                          | 0.4  | 0.5 | 0.6 | 0.7 | 0.7 | 0.8 | 0.8 | 0.8 | Dc/6  | Dc/6                        |                          |
| Graphite                              |           |               | ◎       |     | 200~400                        | 0.3                           | 0.5  | 0.6 | 0.7 | 0.8 | 0.8 | 0.9 | 0.9 | 0.9 | Dc/5  | Dc/5                        |                          |

Note) 1. Data is applicable to short series tools and over  $\phi 12$ mm middle series tools.

2. Refer table 4 for additional data in case of using long series tools and up to  $\phi 12$ mm middle series tools.

◎: First choice  
○: Second choice

# Mirror Ball

**BNM<sub>TYPE</sub>**

**Table 2. Effective tool diameter chart**

| Tool dia.<br>$\phi D_c$<br>(mm) | Effective tool diameter: $D_e$ (mm) |     |     |      |      |      |      |      |      |      |      |      |      |     |
|---------------------------------|-------------------------------------|-----|-----|------|------|------|------|------|------|------|------|------|------|-----|
|                                 | Axial depth of cut: $a_p$ (mm)      |     |     |      |      |      |      |      |      |      |      |      |      |     |
|                                 | 0.2                                 | 0.3 | 0.5 | 1.0  | 1.5  | 2.0  | 2.5  | 3.0  | 3.5  | 4.0  | 4.5  | 5.0  | 5.5  | 6.0 |
| 6                               | 2.2                                 | 2.6 | 3.3 | 4.5  |      |      |      |      |      |      |      |      |      |     |
| 8                               | 2.5                                 | 3   | 3.9 | 5.3  | 6.2  |      |      |      |      |      |      |      |      |     |
| 10                              | 2.8                                 | 3.4 | 4.4 | 6    | 7.1  | 8    |      |      |      |      |      |      |      |     |
| 12                              | 3.1                                 | 3.7 | 4.8 | 6.6  | 7.9  | 8.9  | 9.7  |      |      |      |      |      |      |     |
| 16                              | 3.6                                 | 4.3 | 5.6 | 7.7  | 9.3  | 10.6 | 11.6 | 12.5 |      |      |      |      |      |     |
| 20                              | 4                                   | 4.9 | 6.2 | 8.7  | 10.5 | 12   | 13.2 | 14.3 | 15.2 | 16   |      |      |      |     |
| 25                              | 4.5                                 | 5.4 | 7   | 9.8  | 11.9 | 13.6 | 15   | 16.2 | 17.3 | 18.3 | 19.2 | 20   |      |     |
| 30                              | 4.9                                 | 6   | 7.7 | 10.8 | 13.1 | 15   | 16.6 | 18   | 19.3 | 20.4 | 21.4 | 22.4 | 23.2 | 24  |
| 32                              | 5                                   | 6.2 | 7.9 | 11.1 | 13.5 | 15.5 | 17.2 | 18.7 | 20   | 21.2 | 22.2 | 23.2 | 24.1 | 25  |

**Table 3. Maximum chip thickness chart**

| Work Materials                     | Hardness  | Max. chip thickness: $h_{max}$ (mm) |      |       |      |      |      |      |      |      |
|------------------------------------|-----------|-------------------------------------|------|-------|------|------|------|------|------|------|
|                                    |           | Tool dia.: $D_c$ (mm)               |      |       |      |      |      |      |      |      |
|                                    |           | 6                                   | 8    | 10    | 12   | 16   | 20   | 25   | 30   | 32   |
| Grey cast iron (FC250, FC300)      | 160~260HB | 0.07                                | 0.09 | 0.12  | 0.15 | 0.18 | 0.18 | 0.21 | 0.21 | 0.21 |
| Nodular cast iron (FCD600, FCD700) | 170~300HB | 0.05                                | 0.07 | 0.10  | 0.12 | 0.15 | 0.15 | 0.17 | 0.17 | 0.17 |
| Carbon steel (S50C, S55C)          | 180~280HB | 0.05                                | 0.07 | 0.10  | 0.10 | 0.12 | 0.12 | 0.15 | 0.15 | 0.15 |
| Low alloy steel (SCM440)           | 180~280HB | 0.05                                | 0.07 | 0.10  | 0.10 | 0.12 | 0.12 | 0.15 | 0.15 | 0.15 |
| Mold steel (HPM, NAK)              | 280~400HB | 0.03                                | 0.05 | 0.065 | 0.09 | 0.09 | 0.09 | 0.11 | 0.11 | 0.11 |
| Tool & Die steel (SKD61, SKD11)    | 180~255HB | 0.03                                | 0.05 | 0.065 | 0.09 | 0.11 | 0.11 | 0.13 | 0.13 | 0.13 |
| Hardened die steel (SKD61, SKD11)  | 40~55HRC  | 0.02                                | 0.04 | 0.05  | 0.07 | 0.09 | 0.09 | 0.11 | 0.11 | 0.11 |
| Stainless steel (SUS304, SUS316)   | 150~250HB | 0.03                                | 0.05 | 0.065 | 0.09 | 0.09 | 0.09 | 0.11 | 0.11 | 0.11 |
| Copper alloy                       | 80~150HB  | 0.10                                | 0.12 | 0.15  | 0.18 | 0.21 | 0.21 | 0.24 | 0.24 | 0.24 |
| Aluminium alloy                    | 30~100HB  | 0.12                                | 0.15 | 0.18  | 0.22 | 0.26 | 0.26 | 0.30 | 0.30 | 0.30 |
| Graphite                           |           | 0.15                                | 0.20 | 0.24  | 0.28 | 0.32 | 0.32 | 0.36 | 0.36 | 0.36 |

**Table 4. Reduction ratio of recommended cutting conditions**

| Tool dia.<br>$\phi D_c$<br>(mm) | Short series |              |                |        | Middle series |              |                |        | Long series |              |                |        |
|---------------------------------|--------------|--------------|----------------|--------|---------------|--------------|----------------|--------|-------------|--------------|----------------|--------|
|                                 | $\ell_2$     | $\ell_2/D_c$ | $\min^{-1} \%$ | Feed % | $\ell_2$      | $\ell_2/D_c$ | $\min^{-1} \%$ | Feed % | $\ell_2$    | $\ell_2/D_c$ | $\min^{-1} \%$ | Feed % |
| 6                               | 30           | 5.0          | 100            | 100    | 35            | 5.8          | 100            | 100    | 70          | 11.7         | 45             | 45     |
| 8                               | 35           | 4.4          | 100            | 100    | 53            | 6.6          | 60             | 65     | 75          | 9.4          | 50             | 50     |
| 10                              | 35           | 3.5          | 100            | 100    | 53            | 5.3          | 70             | 80     | 75          | 7.5          | 60             | 65     |
| 12                              | 26           | 2.2          | 100            | 100    | 53            | 4.4          | 90             | 90     | 85          | 7.1          | 65             | 65     |
| 16                              | 32           | 2.0          | 100            | 100    | 63            | 3.9          | 100            | 100    | 100         | 6.3          | 70             | 70     |
| 20                              | 38           | 1.9          | 100            | 100    | 75            | 3.8          | 100            | 100    | 115         | 5.8          | 75             | 75     |
| 25                              | 45           | 1.8          | 100            | 100    | 90            | 3.6          | 100            | 100    | 135         | 5.4          | 80             | 80     |
| 30                              | 53           | 1.8          | 100            | 100    | 106           | 3.5          | 100            | 100    | 160         | 5.3          | 80             | 90     |
| 32                              | 53           | 1.7          | 100            | 100    | 106           | 3.3          | 100            | 100    | 160         | 5.0          | 80             | 90     |

Note) In case of using long series tools, recommend to reduce cutting conditions as per the above percentages.

## Mirror Ball

**BNM**TYPE

### RECOMMENDED CUTTING CONDITIONS/HIGH SPEED MACHINING

#### BNM type insert + Carbide shank holder (C-Body)

| Work Materials                     | Hardness  | Insert Grades | Cutting speed Vc (m/min) | Nominal feed rate f (mm/rev) |      |      |     |      |     |     |     |     | Max depth of cut ap (mm) | Max depth of cut ap (mm) |
|------------------------------------|-----------|---------------|--------------------------|------------------------------|------|------|-----|------|-----|-----|-----|-----|--------------------------|--------------------------|
|                                    |           |               |                          | Tool dia. Dc (mm)            |      |      |     |      |     |     |     |     |                          |                          |
|                                    |           |               |                          | 6                            | 8    | 10   | 12  | 16   | 20  | 25  | 30  | 32  |                          |                          |
| Grey cast iron (FC250, FC300)      | 160~260HB | DH111         | 400~500                  | 0.4                          | 0.5  | 0.5  | 0.6 | 0.8  | 0.8 | 1.0 | 1.0 | 1.0 | 0.1~0.3                  | Dc/40                    |
| Nodular cast iron (FCD600, FCD700) | 170~300HB | DH111         | 300~400                  | 0.3                          | 0.4  | 0.4  | 0.5 | 0.6  | 0.6 | 0.8 | 0.8 | 0.8 | 0.1~0.3                  | Dc/40                    |
| Carbon steel (S50C, S55C)          | 180~280HB | DH111         | 300~400                  | 0.3                          | 0.4  | 0.4  | 0.5 | 0.6  | 0.6 | 0.7 | 0.7 | 0.7 | 0.1~0.3                  | Dc/50                    |
| Low alloy steel (SCM440)           | 180~280HB | DH111         | 300~400                  | 0.3                          | 0.4  | 0.4  | 0.5 | 0.6  | 0.6 | 0.7 | 0.7 | 0.7 | 0.1~0.3                  | Dc/50                    |
| Mold steel (HPM, NAK)              | 280~400HB | DH111         | 300~350                  | 0.25                         | 0.3  | 0.3  | 0.4 | 0.5  | 0.5 | 0.6 | 0.6 | 0.6 | 0.1~0.2                  | Dc/50                    |
| Tool & Die steel (SKD61, SKD11)    | 180~255HB | DH111         | 300~350                  | 0.25                         | 0.3  | 0.3  | 0.4 | 0.4  | 0.4 | 0.6 | 0.6 | 0.6 | 0.1~0.2                  | Dc/50                    |
| Hardened die steel (SKD61, SKD11)  | 40~55HRC  | DH111         | 250~350                  | 0.25                         | 0.3  | 0.3  | 0.4 | 0.5  | 0.5 | 0.6 | 0.6 | 0.6 | 0.1~0.2                  | Dc/50                    |
| Hardened die steel (SKD61, SKD11)  | 55HRC~    | DH111         | 150~250                  | 0.2                          | 0.25 | 0.3  | 0.4 | 0.5  | 0.5 | 0.6 | 0.6 | 0.6 | 0.1~0.2                  | Dc/50                    |
| Stainless steel (SUS304, SUS316)   | 150~250HB | DH111         | 200~300                  | 0.25                         | 0.35 | 0.45 | 0.6 | 0.65 | 0.7 | 0.8 | 0.8 | 0.8 | 0.1~0.2                  | Dc/50                    |
| Copper alloy                       | 80~150HB  | KT9           | 300~400                  | 0.3                          | 0.4  | 0.4  | 0.5 | 0.6  | 0.6 | 0.7 | 0.7 | 0.7 | 0.1~0.5                  | Dc/40                    |
| Aluminium alloy                    | 30~100HB  | KT9           | 400~500                  | 0.35                         | 0.5  | 0.5  | 0.6 | 0.7  | 0.7 | 0.8 | 0.8 | 0.8 | 0.1~0.5                  | Dc/40                    |
| Graphite                           |           | JC10000       | 600~800                  | 0.4                          | 0.6  | 0.6  | 0.7 | 0.8  | 0.8 | 0.9 | 0.9 | 0.9 | 0.1~0.5                  | Dc/40                    |

Note) This data is applicable to short series tools and middle series tools.

# Mirror Ball

**BNM<sub>TYPE</sub>**

## RECOMMENDED CUTTING CONDITIONS

### BNM-SS, BNM-TG type insert Carbide shank holder (C-Body)

| Work<br>Materials                                  | Insert<br>Grades | Cutting<br>speed<br>Vc<br>(m/min) | Nominal feed rate f (mm/rev) |               |              |             |             |             |             |             |             | Max<br>depth<br>of cut<br>ap<br>(mm) | Max<br>pick<br>feed<br>ae<br>(mm) |
|----------------------------------------------------|------------------|-----------------------------------|------------------------------|---------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------------------------------|-----------------------------------|
|                                                    |                  |                                   | Tool dia. Dc (mm)            |               |              |             |             |             |             |             |             |                                      |                                   |
|                                                    |                  |                                   | 6                            | 8             | 10           | 12          | 16          | 20          | 25          | 30          | 32          |                                      |                                   |
| Greycastiron<br>(FC250, FC300)<br>160~260HB        | DH102<br>DH108   | 400~500                           | 0.2~<br>0.35                 | 0.25~<br>0.4  | 0.3~<br>0.5  | 0.4~<br>0.6 | 0.5~<br>0.7 | 0.6~<br>0.8 | 0.6~<br>0.8 | 0.8~<br>1.0 | 0.8~<br>1.0 | 0.02Dc                               | 0.025Dc                           |
| Nodular cast iron<br>(FCD600, FCD700)<br>170~300HB | DH102<br>DH108   | 300~400                           | 0.2~<br>0.3                  | 0.25~<br>0.35 | 0.3~<br>0.4  | 0.4~<br>0.5 | 0.5~<br>0.6 | 0.5~<br>0.7 | 0.5~<br>0.7 | 0.6~<br>0.8 | 0.6~<br>0.8 | 0.02Dc                               | 0.025Dc                           |
| Carbon steel<br>(S50C, S55C)<br>180~280HB          | DH108            | 300~400                           | 0.2~<br>0.3                  | 0.25~<br>0.35 | 0.3~<br>0.4  | 0.3~<br>0.5 | 0.4~<br>0.6 | 0.4~<br>0.6 | 0.4~<br>0.7 | 0.5~<br>0.8 | 0.5~<br>0.8 | 0.02Dc                               | 0.02Dc                            |
| Low alloy steel<br>(SCM440)<br>180~280HB           | DH108            | 300~400                           | 0.2~<br>0.3                  | 0.25~<br>0.35 | 0.3~<br>0.4  | 0.3~<br>0.5 | 0.4~<br>0.6 | 0.4~<br>0.6 | 0.4~<br>0.7 | 0.5~<br>0.8 | 0.5~<br>0.8 | 0.02Dc                               | 0.02Dc                            |
| Mold steel<br>(HPM, NAK)<br>280~400HB              | DH108            | 300~400                           | 0.2~<br>0.3                  | 0.25~<br>0.35 | 0.3~<br>0.4  | 0.3~<br>0.5 | 0.4~<br>0.6 | 0.4~<br>0.6 | 0.4~<br>0.7 | 0.5~<br>0.8 | 0.5~<br>0.8 | 0.02Dc                               | 0.02Dc                            |
| Tool & Die steel<br>(SKD61, SKD11)<br>180~255HB    | DH108            | 300~400                           | 0.2~<br>0.3                  | 0.25~<br>0.35 | 0.3~<br>0.4  | 0.3~<br>0.5 | 0.4~<br>0.6 | 0.4~<br>0.6 | 0.4~<br>0.7 | 0.5~<br>0.8 | 0.5~<br>0.8 | 0.02Dc                               | 0.02Dc                            |
| Hardened die steel<br>(SKD61, SKD11)<br>40~55HRC   | DH102<br>DH108   | 200~300                           | 0.15~<br>0.25                | 0.2~<br>0.3   | 0.25~<br>0.3 | 0.3~<br>0.4 | 0.4~<br>0.5 | 0.4~<br>0.5 | 0.4~<br>0.6 | 0.4~<br>0.7 | 0.4~<br>0.7 | 0.015Dc                              | 0.02Dc                            |
| Hardened die steel<br>(SKD61, SKD11)<br>56~63HRC   | DH102<br>DH108   | 150~250                           | 0.15~<br>0.25                | 0.2~<br>0.3   | 0.25~<br>0.3 | 0.3~<br>0.4 | 0.4~<br>0.5 | 0.4~<br>0.5 | 0.4~<br>0.6 | 0.4~<br>0.7 | 0.4~<br>0.7 | 0.01Dc                               | 0.02Dc                            |
| Stainless steel<br>(SUS304, SUS316)<br>150~250HB   | DH108            | 250~350                           | 0.2~<br>0.3                  | 0.25~<br>0.35 | 0.3~<br>0.4  | 0.3~<br>0.5 | 0.4~<br>0.6 | 0.4~<br>0.6 | 0.4~<br>0.7 | 0.5~<br>0.8 | 0.5~<br>0.8 | 0.02Dc                               | 0.02Dc                            |
| Copper alloy<br>80~150HB                           | JC20003          | 300~400                           | 0.2~<br>0.35                 | 0.25~<br>0.4  | 0.3~<br>0.5  | 0.4~<br>0.6 | 0.5~<br>0.7 | 0.6~<br>0.8 | 0.6~<br>0.8 | 0.8~<br>1.0 | 0.8~<br>1.0 | 0.02Dc                               | 0.025Dc                           |
| Aluminium alloy<br>30~100HB                        | FZ05             | 400~500                           | 0.2~<br>0.35                 | 0.25~<br>0.4  | 0.3~<br>0.5  | 0.4~<br>0.6 | 0.5~<br>0.7 | 0.6~<br>0.8 | 0.6~<br>0.8 | 0.8~<br>1.0 | 0.8~<br>1.0 | 0.03Dc                               | 0.03Dc                            |
| Graphite                                           | JC20003          | 600~800                           | 0.2~<br>0.35                 | 0.25~<br>0.4  | 0.3~<br>0.5  | 0.4~<br>0.6 | 0.5~<br>0.7 | 0.6~<br>0.8 | 0.6~<br>0.8 | 0.8~<br>1.0 | 0.8~<br>1.0 | 0.03Dc                               | 0.03Dc                            |

Note) This data is applicable to short series tools and middle series tools.



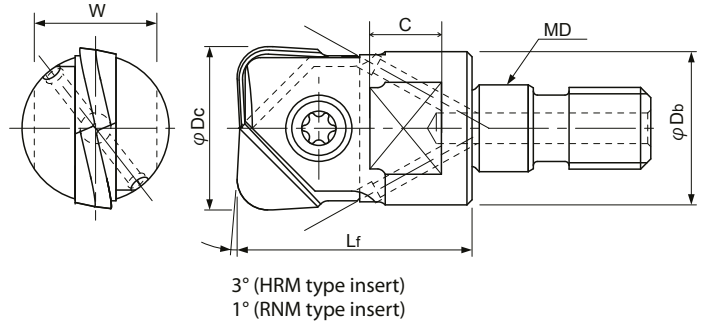
## Mirror Radius

## MRX<sub>TYPE</sub>

### Through Coolant Hole

Accuracy of MRX type modular head mounted on MSN carbide shank holder:

- ☆ HRM type: O.D. run out: **below 15μm** (Target **below 10μm**)  
Corner radius accuracy: **within ±0.015mm**
- ☆ RNM type: O.D. run out: **below 15μm** (Target **below 10μm**)  
Face run out: **below 5μm**  
Corner radius accuracy: **within ±0.010mm**



### ■ BODY

| Cat. No.    | Stock | Dimensions (mm) |    |      |     |      |    | Inserts                          | Parts       |        |
|-------------|-------|-----------------|----|------|-----|------|----|----------------------------------|-------------|--------|
|             |       | φDc             | Lf | φDb  | MD  | C    | W  |                                  | Clamp screw | Wrench |
|             |       |                 |    |      |     |      |    |                                  |             |        |
| MRX-100-M6  | ●     | 10              | 18 | 9.7  | M6  | 6.5  | 8  | RNM-100-...,HRM-100/110-...      | FSW-3007H   | A-08   |
| MRX-120-M6  | ●     | 12              | 20 | 11.5 | M6  | 6.5  | 8  | RNM-120-/130-...,HRM-120/130-... | FSW-3509H   | A-10   |
| MRX-160-M8  | ●     | 16              | 23 | 15   | M8  | 8    | 12 | RNM-160-/170-...,HRM-160/170-... | FSW-4013H   | A-15   |
| MRX-200-M10 | ●     | 20              | 30 | 19   | M10 | 8    | 14 | RNM-200-/210-...,HRM-200/220-... | FSW-5016H   | A-20W  |
| MRX-250-M12 | ●     | 25              | 35 | 24   | M12 | 10   | 17 | RNM-250-/260-...                 | FSW-6020    | A-30   |
| MRX-300-M16 | □     | 30              | 43 | 29   | M16 | 12.5 | 22 | RNM-300-...                      | FSW-8025    | A-40   |
| MRX-320-M16 | ●     | 32              | 43 | 30   | M16 | 12.5 | 22 | RNM-320-...                      | FSW-8025    | A-40   |

Note) 1. Please refer page 22 & 23 for recommended cutting conditions.  
2. All cutters are supplied without inserts and wrench.

| Clamp Screw | Recommended Torque (N·m) |
|-------------|--------------------------|
| FSW-3007H   | 1.2                      |
| FSW-3509H   | 2.0                      |
| FSW-4013H   | 3.0                      |
| FSW-5016H   | 4.0                      |
| FSW-6020    | 5.0                      |
| FSW-8025    | 6.0                      |

## Mirror Radius

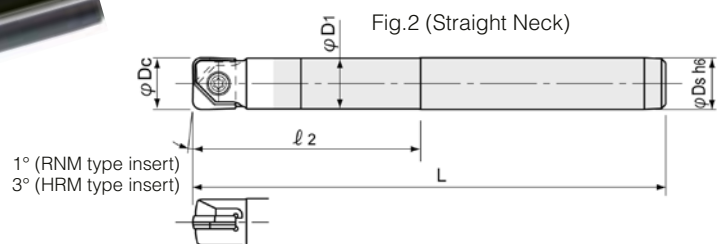
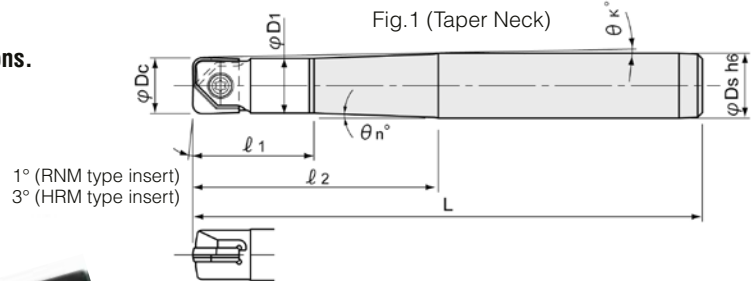


## RNM<sub>TYPE</sub>

1. By adopting carbide shank, tool rigidity is equal to solid carbide radius end mill.
2. Tool life increased to twice compared with MIRROR RADIUS steel shank.
3. Carbide shank can be used on shrink-fit type holders.
4. Insert locates accurately in any of the two radial positions. It is mounted into the cutter body.



**RNM-S-C type** (Straight Neck)  
**RNM-T-C type** (Taper Neck)



### BODY

| Cat. No.          | Stock | Dimensions (mm) |     |       |       |               |               |                  |                                                | Parts                                                                                 |                                                                                       |                                                                                       | Fig.       |
|-------------------|-------|-----------------|-----|-------|-------|---------------|---------------|------------------|------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------|
|                   |       |                 |     |       |       |               |               |                  |                                                | Inserts                                                                               | Clamp screw                                                                           | Wrench                                                                                |            |
|                   |       | $\varphi D_c$   | L   | $l_1$ | $l_2$ | $\varphi D_1$ | $\varphi D_s$ | $\theta_K^\circ$ | $\theta_n^\circ$<br><small>Taper angle</small> |  |  |  |            |
| RNMS-060015U-S06C | ●     | 6               | 60  | —     | 15    | 5.7           | 6             | —                | —                                              | RNM-060...                                                                            | FSW-2005H                                                                             | A-06                                                                                  | 2          |
| RNMM-060030U-S06C | ●     |                 | 80  | —     | 30    |               |               |                  |                                                | HRM-060...                                                                            |                                                                                       |                                                                                       |            |
| RNMS-080020U-S08C | ●     | 8               | 70  | —     | 20    | 7.6           | 8             | —                | —                                              | RNM-080...                                                                            | FSW-2506H                                                                             | A-07                                                                                  | 2          |
| RNMM-080040U-S08C | ●     |                 | 90  | —     | 40    |               | 8             | —                | —                                              | HRM-080/                                                                              |                                                                                       |                                                                                       | 2          |
| RNMM-080053T-S12C | ●     |                 | 110 | 20    | 53    | 7.8           | 12            | 2°12'            | 2°                                             | 090...                                                                                |                                                                                       |                                                                                       | 1          |
| RNML-080075S-S08C | ●     |                 | 140 | —     | 75    |               | 8             | —                | —                                              | FRM-080...                                                                            |                                                                                       |                                                                                       | 2          |
| RNMS-100025U-S10C | ●     | 10              | 75  | —     | 25    | 9.5           | 10            | —                | —                                              | RNM-100...<br>HRM-100/<br>110...                                                      | FSW-3007H                                                                             | A-08                                                                                  | 2          |
| RNMM-100050U-S10C | ●     |                 | 100 | —     | 50    |               |               | —                | —                                              |                                                                                       |                                                                                       |                                                                                       | 2          |
| RNMM-100050S-S10C | ●     |                 | 110 | —     | 50    | 9.8           | 12            | 1°7'             | 1°                                             | FRM-100...                                                                            |                                                                                       |                                                                                       | 2          |
| RNMM-100053T-S12C | ●     |                 | 110 | 22.5  | 53    |               |               |                  |                                                |                                                                                       |                                                                                       |                                                                                       | 1          |
| RNML-100075S-S10C | ●     |                 | 140 | —     | 75    |               |               |                  |                                                |                                                                                       |                                                                                       |                                                                                       | 10         |
| RNMS-120030U-S12C | ●     |                 | 12  | 80    | —     | 30            | 11.5          | 12               | —                                              | —                                                                                     |                                                                                       |                                                                                       | RNM-120... |
| RNMM-120060U-S12C | ●     | 110             |     | —     | 60    | —             |               |                  | —                                              | 2                                                                                     |                                                                                       |                                                                                       |            |
| RNMM-120053S-S12C | ●     | 110             |     | —     | 53    | 11.8          | —             |                  | —                                              | HRM-120/<br>130...                                                                    | 2                                                                                     |                                                                                       |            |
| RNML-120095S-S12C | ●     | 160             |     | —     | 95    |               | —             |                  | —                                              | FRM-120...                                                                            | 2                                                                                     |                                                                                       |            |
| RNMS-160035U-S16C | ●     | 16              | 90  | —     | 35    | 15.5          | 16            | —                | —                                              | RNM-160...                                                                            | FSW-4013H                                                                             | A-15                                                                                  | 2          |
| RNMM-160070S-S16C | ●     |                 | 140 | —     | 70    | —             |               | —                | RNM-170...                                     | 2                                                                                     |                                                                                       |                                                                                       |            |
| RNMM-160090S-S16C | ●     |                 | 160 | —     | 90    | 15.8          |               | —                | —                                              | HRM-160/<br>170...                                                                    |                                                                                       |                                                                                       | 2          |
| RNML-160120S-S16C | ●     |                 | 210 | —     | 120   |               |               | —                | —                                              | FRM-160...                                                                            |                                                                                       |                                                                                       | 2          |
| RNML-160150S-S16C | ●     |                 | 220 | —     | 150   |               |               | —                | —                                              | FRM-170...                                                                            |                                                                                       |                                                                                       | 2          |
|                   | ●     |                 |     |       |       |               |               |                  |                                                |                                                                                       |                                                                                       |                                                                                       |            |

Note) 1. All cutters are supplied without inserts.  
 2. Please refer page 33 & 42 for recommended cutting conditions.

Please refer page 17 for  
**"Caution for the mounting on shrink-fit holder"**

| Clamp Screw | Recommended torque (N·m) | Clamp Screw | Recommended torque (N·m) |
|-------------|--------------------------|-------------|--------------------------|
| FSW-2005H   | 0.5                      | FSW-4013H   | 3.0                      |
| FSW-2506H   | 0.9                      | FSW-5016H   | 4.0                      |
| FSW-3007H   | 1.2                      | FSW-6020    | 5.0                      |
| FSW-3509H   | 2.0                      | FSW-8025    | 6.0                      |

## Mirror Radius

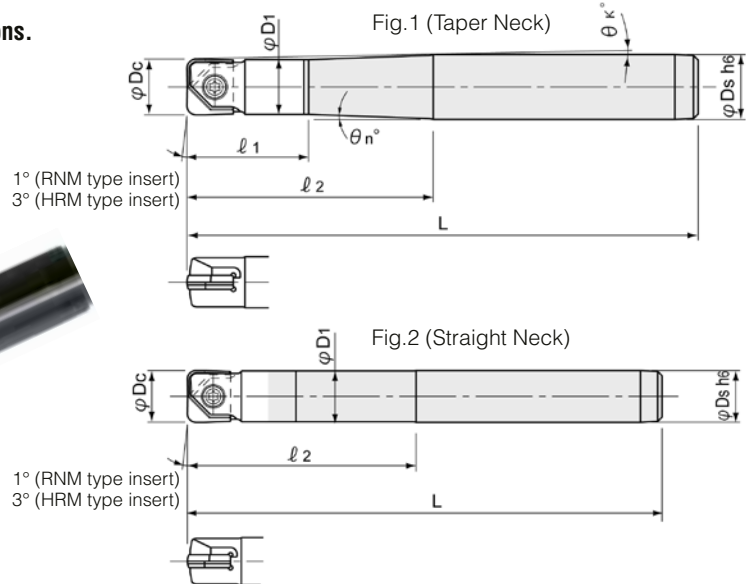


RNM<sub>TYPE</sub>

1. By adopting carbide shank, tool rigidity is equal to solid carbide radius end mill.
2. Tool life increased to twice compared with MIRROR RADIUS steel shank.
3. Carbide shank can be used on shrink-fit type holders.
4. Insert locates accurately in any of the two radial positions. It is mounted into the cutter body.



**RNM-S-Ctype** (Straight Neck)  
**RNM-T-Ctype** (Taper Neck)



### BODY

| Cat. No.          | Stock | Dimensions (mm) |     |          |          |            |            |                  |                  | Parts          |             |        | Fig. |
|-------------------|-------|-----------------|-----|----------|----------|------------|------------|------------------|------------------|----------------|-------------|--------|------|
|                   |       | $\phi D_c$      | L   | $\ell_1$ | $\ell_2$ | $\phi D_1$ | $\phi D_s$ | $\theta_K^\circ$ | $\theta_n^\circ$ | Inserts        | Clamp screw | Wrench |      |
| RNMS-200040U-S20C | ●     |                 | 105 | —        | 40       | 19.5       |            | —                | —                | RNM-200...     |             |        | 2    |
| RNMM-200075S-S20C | ●     |                 | 141 | —        | 75       |            |            | —                | —                | RNM-210...     |             |        |      |
| RNMM-200105S-S20C | ●     | 20              | 180 | —        | 105      | 19.8       | 20         | —                | —                | HRM-200/220... | FSW-5016H   | A-20W  | 2    |
| RNML-200150S-S20C | ●     |                 | 220 | —        | 150      |            |            | —                | —                | FRM-200/210... |             |        |      |
| RNML-200170S-S20C | ●     |                 | 250 | —        | 170      |            |            | —                | —                |                |             |        |      |
| RNMM-250090S-S25C | ●     |                 | 166 | —        | 90       |            |            | —                | —                | RNM-250...     |             |        |      |
| RNMM-250140S-S25C | ●     | 25              | 220 | —        | 140      | 24.8       | 25         | —                | —                | RNM-260...     | FSW-6020    | A-30   | 2    |
| RNML-250190S-S25C | □     |                 | 260 | —        | 190      |            |            | —                | —                | FRM-250...     |             |        |      |
| RNMM-300106S-S32C | ●     | 30              | 186 | —        | 106      | 29.8       | 32         | —                | —                | RNM-300...     | FSW-8025    | A-40   | 2    |
| RNMM-320106S-S32C | □     | 32              | 186 | —        | 106      | 31.8       | 32         | —                | —                | RNM-320...     | FSW-8025    | A-40   | 2    |

Note) 1. All cutters are supplied without inserts.  
2. Please refer page 33-42 for recommended cutting conditions.

| Clamp Screw | Recommended torque (N·m) | Clamp Screw | Recommended torque (N·m) |
|-------------|--------------------------|-------------|--------------------------|
| FSW-2005H   | 0.5                      | FSW-4013H   | 3.0                      |
| FSW-2506H   | 0.9                      | FSW-5016H   | 4.0                      |
| FSW-3007H   | 1.2                      | FSW-6020    | 5.0                      |
| FSW-3509H   | 2.0                      | FSW-8025    | 6.0                      |

### ★ Caution for the mounting on shrink-fit holder (In case of BNM-C Body, RNM-C Body)

When you use a carbide shank (C Body) on the shrink-fit holder, please shrink-fit only carbide shank without putting insert and clamp screw.

**Please mount the insert and tighten the clamp screw after shrink-fit.**

Note) If it shrink-fits with the insert and clamp screw, it will be difficult to loose the clamp screw.

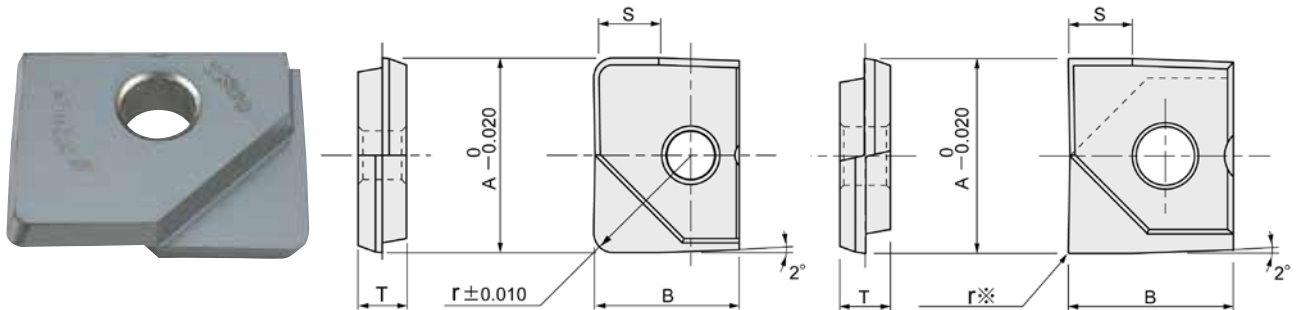
# Mirror Radius

# RNM<sub>TYPE</sub>

Radius form accuracy  
of insert:  
within  $\pm 0.010\text{mm}$

## ■ INSERTS

● RNM-□□□-R0



| Cat. No.    | PVD coated         |                | Diamond coated | Uncoated     | Dimensions (mm) |     |    |     |     |
|-------------|--------------------|----------------|----------------|--------------|-----------------|-----|----|-----|-----|
|             | JC8015<br>(Z10~20) | DH103<br>(Z05) | JC10000        | KT9<br>(K10) | r               | S   | A  | B   | T   |
| RNM-060-R03 | ●                  | ●              |                |              | 0.3             |     |    |     |     |
| RNM-060-R05 | ●                  | ●              |                |              | 0.5             | 2   | 6  | 5   | 2   |
| RNM-060-R10 | ●                  | ●              |                |              | 1               |     |    |     |     |
| RNM-080-R03 | ●                  | ●              |                | □            | 0.3             |     |    |     |     |
| RNM-080-R05 | ●                  | ●              | ●              | ●            | 0.5             | 2.7 | 8  | 7   | 2.4 |
| RNM-080-R10 | ●                  | ●              | □              | ●            | 1               |     |    |     |     |
| RNM-100-R0  | ●                  |                |                |              | ※               |     |    |     |     |
| RNM-100-R03 | ●                  | ●              |                | □            | 0.3             |     |    |     |     |
| RNM-100-R05 | ●                  | ●              | ●              | ●            | 0.5             |     |    |     |     |
| RNM-100-R10 | ●                  | ●              | □              | ●            | 1               | 3.3 | 10 | 8.5 | 2.6 |
| RNM-100-R15 | □                  |                |                | □            | 1.5             |     |    |     |     |
| RNM-100-R20 | ●                  | ●              |                | □            | 2               |     |    |     |     |
| RNM-120-R0  | ●                  |                |                |              | ※               |     |    |     |     |
| RNM-120-R03 | ●                  | ●              |                | □            | 0.3             |     |    |     |     |
| RNM-120-R05 | ●                  | ●              | □              | ●            | 0.5             |     |    |     |     |
| RNM-120-R10 | ●                  | ●              | □              | ●            | 1               | 4   | 12 | 10  | 3   |
| RNM-120-R15 | ●                  | ●              |                | □            | 1.5             |     |    |     |     |
| RNM-120-R20 | ●                  | ●              |                | ●            | 2               |     |    |     |     |
| RNM-160-R0  | ●                  |                |                |              | ※               |     |    |     |     |
| RNM-160-R03 | ●                  | ●              |                | ●            | 0.3             |     |    |     |     |
| RNM-160-R05 | ●                  | ●              |                | ●            | 0.5             |     |    |     |     |
| RNM-160-R10 | ●                  | ●              |                | ●            | 1               | 5.3 | 16 | 12  | 4   |
| RNM-160-R15 | ●                  | ●              |                | □            | 1.5             |     |    |     |     |
| RNM-160-R20 | ●                  | ●              |                | □            | 2               |     |    |     |     |
| RNM-200-R0  | ●                  |                |                |              | ※               |     |    |     |     |
| RNM-200-R03 | ●                  | ●              |                | □            | 0.3             |     |    |     |     |
| RNM-200-R05 | ●                  | ●              |                | □            | 0.5             | 6.7 | 20 | 15  | 5   |
| RNM-200-R10 | ●                  | ●              |                | ●            | 1               |     |    |     |     |

2 inserts per case, but grade JC10000 insert is packed in 1 piece per case.

※ Corner radius: Below 0.1mm

Note) Please refer page 22 for "Instructions for mounting insert."

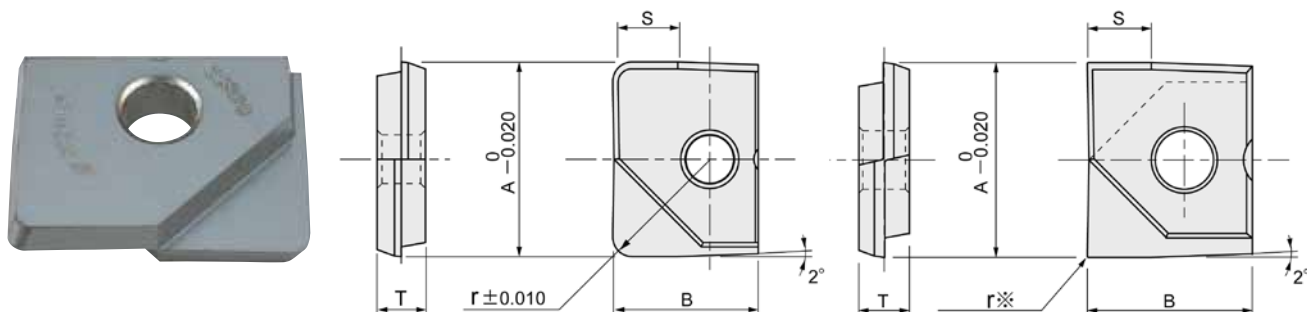
## Mirror Radius

## RNM<sub>TYPE</sub>

Radius form accuracy  
of insert:  
within  $\pm 0.010\text{mm}$

### ■ INSERTS

● RNM-□□□-R0



| Cat. No.    | PVD coated         |                | Diamond coated | Uncoated     | Dimensions (mm) |      |    |      |   |
|-------------|--------------------|----------------|----------------|--------------|-----------------|------|----|------|---|
|             | JC8015<br>(Z10~20) | DH103<br>(Z05) | JC10000        | KT9<br>(K10) | r               | S    | A  | B    | T |
| RNM-200-R15 | ●                  | ●              |                | □            | 1.5             |      |    |      |   |
| RNM-200-R20 | ●                  | ●              |                | □            | 2               | 6.7  | 20 | 15   | 5 |
| RNM-200-R30 | ●                  |                |                |              | 3               |      |    |      |   |
| RNM-250-R0  | □                  |                |                |              | ※               |      |    |      |   |
| RNM-250-R03 | ●                  | ●              |                |              | 0.3             |      |    |      |   |
| RNM-250-R05 | ●                  | ●              |                |              | 0.5             |      |    |      |   |
| RNM-250-R10 | ●                  | ●              |                |              | 1               | 8.3  | 25 | 18.5 | 6 |
| RNM-250-R15 | □                  | □              |                |              | 1.5             |      |    |      |   |
| RNM-250-R20 | ●                  | ●              |                |              | 2               |      |    |      |   |
| RNM-250-R30 | ●                  |                |                |              | 3               |      |    |      |   |
| RNM-300-R03 | □                  | □              |                |              | 0.3             |      |    |      |   |
| RNM-300-R05 | □                  | □              |                |              | 0.5             |      |    |      |   |
| RNM-300-R10 | □                  | □              |                |              | 1               | 10   | 30 | 22.5 | 7 |
| RNM-300-R15 | □                  |                |                |              | 2               |      |    |      |   |
| RNM-300-R20 | □                  | □              |                |              | 2               |      |    |      |   |
| RNM-300-R30 | □                  |                |                |              | 3               |      |    |      |   |
| RNM-320-R03 | ●                  | ●              |                |              | 0.3             |      |    |      |   |
| RNM-320-R05 | ●                  | ●              |                |              | 0.5             |      |    |      |   |
| RNM-320-R10 | ●                  | ●              |                |              | 1               | 10.7 | 32 | 23.5 | 7 |
| RNM-320-R15 | ●                  |                |                |              | 1.5             |      |    |      |   |
| RNM-320-R20 | ●                  | ●              |                |              | 2               |      |    |      |   |
| RNM-320-R30 | □                  |                |                |              | 3               |      |    |      |   |

2 inserts per case, but grade JC10000 insert is packed in 1 piece per case.

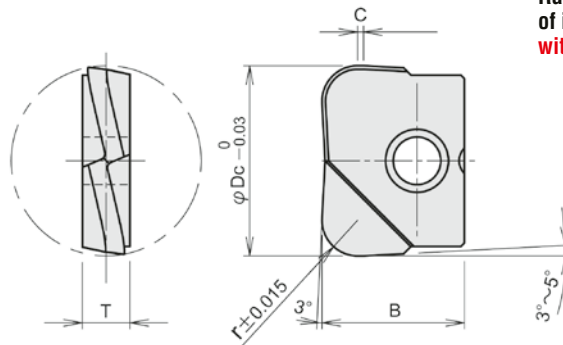
※ Corner radius: Below 0.1mm

Note) Please refer page 22 for "Instructions for mounting insert."

# Mirror Radius

# HRM<sub>TYPE</sub>

## ■ INSERTS



Radius form accuracy  
of insert:  
within  $\pm 0.015\text{mm}$

| Cat. No.    | PVD coated      | Dimensions (mm) |     |     |     |     |
|-------------|-----------------|-----------------|-----|-----|-----|-----|
|             | JC8015 (Z10~20) | $\phi Dc$       | r   | B   | C   | T   |
| HRM-060-R05 | ●               |                 | 0.5 |     |     |     |
| HRM-060-R10 | ●               | 6               | 1   | 5   | —   | 2   |
| HRM-060-R15 | ●               |                 | 1.5 |     |     |     |
| HRM-080-R20 | ●               | 8               | 2   | 7   | 0.3 | 2.4 |
| HRM-090-R20 | ●               | 9               | 2   | 7   | 0.3 | 2.4 |
| HRM-100-R20 | ●               | 10              | 2   | 8.5 | 0.3 | 2.6 |
| HRM-110-R20 | ●               | 11              | 2   | 8.5 | 0.3 | 2.6 |
| HRM-120-R20 | ●               | 12              | 2   | 10  | 0.5 | 3   |

| Cat. No.    | PVD coated      | Dimensions (mm) |   |    |     |   |
|-------------|-----------------|-----------------|---|----|-----|---|
|             | JC8015 (Z10~20) | $\phi Dc$       | r | B  | C   | T |
| HRM-130-R20 | ●               | 13              | 2 | 10 | 0.5 | 3 |
| HRM-160-R20 | ●               | 16              | 2 | 12 | 0.5 | 4 |
| HRM-160-R30 | ●               |                 | 3 |    |     |   |
| HRM-170-R30 | ●               | 17              | 3 | 12 | 0.5 | 4 |
| HRM-200-R20 | ●               | 20              | 2 | 15 | 0.5 | 5 |
| HRM-200-R30 | ●               |                 | 3 |    |     |   |
| HRM-220-R30 | □               | 22              | 3 | 15 | 0.5 | 5 |

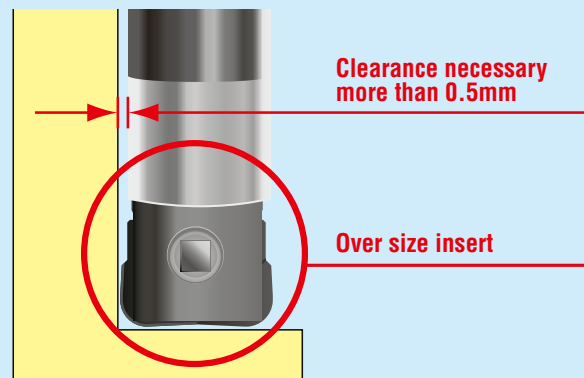
2 inserts per case

Note) "HRM" insert is exclusive use of MIRROR RADIUS carbide shank body.  
Please use only in MIRROR RADIUS carbide shank body and modular head.

## Features of "MIRROR RADIUS" Over size inserts

In case of using HRM inserts, recommend to use over size inserts for increasing side clearance to prevent the damage of shank by sticking chips

(※) HRM-090-R20, HRM-110-R20, HRM-130-R20, HRM-170-R30, HRM-220-R30



Please refer page 22 for "Instructions for mounting insert"

## Mirror Radius

## FRM<sub>TYPE</sub>



# FRM

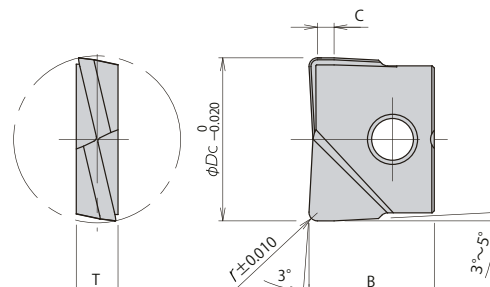
FRM type insert for MIRROR RADIUS RNM /MRN type.

- Adopted new PVD coated grade “DH102” suitable for high hardened material, and PVD coated grade “JC8015” suitable for general steel.
- Adopting positive rake cutting edge achieved low cutting force and sharpness. And available large size over 25mm.
- Intensive tool management can be possible from roughing to finishing with same body by using inserts properly.

Side & bottom face finishing for high hardened steel, etc.



Corner radius accuracy of inserts:  
below  $\pm 0.010\text{mm}$



Longer periphery straight edge achieved longer tool life, better surface roughness and deflection on vertical wall application.

| Cat. No.    | PVD coated |       | Dimensions (mm) |     |      |     |     |
|-------------|------------|-------|-----------------|-----|------|-----|-----|
|             | JC8015     | DH102 | $\phi Dc$       | r   | B    | C   | T   |
| FRM-060-R05 | ●          | ●     | 6               | 0.5 | 5    | 0.8 | 2   |
| FRM-060-R10 | ●          | ●     |                 | 1   |      |     |     |
| FRM-080-R05 | ●          | ●     | 8               | 0.5 | 7    | 1.2 | 2.4 |
| FRM-080-R10 | ●          | ●     |                 | 1   |      |     |     |
| FRM-100-R05 | ●          | ●     | 10              | 0.5 | 8.5  | 1.5 | 2.6 |
| FRM-100-R10 | ●          | ●     |                 | 1   |      |     |     |
| FRM-100-R20 |            | ●     |                 | 2   |      |     |     |
| FRM-120-R05 | ●          | ●     | 12              | 0.5 | 10   | 1.5 | 3   |
| FRM-120-R10 | ●          | ●     |                 | 1   |      |     |     |
| FRM-120-R20 | ●          | ●     |                 | 2   |      |     |     |
| FRM-120-R30 |            | ●     |                 | 3   |      |     |     |
| FRM-160-R05 | ●          | ●     | 16              | 0.5 | 12   | 2   | 4   |
| FRM-160-R10 | ●          | ●     |                 | 1   |      |     |     |
| FRM-160-R15 |            | ●     |                 | 1.5 |      |     |     |
| FRM-160-R20 | ●          | ●     |                 | 2   |      |     |     |
| FRM-160-R30 |            | ●     |                 | 3   |      |     |     |
| FRM-170-R10 | □          | □     | 17              | 1   | 12   | 2   | 4   |
| FRM-200-R05 | ●          | ●     | 20              | 0.5 | 15   | 2   | 5   |
| FRM-200-R10 | ●          | ●     |                 | 1   |      |     |     |
| FRM-200-R15 |            | ●     |                 | 1.5 |      |     |     |
| FRM-200-R20 | ●          | ●     |                 | 2   |      |     |     |
| FRM-200-R30 |            | ●     |                 | 3   |      |     |     |
| FRM-210-R10 | ●          | □     | 21              | 1   | 15   | 2   | 5   |
| FRM-250-R05 |            | ●     | 25              | 0.5 | 18.5 | 2.5 | 6   |
| FRM-250-R10 | ●          | ●     |                 | 1   |      |     |     |
| FRM-250-R20 | ●          | ●     |                 | 2   |      |     |     |
| FRM-250-R30 |            | ●     |                 | 3   |      |     |     |
| FRM-300-R05 |            | □     | 30              | 0.5 | 22.5 | 3   | 7   |
| FRM-300-R10 | □          | □     |                 | 1   |      |     |     |
| FRM-300-R20 | □          | □     |                 | 2   |      |     |     |
| FRM-300-R30 |            | □     |                 | 3   |      |     |     |
| FRM-320-R05 |            | □     | 32              | 0.5 | 23.5 | 3   | 7   |
| FRM-320-R10 | ●          | ●     |                 | 1   |      |     |     |
| FRM-320-R20 | ●          | ●     |                 | 2   |      |     |     |
| FRM-320-R30 |            | ●     |                 | 3   |      |     |     |

2 inserts per case

Note) Recommend to use FRM inserts combined with Mirror Radius End Mill carbide shank body (page 16 & 17) or Mirror Radius modular heads (page 15).

Please see page 22 for Attention to mounting insert.



# Mirror Radius

# MRX<sub>TYPE</sub>

## RECOMMENDED CUTTING CONDITIONS / HIGH SPEED MACHINING

### MRX type with RNM insert + MSN Carbide Shank Holder

| Work Materials                         | Insert Grades    | Cutting speed<br>V <sub>c</sub><br>(m/min) | Tool dia. (mm)                    |                            |                           |                            |                           |                            |
|----------------------------------------|------------------|--------------------------------------------|-----------------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|
|                                        |                  |                                            | 10                                |                            | 12/13                     |                            | 16/17                     |                            |
|                                        |                  |                                            | n<br>(min <sup>-1</sup> )         | V <sub>f</sub><br>(mm/min) | n<br>(min <sup>-1</sup> ) | V <sub>f</sub><br>(mm/min) | n<br>(min <sup>-1</sup> ) | V <sub>f</sub><br>(mm/min) |
|                                        |                  |                                            | Max. D.O.C. & Max. Pick feed (mm) |                            |                           |                            |                           |                            |
| Grey cast iron<br>160-260 HB           | DH103            | 500                                        | 16,000                            | 6,400                      | 13,500                    | 6,100                      | 10,000                    | 5,000                      |
|                                        |                  |                                            | Max.ap=0.3,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Nodular cast iron<br>170-300 HB        | DH103            | 400                                        | 12,700                            | 4,400                      | 10,600                    | 3,700                      | 8,000                     | 3,200                      |
|                                        |                  |                                            | Max.ap=0.3,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Carbon steel<br>180-280 HB             | DH103            | 400                                        | 12,700                            | 4,400                      | 10,600                    | 3,700                      | 8,000                     | 3,200                      |
|                                        |                  |                                            | Max.ap=0.3,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Low alloy steel<br>180-280 HB          | DH103            | 350                                        | 11,000                            | 3,500                      | 9,200                     | 2,900                      | 7,000                     | 2,660                      |
|                                        |                  |                                            | Max.ap=0.3,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Mold steel<br>280-400 HB               | DH103            | 350                                        | 11,000                            | 3,100                      | 9,200                     | 2,600                      | 7,000                     | 2,300                      |
|                                        |                  |                                            | Max.ap=0.3,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Tool & Die steel<br>180-255 HB         | DH103            | 350                                        | 11,000                            | 3,100                      | 9,200                     | 2,600                      | 7,000                     | 2,300                      |
|                                        |                  |                                            | Max.ap=0.25,Max. ae=0.1 × Dc      |                            |                           |                            |                           |                            |
| Hardened die steel<br>40-55 HRC        | DH103            | 200                                        | 6,400                             | 1,500                      | 5,300                     | 1,200                      | 4,000                     | 1,000                      |
|                                        |                  |                                            | Max.ap=0.2,Max. ae=0.05 × Dc      |                            |                           |                            |                           |                            |
| Hardened die steel<br>56-63 HRC        | DH103            | 100                                        | 3,200                             | 600                        | 2,700                     | 500                        | 2,000                     | 400                        |
|                                        |                  |                                            | Max.ap=0.15,Max. ae=0.02 × Dc     |                            |                           |                            |                           |                            |
| Stainless steel<br>150-250 HB          | DH103            | 350                                        | 11,000                            | 2,500                      | 9,200                     | 2,100                      | 7,000                     | 1,750                      |
|                                        |                  |                                            | Max.ap=0.25,Max. ae=0.1 × Dc      |                            |                           |                            |                           |                            |
| Inconel<br>Titanium alloy<br>30-40 HRC | DH103            | 90                                         | 2,900                             | 700                        | 2,400                     | 600                        | 1,790                     | 450                        |
|                                        |                  |                                            | Max.ap=0.2,Max. ae=0.05 × Dc      |                            |                           |                            |                           |                            |
| Copper alloy<br>80-150 HB              | DH103            | 350                                        | 11,000                            | 4,400                      | 9,200                     | 3,700                      | 7,000                     | 3,500                      |
|                                        |                  |                                            | Max.ap=0.3,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Aluminium alloy<br>30-100HB            | DH103<br>KT9     | 600                                        | 19,000                            | 7,600                      | 16,000                    | 6,400                      | 12,000                    | 6,000                      |
|                                        |                  |                                            | Max.ap=0.4,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Graphite                               | DH103<br>JC10000 | 600                                        | 19,000                            | 7,600                      | 16,000                    | 6,400                      | 12,000                    | 6,000                      |
|                                        |                  |                                            | Max.ap=0.4,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |

n: Spindle speed, V<sub>f</sub>: Feed speed

## ★ Instruction for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Do not tighten the clamp screw too hard.

**Recommend to use Torque control wrenches (Page 6)**

**Refer the right table for recommended tightening torque.**

| Dimensions | Recommended Torque |
|------------|--------------------|
| φ Dc       | N~m                |
| 10         | 1.2                |
| 12         | 2.0                |
| 16         | 3.0                |
| 20         | 4.0                |
| 25         | 5.0                |
| 30         | 6.0                |
| 32         | 6.0                |



## Mirror Radius

## MRX<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS / HIGH SPEED MACHINING

#### MRX type with RNM insert + MSN Carbide Shank Holder

| Work Materials                         | Insert Grades    | Cutting speed<br>V <sub>c</sub><br>(m/min) | Tool dia. (mm)                    |                            |                           |                            |                           |                            |
|----------------------------------------|------------------|--------------------------------------------|-----------------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|
|                                        |                  |                                            | 20/21                             |                            | 25/26                     |                            | 30/32                     |                            |
|                                        |                  |                                            | n<br>(min <sup>-1</sup> )         | V <sub>f</sub><br>(mm/min) | n<br>(min <sup>-1</sup> ) | V <sub>f</sub><br>(mm/min) | n<br>(min <sup>-1</sup> ) | V <sub>f</sub><br>(mm/min) |
|                                        |                  |                                            | Max. D.O.C. & Max. Pick feed (mm) |                            |                           |                            |                           |                            |
| Grey cast iron<br>160-260 HB           | DH103            | 500                                        | 8,000                             | 4,000                      | 6,400                     | 3,200                      | 5,300                     | 2,650                      |
|                                        |                  |                                            | Max.ap=0.3,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Nodular cast iron<br>170-300 HB        | DH103            | 400                                        | 6,400                             | 2,560                      | 5,100                     | 2,040                      | 4,200                     | 1,700                      |
|                                        |                  |                                            | Max.ap=0.3,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Carbon steel<br>180-280 HB             | DH103            | 400                                        | 6,400                             | 2,560                      | 5,100                     | 2,040                      | 4,200                     | 1,700                      |
|                                        |                  |                                            | Max.ap=0.3,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Low alloy steel<br>180-280 HB          | DH103            | 350                                        | 5,600                             | 2,130                      | 4,500                     | 1,710                      | 3,700                     | 1,400                      |
|                                        |                  |                                            | Max.ap=0.3,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Mold steel<br>280-400 HB               | DH103            | 350                                        | 5,600                             | 1,850                      | 4,500                     | 1,490                      | 3,700                     | 1,220                      |
|                                        |                  |                                            | Max.ap=0.3,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Tool & Die steel<br>180-255 HB         | DH103            | 350                                        | 5,600                             | 1,850                      | 4,500                     | 1,490                      | 3,700                     | 1,220                      |
|                                        |                  |                                            | Max.ap=0.25,Max. ae=0.1 × Dc      |                            |                           |                            |                           |                            |
| Hardened die steel<br>40-55 HRC        | DH103            | 200                                        | 3,180                             | 800                        | 2,550                     | 640                        | 2,100                     | 525                        |
|                                        |                  |                                            | Max.ap=0.2,Max. ae=0.05 × Dc      |                            |                           |                            |                           |                            |
| Hardened die steel<br>56-63 HRC        | DH103            | 100                                        | 1,590                             | 320                        | 1,270                     | 250                        | 1,060                     | 210                        |
|                                        |                  |                                            | Max.ap=0.15,Max. ae=0.02 × Dc     |                            |                           |                            |                           |                            |
| Stainless steel<br>150-250 HB          | DH103            | 350                                        | 5,600                             | 1,400                      | 4,500                     | 1,130                      | 3,700                     | 925                        |
|                                        |                  |                                            | Max.ap=0.25,Max. ae=0.1 × Dc      |                            |                           |                            |                           |                            |
| Inconel<br>Titanium alloy<br>30-40 HRC | DH103            | 90                                         | 1,430                             | 360                        | 1,150                     | 290                        | 955                       | 240                        |
|                                        |                  |                                            | Max.ap=0.2,Max. ae=0.05 × Dc      |                            |                           |                            |                           |                            |
| Copper alloy<br>80-150 HB              | DH103            | 350                                        | 5,600                             | 2,800                      | 4,500                     | 2,250                      | 3,700                     | 1,850                      |
|                                        |                  |                                            | Max.ap=0.3,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Aluminium alloy<br>30-100HB            | DH103<br>KT9     | 600                                        | 9,600                             | 4,800                      | 7,650                     | 3,800                      | 6,350                     | 3,200                      |
|                                        |                  |                                            | Max.ap=0.4,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |
| Graphite                               | DH103<br>JC10000 | 600                                        | 9,600                             | 4,800                      | 7,650                     | 3,800                      | 6,350                     | 3,200                      |
|                                        |                  |                                            | Max.ap=0.4,Max. ae=0.1 × Dc       |                            |                           |                            |                           |                            |

n: Spindle speed, V<sub>f</sub>: Feed speed

### ★ Instruction for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Do not tighten the clamp screw too hard.

**Recommend to use Torque control wrenches (Page 6)**

**Refer the right table for recommended tightening torque.**

| Dimensions | Recommended Torque |
|------------|--------------------|
| φ Dc       | N~m                |
| 10         | 1.2                |
| 12         | 2.0                |
| 16         | 3.0                |
| 20         | 4.0                |
| 25         | 5.0                |
| 30         | 6.0                |
| 32         | 6.0                |

# Mirror Radius

# MRX<sub>TYPE</sub>

## RECOMMENDED CUTTING CONDITIONS

● **MRX type with RNM insert** + **MSN Carbide Shank Holder**

| Work Materials                         | Insert Grades    | Cutting speed<br>V <sub>c</sub><br>(m/min) | Tool dia. (mm)                    |                            |                           |                            |                           |                            |
|----------------------------------------|------------------|--------------------------------------------|-----------------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|
|                                        |                  |                                            | 10                                |                            | 12/13                     |                            | 16/17                     |                            |
|                                        |                  |                                            | n<br>(min <sup>-1</sup> )         | V <sub>f</sub><br>(mm/min) | n<br>(min <sup>-1</sup> ) | V <sub>f</sub><br>(mm/min) | n<br>(min <sup>-1</sup> ) | V <sub>f</sub><br>(mm/min) |
|                                        |                  |                                            | Max. D.O.C. & Max. Pick feed (mm) |                            |                           |                            |                           |                            |
| Grey cast iron<br>160-260 HB           | DH103            | 300                                        | 9,500                             | 3,800                      | 8,000                     | 3,600                      | 6,000                     | 3,000                      |
|                                        |                  |                                            | 0.3                               |                            | 0.4                       |                            | 0.5                       |                            |
| Nodular cast iron<br>170-300 HB        | DH103            | 250                                        | 8,000                             | 2,800                      | 6,700                     | 2,300                      | 5,000                     | 2,000                      |
|                                        |                  |                                            | 0.3                               |                            | 0.3                       |                            | 0.4                       |                            |
| Carbon steel<br>180-280 HB             | DH103<br>JC8015  | 250                                        | 8,000                             | 2,800                      | 6,700                     | 2,300                      | 5,000                     | 2,000                      |
|                                        |                  |                                            | 0.3                               |                            | 0.3                       |                            | 0.4                       |                            |
| Low alloy steel<br>180-280 HB          | DH103<br>JC8015  | 250                                        | 8,000                             | 2,600                      | 6,700                     | 2,100                      | 5,000                     | 1,900                      |
|                                        |                  |                                            | 0.3                               |                            | 0.3                       |                            | 0.4                       |                            |
| Mold steel<br>280-400 HB               | DH103<br>JC8015  | 250                                        | 8,000                             | 2,200                      | 6,700                     | 1,900                      | 5,000                     | 1,650                      |
|                                        |                  |                                            | 0.3                               |                            | 0.3                       |                            | 0.4                       |                            |
| Tool & Die steel<br>180-255 HB         | DH103<br>JC8015  | 250                                        | 8,000                             | 2,200                      | 6,700                     | 1,900                      | 5,000                     | 1,650                      |
|                                        |                  |                                            | 0.3                               |                            | 0.3                       |                            | 0.4                       |                            |
| Hardened die steel<br>40-55 HRC        | DH103            | 135                                        | 4,300                             | 1,000                      | 3,600                     | 800                        | 2,700                     | 675                        |
|                                        |                  |                                            | 0.3                               |                            | 0.3                       |                            | 0.3                       |                            |
| Hardened die steel<br>56-63 HRC        | DH103            | 75                                         | 2,400                             | 500                        | 2,000                     | 400                        | 1,500                     | 300                        |
|                                        |                  |                                            | 0.15                              |                            | 0.15                      |                            | 0.18                      |                            |
| Stainless steel<br>150-250 HB          | DH103<br>JC8015  | 250                                        | 8,000                             | 1,800                      | 6,700                     | 1,500                      | 5,000                     | 1250                       |
|                                        |                  |                                            | 0.3                               |                            | 0.3                       |                            | 0.4                       |                            |
| Inconel<br>Titanium alloy<br>30-40 HRC | DH103<br>JC8015  | 55                                         | 1,700                             | 400                        | 1,500                     | 300                        | 1,100                     | 275                        |
|                                        |                  |                                            | 0.25                              |                            | 0.25                      |                            | 0.25                      |                            |
| Copper alloy<br>80-150 HB              | DH103<br>KT9     | 250                                        | 8,000                             | 3,200                      | 6,700                     | 2,700                      | 5,000                     | 2,500                      |
|                                        |                  |                                            | 0.3                               |                            | 0.4                       |                            | 0.5                       |                            |
| Aluminium alloy<br>30-100HB            | DH103<br>KT9     | 350                                        | 11,000                            | 4,400                      | 9,200                     | 3,700                      | 7,000                     | 3,500                      |
|                                        |                  |                                            | 0.5                               |                            | 0.6                       |                            | 0.8                       |                            |
| Graphite                               | DH103<br>JC10000 | 350                                        | 11,000                            | 4,400                      | 9,200                     | 3,700                      | 7,000                     | 3,500                      |
|                                        |                  |                                            | 0.5                               |                            | 0.6                       |                            | 0.8                       |                            |

n: Spindle speed, V<sub>f</sub>: Feed speed

## ★ Instruction for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Do not tighten the clamp screw too hard.

**Recommend to use Torque control wrenches (Page 6)**

**Refer the right table for recommended tightening torque.**

| Dimensions | Recommended Torque |
|------------|--------------------|
| φDc        | N~m                |
| 10         | 1.2                |
| 12         | 2.0                |
| 16         | 3.0                |
| 20         | 4.0                |
| 25         | 5.0                |
| 30         | 6.0                |
| 32         | 6.0                |

## Mirror Radius

## MRX<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS

● **MRX type with RNM insert** + **MSN Carbide Shank Holder**

| Work Materials                         | Insert Grades    | Cutting speed<br>V <sub>c</sub><br>(m/min) | Tool dia. (mm)                    |                            |                           |                            |                           |                            |
|----------------------------------------|------------------|--------------------------------------------|-----------------------------------|----------------------------|---------------------------|----------------------------|---------------------------|----------------------------|
|                                        |                  |                                            | 20/21                             |                            | 25/26                     |                            | 30/32                     |                            |
|                                        |                  |                                            | n<br>(min <sup>-1</sup> )         | V <sub>f</sub><br>(mm/min) | n<br>(min <sup>-1</sup> ) | V <sub>f</sub><br>(mm/min) | n<br>(min <sup>-1</sup> ) | V <sub>f</sub><br>(mm/min) |
|                                        |                  |                                            | Max. D.O.C. & Max. Pick feed (mm) |                            |                           |                            |                           |                            |
| Grey cast iron<br>160-260 HB           | DH103            | 300                                        | 4,800                             | 2,400                      | 3,800                     | 1,900                      | 3,180                     | 1,590                      |
|                                        |                  |                                            | 0.7                               |                            | 0.8                       |                            | 1.0                       |                            |
| Nodular cast iron<br>170-300 HB        | DH103            | 250                                        | 4,000                             | 1,600                      | 3,200                     | 1,280                      | 2,650                     | 1,060                      |
|                                        |                  |                                            | 0.5                               |                            | 0.6                       |                            | 0.8                       |                            |
| Carbon steel<br>180-280 HB             | DH103<br>JC8015  | 250                                        | 4,000                             | 1,600                      | 3,200                     | 1,280                      | 2,650                     | 1,060                      |
|                                        |                  |                                            | 0.5                               |                            | 0.6                       |                            | 0.8                       |                            |
| Low alloy steel<br>180-280 HB          | DH103<br>JC8015  | 250                                        | 4,000                             | 1,520                      | 3,200                     | 1,210                      | 2,650                     | 1,000                      |
|                                        |                  |                                            | 0.5                               |                            | 0.6                       |                            | 0.8                       |                            |
| Mold steel<br>280-400 HB               | DH103<br>JC8015  | 250                                        | 4,000                             | 1,320                      | 3,200                     | 1,060                      | 2,650                     | 880                        |
|                                        |                  |                                            | 0.5                               |                            | 0.6                       |                            | 0.8                       |                            |
| Tool & Die steel<br>180-255 HB         | DH103<br>JC8015  | 250                                        | 4,000                             | 1,320                      | 3,200                     | 1,060                      | 2,650                     | 880                        |
|                                        |                  |                                            | 0.5                               |                            | 0.6                       |                            | 0.8                       |                            |
| Hardened die steel<br>40-55 HRC        | DH103            | 135                                        | 2,150                             | 540                        | 1,720                     | 430                        | 1,430                     | 360                        |
|                                        |                  |                                            | 0.4                               |                            | 0.5                       |                            | 0.6                       |                            |
| Hardened die steel<br>56-63 HRC        | DH103            | 75                                         | 1,200                             | 240                        | 950                       | 190                        | 800                       | 160                        |
|                                        |                  |                                            | 0.2                               |                            | 0.25                      |                            | 0.3                       |                            |
| Stainless steel<br>150-250 HB          | DH103<br>JC8015  | 250                                        | 4,000                             | 1,000                      | 3,200                     | 800                        | 2,650                     | 660                        |
|                                        |                  |                                            | 0.5                               |                            | 0.6                       |                            | 0.8                       |                            |
| Inconel<br>Titanium alloy<br>30-40 HRC | DH103<br>JC8015  | 55                                         | 875                               | 220                        | 700                       | 175                        | 580                       | 145                        |
|                                        |                  |                                            | 0.3                               |                            | 0.35                      |                            | 0.4                       |                            |
| Copper alloy<br>80-150 HB              | DH103<br>KT9     | 250                                        | 4,000                             | 2,000                      | 3,200                     | 1,600                      | 2,650                     | 1,325                      |
|                                        |                  |                                            | 0.7                               |                            | 0.8                       |                            | 1.0                       |                            |
| Aluminium alloy<br>30-100HB            | DH103<br>KT9     | 350                                        | 5,600                             | 2,800                      | 4,500                     | 2,250                      | 3,700                     | 1,850                      |
|                                        |                  |                                            | 1.0                               |                            | 1.2                       |                            | 1.6                       |                            |
| Graphite                               | DH103<br>JC10000 | 350                                        | 5,600                             | 2,800                      | 4,500                     | 2,250                      | 3,700                     | 1,850                      |
|                                        |                  |                                            | 1.0                               |                            | 1.2                       |                            | 1.6                       |                            |

n: Spindle speed, V<sub>f</sub>: Feed speed

### ★ Instruction for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Do not tighten the clamp screw too hard.

**Recommend to use Torque control wrenches (Page 6)**

**Refer the right table for recommended tightening torque.**

| Dimensions | Recommended Torque |
|------------|--------------------|
| φDc        | N~m                |
| 10         | 1.2                |
| 12         | 2.0                |
| 16         | 3.0                |
| 20         | 4.0                |
| 25         | 5.0                |
| 30         | 6.0                |
| 32         | 6.0                |

## Mirror Radius

MRX<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS / HIGH FEED MACHINING

MRX type with HRM/FRM insert + MSN Carbide Shank Holder

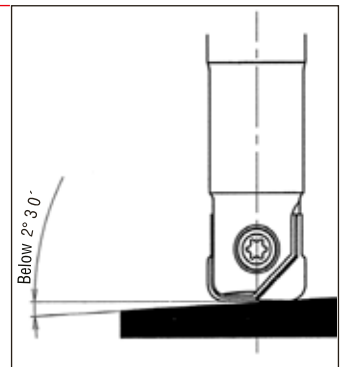
※ Recommended to reduce depth of cut  $a_p$  by corner radius with keeping feed speed  $V_f$ . (Refer the below table)

| Work Materials                                                        | Insert Grades | Tool dia. (mm)                                                                            |               |                   |                             |                   |                                         |               |                   |                             |                   |
|-----------------------------------------------------------------------|---------------|-------------------------------------------------------------------------------------------|---------------|-------------------|-----------------------------|-------------------|-----------------------------------------|---------------|-------------------|-----------------------------|-------------------|
|                                                                       |               | $\phi 10 \times R2 / \phi 11 \times R2$                                                   |               |                   |                             |                   | $\phi 12 \times R2 / \phi 13 \times R2$ |               |                   |                             |                   |
|                                                                       |               | $\ell$<br>(mm)                                                                            | $a_e$<br>(mm) | $a_p$<br>(mm)     | $n$<br>(min <sup>-1</sup> ) | $V_f$<br>(mm/min) | $\ell$<br>(mm)                          | $a_e$<br>(mm) | $a_p$<br>(mm)     | $n$<br>(min <sup>-1</sup> ) | $V_f$<br>(mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB               | JC8015        | 50                                                                                        | 4.2           | 0.40              | 6,000                       | 6,000             | 60                                      | 5.6           | 0.40              | 5,000                       | 5,000             |
|                                                                       |               | 75                                                                                        | 4.2           | 0.25              | 6,000                       | 6,000             | 80                                      | 5.6           | 0.25              | 5,000                       | 5,000             |
|                                                                       |               | 100                                                                                       | 4.2           | 0.20              | 6,000                       | 6,000             | 110                                     | 5.6           | 0.20              | 5,000                       | 5,000             |
| Mold steel<br>HPM7, PX5, NAK80, P20<br>(1.2311, P20)<br>30-43HRC      | JC8015        | 50                                                                                        | 4.2           | 0.40              | 5,700                       | 5,700             | 60                                      | 5.6           | 0.40              | 4,700                       | 4,700             |
|                                                                       |               | 75                                                                                        | 4.2           | 0.25              | 5,700                       | 5,700             | 80                                      | 5.6           | 0.25              | 4,700                       | 4,700             |
|                                                                       |               | 100                                                                                       | 4.2           | 0.20              | 5,700                       | 5,700             | 110                                     | 5.6           | 0.20              | 4,700                       | 4,700             |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB          | JC8015        | 50                                                                                        | 4.2           | 0.40              | 5,700                       | 5,700             | 60                                      | 5.6           | 0.40              | 4,700                       | 4,700             |
|                                                                       |               | 75                                                                                        | 4.2           | 0.25              | 5,700                       | 5,700             | 80                                      | 5.6           | 0.25              | 4,700                       | 4,700             |
|                                                                       |               | 100                                                                                       | 4.2           | 0.20              | 5,700                       | 5,700             | 110                                     | 5.6           | 0.20              | 4,700                       | 4,700             |
| Stainless steel<br>SUS304<br>Below 250HB                              | JC8015        | 50                                                                                        | 4.2           | 0.40              | 5,400                       | 5,400             | 60                                      | 5.6           | 0.40              | 4,500                       | 4,500             |
|                                                                       |               | 75                                                                                        | 4.2           | 0.25              | 5,400                       | 5,400             | 80                                      | 5.6           | 0.25              | 4,500                       | 4,500             |
|                                                                       |               | 100                                                                                       | 4.2           | 0.20              | 5,400                       | 5,400             | 110                                     | 5.6           | 0.20              | 4,500                       | 4,500             |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>40-50HRC | JC8015        | 50                                                                                        | 4.2           | 0.20              | 4,700                       | 4,700             | 60                                      | 5.6           | 0.20              | 4,000                       | 4,000             |
|                                                                       |               | 75                                                                                        | 4.2           | 0.15              | 4,700                       | 4,700             | 80                                      | 5.6           | 0.15              | 4,000                       | 4,000             |
|                                                                       |               | 100                                                                                       | 4.2           | 0.10              | 4,700                       | 4,700             | 110                                     | 5.6           | 0.10              | 4,000                       | 4,000             |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB       | JC8015        | 50                                                                                        | 4.2           | 0.40              | 5,100                       | 5,100             | 60                                      | 5.6           | 0.40              | 4,200                       | 4,200             |
|                                                                       |               | 75                                                                                        | 4.2           | 0.25              | 5,100                       | 5,100             | 80                                      | 5.6           | 0.25              | 4,200                       | 4,200             |
|                                                                       |               | 100                                                                                       | 4.2           | 0.20              | 5,100                       | 5,100             | 110                                     | 5.6           | 0.20              | 4,200                       | 4,200             |
| Depth of cut adjustment<br>by corner radius<br>( $a_p \times$ ratio)  |               | Corner<br>radius                                                                          | R0.5          | $a_p \times 0.60$ |                             |                   | Corner<br>radius                        | R0.5          | $a_p \times 0.60$ |                             |                   |
|                                                                       |               |                                                                                           | R1            | $a_p \times 0.70$ |                             |                   |                                         | R1            | $a_p \times 0.70$ |                             |                   |
|                                                                       |               |                                                                                           | R2            | $a_p \times 1.0$  |                             |                   |                                         | R1.5          | $a_p \times 0.85$ |                             |                   |
|                                                                       |               |                                                                                           |               |                   |                             |                   |                                         | R2            | $a_p \times 1.0$  |                             |                   |
|                                                                       |               | ※ Recommend to reduce depth of cut $a_p$ according to above table with keeping feed speed |               |                   |                             |                   |                                         |               |                   |                             |                   |

$\ell$  : Overhung length,  $a_p$  : Depth of cut,  $a_e$  : Pick feed,  $n$  : Spindle speed,  $V_f$  : Feed speed

### NOTE

- 1) The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- 2) In case chatter occurs, recommend to reduce depth of cut or feed speed.
- 3) If machine does not have enough power, recommend to reduce depth of cut first and reduce spindle speed and feed speed.
- 4) Use air blow to flush the chips out.
- 5) In case of 50-55 HRC (Hardened die steel), recommend to reduce  $a_p$ ,  $n$ ,  $V_f$  by 30% on above table.
- 6) In case of good surface requirement, recommend to reduce feed speed.
- 7) In case of ramping, ramping angle up to  $2^\circ 30'$  is recommended.
- 8) In case of ramping and helical interpolation, apply 70% or less feed speed from above table.



### ★ Instruction for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Do not tighten the clamp screw too hard.

Recommend to use Torque control wrenches (Page 6)

Refer the right table for recommended tightening torque.

| Dimensions | Recommended Torque |
|------------|--------------------|
| $\phi D_c$ | N~m                |
| 10         | 1.2                |
| 12         | 2.0                |
| 16         | 3.0                |
| 20         | 4.0                |

## Mirror Radius

MRX<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS / HIGH FEED MACHINING

#### MRX type with HRM/FRM insert + MSN Carbide Shank Holder

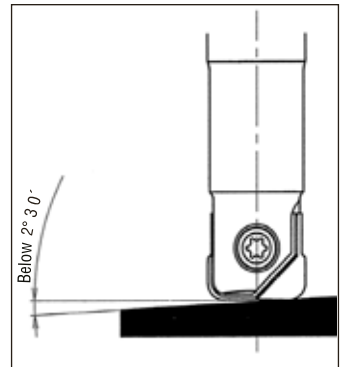
※ Recommended to reduce depth of cut  $a_p$  by corner radius with keeping feed speed  $V_f$ . (Refer the below table)

| Work Materials                                                        | Insert Grades | Tool dia. (mm)                                                                           |               |               |                             |                   |                                         |               |               |                             |                   |
|-----------------------------------------------------------------------|---------------|------------------------------------------------------------------------------------------|---------------|---------------|-----------------------------|-------------------|-----------------------------------------|---------------|---------------|-----------------------------|-------------------|
|                                                                       |               | $\phi 16 \times R3 / \phi 17 \times R3$                                                  |               |               |                             |                   | $\phi 20 \times R3 / \phi 22 \times R3$ |               |               |                             |                   |
|                                                                       |               | $\ell$<br>(mm)                                                                           | $a_e$<br>(mm) | $a_p$<br>(mm) | $n$<br>(min <sup>-1</sup> ) | $V_f$<br>(mm/min) | $\ell$<br>(mm)                          | $a_e$<br>(mm) | $a_p$<br>(mm) | $n$<br>(min <sup>-1</sup> ) | $V_f$<br>(mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB               | JC8015        | 80                                                                                       | 7.0           | 0.60          | 3,800                       | 3,800             | 100                                     | 9.8           | 0.60          | 3,000                       | 3,000             |
|                                                                       |               | 120                                                                                      | 7.0           | 0.40          | 3,800                       | 3,800             | 150                                     | 9.8           | 0.40          | 3,000                       | 3,000             |
|                                                                       |               | 160                                                                                      | 7.0           | 0.30          | 3,800                       | 3,800             | 200                                     | 9.8           | 0.30          | 3,000                       | 3,000             |
| Mold steel<br>HPM7, PX5, NAK80, P20<br>(1.2311, P20)<br>30-43HRC      | JC8015        | 80                                                                                       | 7.0           | 0.60          | 3,500                       | 3,500             | 100                                     | 9.8           | 0.60          | 2,800                       | 2,800             |
|                                                                       |               | 120                                                                                      | 7.0           | 0.40          | 3,500                       | 3,500             | 150                                     | 9.8           | 0.40          | 2,800                       | 2,800             |
|                                                                       |               | 160                                                                                      | 7.0           | 0.30          | 3,500                       | 3,500             | 200                                     | 9.8           | 0.30          | 2,800                       | 2,800             |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB          | JC8015        | 80                                                                                       | 7.0           | 0.60          | 3,500                       | 3,500             | 100                                     | 9.8           | 0.60          | 2,800                       | 2,800             |
|                                                                       |               | 120                                                                                      | 7.0           | 0.40          | 3,500                       | 3,500             | 150                                     | 9.8           | 0.40          | 2,800                       | 2,800             |
|                                                                       |               | 160                                                                                      | 7.0           | 0.30          | 3,500                       | 3,500             | 200                                     | 9.8           | 0.30          | 2,800                       | 2,800             |
| Stainless steel<br>SUS304<br>Below 250HB                              | JC8015        | 80                                                                                       | 7.0           | 0.60          | 3,400                       | 3,400             | 100                                     | 9.8           | 0.60          | 2,700                       | 2,700             |
|                                                                       |               | 120                                                                                      | 7.0           | 0.40          | 3,400                       | 3,400             | 150                                     | 9.8           | 0.40          | 2,700                       | 2,700             |
|                                                                       |               | 160                                                                                      | 7.0           | 0.30          | 3,400                       | 3,400             | 200                                     | 9.8           | 0.30          | 2,700                       | 2,700             |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>40-50HRC | JC8015        | 80                                                                                       | 7.0           | 0.60          | 3,000                       | 3,000             | 100                                     | 9.8           | 0.60          | 2,400                       | 2,400             |
|                                                                       |               | 120                                                                                      | 7.0           | 0.40          | 3,000                       | 3,000             | 150                                     | 9.8           | 0.40          | 2,400                       | 2,400             |
|                                                                       |               | 160                                                                                      | 7.0           | 0.30          | 3,000                       | 3,000             | 200                                     | 9.8           | 0.30          | 2,400                       | 2,400             |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB       | JC8015        | 80                                                                                       | 7.0           | 0.60          | 3,200                       | 3,200             | 100                                     | 9.8           | 0.60          | 2,500                       | 2,500             |
|                                                                       |               | 120                                                                                      | 7.0           | 0.40          | 3,200                       | 3,200             | 150                                     | 9.8           | 0.40          | 2,500                       | 2,500             |
|                                                                       |               | 160                                                                                      | 7.0           | 0.30          | 3,200                       | 3,200             | 200                                     | 9.8           | 0.30          | 2,500                       | 2,500             |
| Depth of cut adjustment<br>by corner radius<br>( $a_p \times$ ratio)  |               | Corner<br>radius                                                                         | R1            | ap×0.50       |                             |                   | Corner<br>radius                        | R1            | ap×0.50       |                             |                   |
|                                                                       |               |                                                                                          | R1.5          | ap×0.60       |                             |                   |                                         | R1.5          | ap×0.60       |                             |                   |
|                                                                       |               |                                                                                          | R2            | ap×0.75       |                             |                   |                                         | R2            | ap×0.75       |                             |                   |
|                                                                       |               |                                                                                          | R3            | ap×1.0        |                             |                   |                                         | R3            | ap×1.0        |                             |                   |
|                                                                       |               | ※Recommend to reduce depth of cut $a_p$ according to above table with keeping feed speed |               |               |                             |                   |                                         |               |               |                             |                   |

$\ell$  : Overhung length,  $a_p$  : Depth of cut,  $a_e$  : Pick feed,  $n$  : Spindle speed,  $V_f$  : Feed speed

#### NOTE

- 1) The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- 2) In case chatter occurs, recommend to reduce depth of cut or feed speed.
- 3) If machine does not have enough power, recommend to reduce depth of cut first and reduce spindle speed and feed speed.
- 4) Use air blow to flush the chips out.
- 5) In case of 50-55 HRC (Hardened die steel), recommend to reduce  $a_p$ ,  $n$ ,  $V_f$  by 30% on above table.
- 6) In case of good surface requirement, recommend to reduce feed speed.
- 7) In case of ramping, ramping angle up to  $2^\circ 30'$  is recommended.
- 8) In case of ramping and helical interpolation, apply 70% or less feed speed from above table.



#### ★ Instruction for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Do not tighten the clamp screw too hard.

Recommend to use Torque control wrenches (Page 6)

Refer the right table for recommended tightening torque.

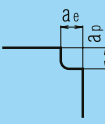
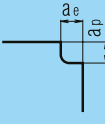
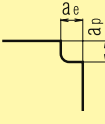
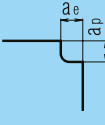
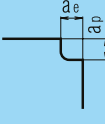
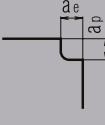
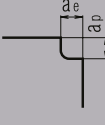
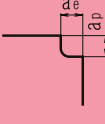
| Dimensions | Recommended Torque |
|------------|--------------------|
| $\phi D_c$ | N~m                |
| 10         | 1.2                |
| 12         | 2.0                |
| 16         | 3.0                |
| 20         | 4.0                |

# Mirror Radius

# MRX<sub>TYPE</sub>

## RECOMMENDED CUTTING CONDITIONS / SIDE FACE FINISHING

### MRX type with FRM insert + MSN Carbide Shank Holder

| Work Materials                                                         | Insert Grades   | Type of machining                                                                   | Cutting speed Vc (m/min) | Tool dia. (mm)         |                         |                        |                         |
|------------------------------------------------------------------------|-----------------|-------------------------------------------------------------------------------------|--------------------------|------------------------|-------------------------|------------------------|-------------------------|
|                                                                        |                 |                                                                                     |                          | $\phi 10$              |                         | $\phi 12$              |                         |
|                                                                        |                 |                                                                                     |                          | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB                | JC8015          |    | 300                      | 9,550                  | 2,860                   | 7,960                  | 2,380                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.25                   |                         | 0.30                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.10                   |                         | 0.12                   |                         |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB           | JC8015          |    | 300                      | 9,550                  | 2,860                   | 7,960                  | 2,380                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.25                   |                         | 0.30                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.10                   |                         | 0.12                   |                         |
| Stainless steel<br>SUS304<br>Below 250HB                               | JC8015          |   | 280                      | 8,910                  | 2,670                   | 7,420                  | 2,220                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.25                   |                         | 0.30                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.10                   |                         | 0.12                   |                         |
| Mold steel<br>HPM7, PX5, P20<br>(1.2311, P20)<br>30-36HRC              | JC8015<br>DH102 |  | 300                      | 9,550                  | 2,860                   | 7,960                  | 2,380                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.25                   |                         | 0.30                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.10                   |                         | 0.12                   |                         |
| Mold steel<br>NAK80, HPM1, P21<br>(1.2311, P21)<br>38-43HRC            | DH102           |  | 280                      | 8,910                  | 2,670                   | 7,420                  | 2,220                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.25                   |                         | 0.30                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.10                   |                         | 0.12                   |                         |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>42-52HRC  | DH102           |  | 250                      | 7,960                  | 800                     | 6,630                  | 800                     |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.25                   |                         | 0.30                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.10                   |                         | 0.12                   |                         |
| Hardened die steel<br>SKD11, SLD, DC11<br>(1.2344, 1.2379)<br>55-62HRC | DH102           |  | 200                      | 6,360                  | 640                     | 5,300                  | 640                     |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.25                   |                         | 0.30                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.10                   |                         | 0.12                   |                         |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB        | JC8015<br>DH102 |  | 350                      | 11,140                 | 3,900                   | 9,280                  | 3,710                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.25                   |                         | 0.30                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.15                   |                         | 0.20                   |                         |

a<sub>p</sub>: Axial depth of cut, a<sub>e</sub>: Radial depth of cut, n: Spindle speed, V<sub>f</sub>: Feed speed

### NOTE

- 1) The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- 2) In case chatter occurs, recommend to reduce depth of cut or feed speed.
- 3) In case of overhung length over 3 x Dc, cutting speed and feed speed to be reduced according to the right table.
- 4) Use air blow to flush the chips out.

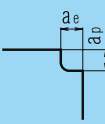
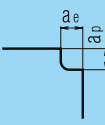
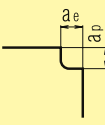
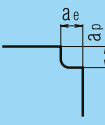
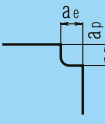
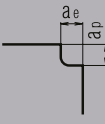
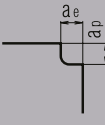
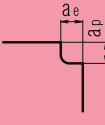
| Overhung length L/Dc             | Vc (m/min) | V <sub>f</sub> (mm/min) |
|----------------------------------|------------|-------------------------|
| ~3Dc<br>3Dc or less              | 100%       | 100%                    |
| 3Dc~5Dc<br>Over 3Dc, up to 5Dc   | 70%        | 70%                     |
| 5Dc~10Dc<br>Over 5Dc, up to 10Dc | 50%        | 50%                     |

## Mirror Radius

## MRX<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS / SIDE FACE FINISHING

#### MRX type with FRM insert + MSN Carbide Shank Holder

| Work Materials                                                         | Insert Grades   | Type of machining                                                                   | Cutting speed V <sub>c</sub> (m/min) | Tool dia. (mm)         |                         |                        |                         |
|------------------------------------------------------------------------|-----------------|-------------------------------------------------------------------------------------|--------------------------------------|------------------------|-------------------------|------------------------|-------------------------|
|                                                                        |                 |                                                                                     |                                      | φ 16                   |                         | φ 20                   |                         |
|                                                                        |                 |                                                                                     |                                      | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB                | JC8015          |    | 300                                  | 5,970                  | 2,390                   | 4,770                  | 1,910                   |
|                                                                        |                 |                                                                                     | ap(mm)                               | 0.40                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | ae(mm)                               | 0.16                   |                         | 0.20                   |                         |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB           | JC8015          |    | 300                                  | 5,970                  | 2,390                   | 4,770                  | 1,910                   |
|                                                                        |                 |                                                                                     | ap(mm)                               | 0.40                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | ae(mm)                               | 0.16                   |                         | 0.20                   |                         |
| Stainless steel<br>SUS304<br>Below 250HB                               | JC8015          |   | 280                                  | 5,570                  | 2,230                   | 4,560                  | 1,820                   |
|                                                                        |                 |                                                                                     | ap(mm)                               | 0.40                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | ae(mm)                               | 0.16                   |                         | 0.20                   |                         |
| Mold steel<br>HPM7, PX5, P20<br>(1.2311, P20)<br>30-36HRC              | JC8015<br>DH102 |  | 300                                  | 5,970                  | 2,390                   | 4,770                  | 1,910                   |
|                                                                        |                 |                                                                                     | ap(mm)                               | 0.40                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | ae(mm)                               | 0.16                   |                         | 0.20                   |                         |
| Mold steel<br>NAK80, HPM1, P21<br>(1.2311, P21)<br>38-43HRC            | DH102           |  | 280                                  | 5,570                  | 1,670                   | 4,560                  | 1,370                   |
|                                                                        |                 |                                                                                     | ap(mm)                               | 0.40                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | ae(mm)                               | 0.16                   |                         | 0.20                   |                         |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>42-52HRC  | DH102           |  | 250                                  | 4,970                  | 750                     | 3,980                  | 600                     |
|                                                                        |                 |                                                                                     | ap(mm)                               | 0.40                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | ae(mm)                               | 0.16                   |                         | 0.20                   |                         |
| Hardened die steel<br>SKD11, SLD, DC11<br>(1.2344, 1.2379)<br>55-62HRC | DH102           |  | 200                                  | 3,980                  | 600                     | 3,180                  | 480                     |
|                                                                        |                 |                                                                                     | ap(mm)                               | 0.40                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | ae(mm)                               | 0.16                   |                         | 0.20                   |                         |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB        | JC8015<br>DH102 |  | 350                                  | 6,960                  | 3,480                   | 5,570                  | 3,340                   |
|                                                                        |                 |                                                                                     | ap(mm)                               | 0.40                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | ae(mm)                               | 0.20                   |                         | 0.25                   |                         |

ap: Axial depth of cut, ae: Radial depth of cut, n: Spindle speed, Vf: Feed speed

#### NOTE

- 1) The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- 2) In case chatter occurs, recommend to reduce depth of cut or feed speed.
- 3) In case of overhung length over 3 x Dc, cutting speed and feed speed to be reduced according to the right table.
- 4) Use air blow to flush the chips out.

| Overhung length<br>L/Dc          | V <sub>c</sub><br>(m/min) | V <sub>f</sub><br>(mm/min) |
|----------------------------------|---------------------------|----------------------------|
| ~3Dc<br>3Dc or less              | 100%                      | 100%                       |
| 3Dc~5Dc<br>Over 3Dc, up to 5Dc   | 70%                       | 70%                        |
| 5Dc~10Dc<br>Over 5Dc, up to 10Dc | 50%                       | 50%                        |

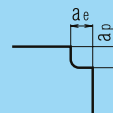
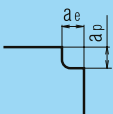
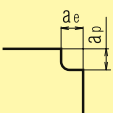
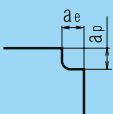
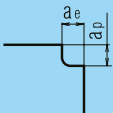
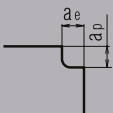
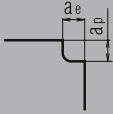
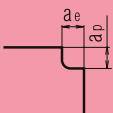


# Mirror Radius

# MRX<sub>TYPE</sub>

## RECOMMENDED CUTTING CONDITIONS / SIDE FACE FINISHING

### MRX type with FRM insert + MSN Carbide Shank Holder

| Work Materials                                    | Insert Grades   | Type of machining                                                                   | Cutting speed V <sub>c</sub> (m/min) | Tool dia. (mm)         |                         |                        |                         |                        |                         |                        |                         |
|---------------------------------------------------|-----------------|-------------------------------------------------------------------------------------|--------------------------------------|------------------------|-------------------------|------------------------|-------------------------|------------------------|-------------------------|------------------------|-------------------------|
|                                                   |                 |                                                                                     |                                      | φ 21                   |                         | φ 25                   |                         | φ 30                   |                         | φ 32                   |                         |
|                                                   |                 |                                                                                     |                                      | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) |
| Carbon steel (C50, C55)<br>Below 250HB            | JC8015          |    | 300                                  | 4,550                  | 1,820                   | 3,820                  | 1,530                   | 3,180                  | 1,270                   | 2,980                  | 1,190                   |
|                                                   |                 |                                                                                     | a <sub>p</sub> (mm)                  | 0.50                   |                         | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                   |                 |                                                                                     | a <sub>e</sub> (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Die steel (1.2344, 1.2379)<br>Below 255HB         | JC8015          |    | 300                                  | 4,550                  | 1,820                   | 3,820                  | 1,530                   | 3,180                  | 1,270                   | 2,980                  | 1,190                   |
|                                                   |                 |                                                                                     | a <sub>p</sub> (mm)                  | 0.50                   |                         | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                   |                 |                                                                                     | a <sub>e</sub> (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Stainless steel<br>Below 250HB                    | JC8015          |    | 280                                  | 4,240                  | 1,700                   | 3,560                  | 1,420                   | 2,970                  | 1,190                   | 2,780                  | 1,110                   |
|                                                   |                 |                                                                                     | a <sub>p</sub> (mm)                  | 0.50                   |                         | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                   |                 |                                                                                     | a <sub>e</sub> (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Mold steel (1.2311, P20)<br>30-36HRC              | JC8015<br>DH102 |  | 300                                  | 4,550                  | 1,820                   | 3,820                  | 1,530                   | 3,180                  | 1,270                   | 2,980                  | 1,190                   |
|                                                   |                 |                                                                                     | a <sub>p</sub> (mm)                  | 0.50                   |                         | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                   |                 |                                                                                     | a <sub>e</sub> (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Mold steel (1.2311, P21)<br>38-43HRC              | DH102           |  | 280                                  | 4,240                  | 1,270                   | 3,560                  | 1,070                   | 2,970                  | 890                     | 2,780                  | 830                     |
|                                                   |                 |                                                                                     | a <sub>p</sub> (mm)                  | 0.50                   |                         | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                   |                 |                                                                                     | a <sub>e</sub> (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Hardened die steel (1.2344, 1.2379)<br>42-52HRC   | DH102           |  | 250                                  | 3,790                  | 570                     | 3,180                  | 480                     | 2,650                  | 400                     | 2,480                  | 370                     |
|                                                   |                 |                                                                                     | a <sub>p</sub> (mm)                  | 0.50                   |                         | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                   |                 |                                                                                     | a <sub>e</sub> (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Hardened die steel (1.2344, 1.2379)<br>55-62HRC   | DH102           |  | 200                                  | 3,000                  | 450                     | 2,540                  | 380                     | 2,120                  | 320                     | 1,990                  | 300                     |
|                                                   |                 |                                                                                     | a <sub>p</sub> (mm)                  | 0.50                   |                         | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                   |                 |                                                                                     | a <sub>e</sub> (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Grey & Nodular cast iron (GG, GGG)<br>Below 300HB | JC8015<br>DH102 |  | 350                                  | 5,300                  | 3,180                   | 4,450                  | 2,670                   | 3,710                  | 2,230                   | 3,480                  | 2,090                   |
|                                                   |                 |                                                                                     | a <sub>p</sub> (mm)                  | 0.50                   |                         | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                   |                 |                                                                                     | a <sub>e</sub> (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |

a<sub>p</sub>: Axial depth of cut, a<sub>e</sub>: Radial depth of cut, n: Spindle speed, V<sub>f</sub>: Feed speed

### NOTE

- 1) The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- 2) In case chatter occurs, recommend to reduce depth of cut or feed speed.
- 3) In case of overhung length over 3 x D<sub>c</sub>, cutting speed and feed speed to be reduced according to the right table.
- 4) Use air blow to flush the chips out.

| ℓ / D <sub>c</sub>                            | V <sub>c</sub> (m/min) | V <sub>f</sub> (mm/min) |
|-----------------------------------------------|------------------------|-------------------------|
| 3D <sub>c</sub> or less                       | 100%                   | 100%                    |
| Over 3D <sub>c</sub> , up to 5D <sub>c</sub>  | 70%                    | 70%                     |
| Over 5D <sub>c</sub> , up to 10D <sub>c</sub> | 50%                    | 50%                     |

## Mirror Radius

## MRX<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS / BOTTOM FACE FINISHING

#### MRX type with FRM insert + MSN Carbide Shank Holder

| Work Materials                                                         | Insert Grades   | Type of machining | Cutting speed Vc (m/min) | Tool dia. (mm)         |             |                        |             |                        |             |                        |             |
|------------------------------------------------------------------------|-----------------|-------------------|--------------------------|------------------------|-------------|------------------------|-------------|------------------------|-------------|------------------------|-------------|
|                                                                        |                 |                   |                          | $\phi 10$              |             | $\phi 12$              |             | $\phi 16$              |             | $\phi 20$              |             |
|                                                                        |                 |                   |                          | n (min <sup>-1</sup> ) | Vf (mm/min) | n (min <sup>-1</sup> ) | Vf (mm/min) | n (min <sup>-1</sup> ) | Vf (mm/min) | n (min <sup>-1</sup> ) | Vf (mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB                | JC8015          |                   | 260                      | 8,280                  | 2,480       | 6,900                  | 2,070       | 5,170                  | 2,070       | 4,140                  | 1,660       |
|                                                                        |                 |                   | ap(mm)                   | 0.15                   | 0.20        | 0.20                   | 0.20        | 0.20                   | 0.20        | 0.20                   | 0.20        |
|                                                                        |                 |                   | ae(mm)                   | 1.2                    | 1.5         | 2.0                    | 2.5         | 2.0                    | 2.5         | 2.5                    | 2.5         |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB           | JC8015          |                   | 260                      | 8,280                  | 2,480       | 6,900                  | 2,070       | 5,170                  | 2,070       | 4,140                  | 1,660       |
|                                                                        |                 |                   | ap(mm)                   | 0.15                   | 0.20        | 0.20                   | 0.20        | 0.20                   | 0.20        | 0.20                   | 0.20        |
|                                                                        |                 |                   | ae(mm)                   | 1.2                    | 1.5         | 2.0                    | 2.5         | 2.0                    | 2.5         | 2.5                    | 2.5         |
| Stainless steel<br>SUS304<br>Below 250HB                               | JC8015          |                   | 240                      | 7,640                  | 2,290       | 6,360                  | 1,900       | 4,770                  | 1,910       | 3,810                  | 1,520       |
|                                                                        |                 |                   | ap(mm)                   | 0.15                   | 0.20        | 0.20                   | 0.20        | 0.20                   | 0.20        | 0.20                   | 0.20        |
|                                                                        |                 |                   | ae(mm)                   | 1.2                    | 1.5         | 2.0                    | 2.5         | 2.0                    | 2.5         | 2.5                    | 2.5         |
| Mold steel<br>HPM7, PX5, P20<br>(1.2311, P20)<br>30-36HRC              | JC8015<br>DH102 |                   | 260                      | 8,280                  | 2,480       | 6,900                  | 2,060       | 5,170                  | 2,070       | 4,140                  | 1,660       |
|                                                                        |                 |                   | ap(mm)                   | 0.15                   | 0.20        | 0.20                   | 0.20        | 0.20                   | 0.20        | 0.20                   | 0.20        |
|                                                                        |                 |                   | ae(mm)                   | 1.2                    | 1.5         | 2.0                    | 2.5         | 2.0                    | 2.5         | 2.5                    | 2.5         |
| Mold steel<br>NAK80, HPM1, P21<br>(1.2311, P21)<br>38-43HRC            | DH102           |                   | 240                      | 7,640                  | 2,290       | 6,360                  | 1,900       | 4,770                  | 1,430       | 3,810                  | 1,140       |
|                                                                        |                 |                   | ap(mm)                   | 0.15                   | 0.20        | 0.20                   | 0.20        | 0.20                   | 0.20        | 0.20                   | 0.20        |
|                                                                        |                 |                   | ae(mm)                   | 1.2                    | 1.5         | 2.0                    | 2.5         | 2.0                    | 2.5         | 2.5                    | 2.5         |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>42-52HRC  | DH102           |                   | 190                      | 6,050                  | 610         | 5,040                  | 600         | 3,780                  | 570         | 3,020                  | 450         |
|                                                                        |                 |                   | ap(mm)                   | 0.10                   | 0.15        | 0.15                   | 0.15        | 0.15                   | 0.15        | 0.15                   | 0.15        |
|                                                                        |                 |                   | ae(mm)                   | 0.90                   | 1.1         | 1.4                    | 1.8         | 1.4                    | 1.8         | 1.8                    | 1.8         |
| Hardened die steel<br>SKD11, SLD, DC11<br>(1.2344, 1.2379)<br>55-62HRC | DH102           |                   | 130                      | 4,140                  | 410         | 3,450                  | 410         | 2,590                  | 390         | 2,070                  | 310         |
|                                                                        |                 |                   | ap(mm)                   | 0.10                   | 0.15        | 0.15                   | 0.15        | 0.15                   | 0.15        | 0.15                   | 0.15        |
|                                                                        |                 |                   | ae(mm)                   | 0.90                   | 1.0         | 1.2                    | 1.5         | 1.2                    | 1.5         | 1.5                    | 1.5         |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB        | JC8015<br>DH102 |                   | 300                      | 9,450                  | 3,310       | 7,960                  | 3,180       | 5,970                  | 2,390       | 4,770                  | 1,910       |
|                                                                        |                 |                   | ap(mm)                   | 0.15                   | 0.20        | 0.20                   | 0.20        | 0.20                   | 0.20        | 0.20                   | 0.20        |
|                                                                        |                 |                   | ae(mm)                   | 1.5                    | 1.8         | 2.4                    | 3.0         | 2.4                    | 3.0         | 3.0                    | 3.0         |

ap: Depth of cut, ae: Pick feed, n: Spindle speed, Vf: Feed speed

#### NOTE

- 1) The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- 2) In case chatter occurs, recommend to reduce depth of cut or feed speed.
- 3) In case of overhung length over 3 x Dc, cutting speed and feed speed to be reduced according to the right table.
- 4) Use air blow to flush the chips out.

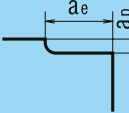
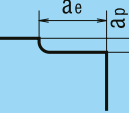
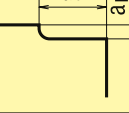
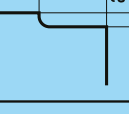
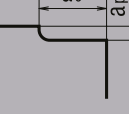
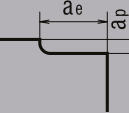
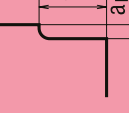
| Overhung length<br>L/Dc          | Vc<br>(m/min) | Vf<br>(mm/min) |
|----------------------------------|---------------|----------------|
| ~3Dc<br>3Dc or less              | 100%          | 100%           |
| 3Dc~5Dc<br>Over 3Dc, up to 5Dc   | 70%           | 70%            |
| 5Dc~10Dc<br>Over 5Dc, up to 10Dc | 50%           | 50%            |

# Mirror Radius

MRX<sub>TYPE</sub>

## RECOMMENDED CUTTING CONDITIONS / BOTTOM FACE FINISHING

### MRX type with FRM insert + MSN Carbide Shank Holder

| Work Materials                                    | Insert Grades   | Type of machining                                                                   | Cutting speed Vc (m/min) | Tool dia. (mm)         |             |                        |             |                        |             |                        |             |
|---------------------------------------------------|-----------------|-------------------------------------------------------------------------------------|--------------------------|------------------------|-------------|------------------------|-------------|------------------------|-------------|------------------------|-------------|
|                                                   |                 |                                                                                     |                          | $\phi 21$              |             | $\phi 25$              |             | $\phi 30$              |             | $\phi 32$              |             |
|                                                   |                 |                                                                                     |                          | n (min <sup>-1</sup> ) | Vf (mm/min) | n (min <sup>-1</sup> ) | Vf (mm/min) | n (min <sup>-1</sup> ) | Vf (mm/min) | n (min <sup>-1</sup> ) | Vf (mm/min) |
| Carbon steel (C50, C55)<br>Below 250HB            | JC8015          |    | 260                      | 3,940                  | 1,570       | 3,310                  | 1,320       | 2,750                  | 1,100       | 2,580                  | 1,030       |
|                                                   |                 |                                                                                     | ap(mm)                   | 0.20                   |             | 0.20                   |             | 0.20                   |             | 0.20                   |             |
|                                                   |                 |                                                                                     | ae(mm)                   | 2.5                    |             | 3.0                    |             | 4.0                    |             | 4.2                    |             |
| Die steel (1.2344, 1.2379)<br>Below 255HB         | JC8015          |    | 260                      | 3,940                  | 1,570       | 3,310                  | 1,320       | 2,750                  | 1,100       | 2,580                  | 1,030       |
|                                                   |                 |                                                                                     | ap(mm)                   | 0.20                   |             | 0.20                   |             | 0.20                   |             | 0.20                   |             |
|                                                   |                 |                                                                                     | ae(mm)                   | 2.5                    |             | 3.0                    |             | 4.0                    |             | 4.2                    |             |
| Stainless steel<br>Below 250HB                    | JC8015          |   | 240                      | 3,640                  | 1,450       | 3,050                  | 1,220       | 2,540                  | 1,020       | 2,380                  | 950         |
|                                                   |                 |                                                                                     | ap(mm)                   | 0.20                   |             | 0.20                   |             | 0.20                   |             | 0.20                   |             |
|                                                   |                 |                                                                                     | ae(mm)                   | 2.5                    |             | 3.0                    |             | 4.0                    |             | 4.2                    |             |
| Mold steel (1.2311, P20)<br>30-36HRC              | JC8015<br>DH102 |  | 260                      | 3,940                  | 1,570       | 3,310                  | 1,320       | 2,750                  | 1,100       | 2,580                  | 1,030       |
|                                                   |                 |                                                                                     | ap(mm)                   | 0.20                   |             | 0.20                   |             | 0.20                   |             | 0.20                   |             |
|                                                   |                 |                                                                                     | ae(mm)                   | 2.5                    |             | 3.0                    |             | 4.0                    |             | 4.2                    |             |
| Mold steel (1.2311, P21)<br>38-43HRC              | DH102           |  | 240                      | 3,640                  | 1,090       | 3,050                  | 910         | 2,540                  | 760         | 2,380                  | 710         |
|                                                   |                 |                                                                                     | ap(mm)                   | 0.20                   |             | 0.20                   |             | 0.20                   |             | 0.20                   |             |
|                                                   |                 |                                                                                     | ae(mm)                   | 2.5                    |             | 3.0                    |             | 4.0                    |             | 4.2                    |             |
| Hardened die steel (1.2344, 1.2379)<br>42-52HRC   | DH102           |  | 190                      | 2,880                  | 430         | 2,420                  | 360         | 2,010                  | 300         | 1,890                  | 280         |
|                                                   |                 |                                                                                     | ap(mm)                   | 0.15                   |             | 0.15                   |             | 0.15                   |             | 0.15                   |             |
|                                                   |                 |                                                                                     | ae(mm)                   | 1.8                    |             | 2.2                    |             | 2.7                    |             | 2.8                    |             |
| Hardened die steel (1.2344, 1.2379)<br>55-62HRC   | DH102           |  | 130                      | 1,970                  | 290         | 1,650                  | 250         | 1,380                  | 200         | 1,290                  | 190         |
|                                                   |                 |                                                                                     | ap(mm)                   | 0.15                   |             | 0.15                   |             | 0.15                   |             | 0.15                   |             |
|                                                   |                 |                                                                                     | ae(mm)                   | 1.5                    |             | 1.8                    |             | 2.2                    |             | 2.3                    |             |
| Grey & Nodular cast iron (GG, GGG)<br>Below 300HB | JC8015<br>DH102 |  | 300                      | 4,550                  | 1,820       | 3,820                  | 1,900       | 3,180                  | 1,590       | 2,980                  | 1,490       |
|                                                   |                 |                                                                                     | ap(mm)                   | 0.20                   |             | 0.20                   |             | 0.20                   |             | 0.20                   |             |
|                                                   |                 |                                                                                     | ae(mm)                   | 3.0                    |             | 3.0                    |             | 4.0                    |             | 4.2                    |             |

Ap: Axial depth of cut, ae: Radial depth of cut, N: Spindle speed, Vf: Feed speed

### NOTE

- 1) The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- 2) In case chatter occurs, recommend to reduce depth of cut or feed speed.
- 3) In case of overhung length over 3 x Dc, cutting speed and feed speed to be reduced according to the right table.
- 4) Use air blow to flush the chips out.

| $l / Dc$             | Vc (m/min) | Vf (mm/min) |
|----------------------|------------|-------------|
| 3Dc or less          | 100%       | 100%        |
| Over 3Dc, up to 5Dc  | 70%        | 70%         |
| Over 5Dc, up to 10Dc | 50%        | 50%         |

## Mirror Radius

RNM<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS

#### RNM type insert

| Work Materials                                     | Insert Grades              | Cutting speed<br>V <sub>c</sub><br>(m/min) | Nominal feed rate: f (mm/rev)                 |      |      |       |       |       |       |      |      |
|----------------------------------------------------|----------------------------|--------------------------------------------|-----------------------------------------------|------|------|-------|-------|-------|-------|------|------|
|                                                    |                            |                                            | Maximum a <sub>p</sub> or a <sub>e</sub> (mm) |      |      |       |       |       |       |      |      |
|                                                    |                            |                                            | Tool dia. D <sub>c</sub> (mm)                 |      |      |       |       |       |       |      |      |
|                                                    |                            |                                            | 6                                             | 8    | 10   | 12/13 | 16/17 | 20/21 | 25/26 | 30   | 32   |
| Grey cast iron<br>(FC250, FC300)<br>160~260HB      | JC8003<br>DH103<br>JC8015  | 250                                        | 0.25                                          | 0.35 | 0.4  | 0.45  | 0.5   | 0.5   | 0.5   | 0.5  | 0.5  |
|                                                    |                            |                                            | 0.2                                           | 0.3  | 0.3  | 0.4   | 0.5   | 0.7   | 0.8   | 1.0  | 1.0  |
| Nodular cast iron<br>(FCD600, FCD700)<br>170~300HB | JC8003<br>DH103<br>JC8015  | 200                                        | 0.2                                           | 0.3  | 0.35 | 0.35  | 0.4   | 0.4   | 0.4   | 0.4  | 0.4  |
|                                                    |                            |                                            | 0.2                                           | 0.3  | 0.3  | 0.3   | 0.4   | 0.5   | 0.6   | 0.8  | 0.8  |
| Carbon steel<br>(S50C, S55C)<br>180~280HB          | JC8003<br>DH103<br>JC8015  | 200                                        | 0.2                                           | 0.3  | 0.35 | 0.35  | 0.4   | 0.4   | 0.4   | 0.4  | 0.4  |
|                                                    |                            |                                            | 0.2                                           | 0.3  | 0.3  | 0.3   | 0.4   | 0.5   | 0.6   | 0.8  | 0.8  |
| Low alloy steel<br>(SCM440)<br>180~280HB           | JC8003<br>DH103<br>JC8015  | 180                                        | 0.26                                          | 0.28 | 0.32 | 0.32  | 0.36  | 0.36  | 0.36  | 0.36 | 0.36 |
|                                                    |                            |                                            | 0.2                                           | 0.3  | 0.3  | 0.3   | 0.4   | 0.5   | 0.6   | 0.8  | 0.8  |
| Mold steel<br>(HPM, NAK)<br>280~400HB              | JC8003<br>DH103<br>JC8015  | 150                                        | 0.18                                          | 0.25 | 0.28 | 0.28  | 0.32  | 0.32  | 0.32  | 0.32 | 0.32 |
|                                                    |                            |                                            | 0.2                                           | 0.3  | 0.3  | 0.3   | 0.4   | 0.5   | 0.6   | 0.8  | 0.8  |
| Tool & Die steel<br>(SKD61, SKD11)<br>180~255HB    | JC8003<br>DH103<br>JC8015  | 150                                        | 0.18                                          | 0.25 | 0.28 | 0.28  | 0.32  | 0.32  | 0.32  | 0.32 | 0.32 |
|                                                    |                            |                                            | 0.2                                           | 0.3  | 0.3  | 0.3   | 0.4   | 0.5   | 0.6   | 0.8  | 0.8  |
| Hardened die steel<br>(SKD61, SKD11)<br>40~55HRC   | JC8003<br>DH103            | 80                                         | 0.13                                          | 0.2  | 0.23 | 0.23  | 0.25  | 0.25  | 0.25  | 0.25 | 0.25 |
|                                                    |                            |                                            | 0.2                                           | 0.3  | 0.3  | 0.3   | 0.3   | 0.4   | 0.5   | 0.6  | 0.6  |
| Stainless steel<br>(SUS304, SUS316)<br>150~250HB   | JC8003<br>DH103<br>JC8015  | 130                                        | 0.13                                          | 0.2  | 0.23 | 0.23  | 0.25  | 0.25  | 0.25  | 0.25 | 0.25 |
|                                                    |                            |                                            | 0.2                                           | 0.3  | 0.3  | 0.3   | 0.4   | 0.5   | 0.6   | 0.8  | 0.8  |
| Copper alloy<br>80~150HB                           | JC8003<br>DH103<br>KT9     | 250                                        | 0.25                                          | 0.35 | 0.4  | 0.4   | 0.5   | 0.5   | 0.5   | 0.5  | 0.5  |
|                                                    |                            |                                            | 0.3                                           | 0.4  | 0.5  | 0.6   | 0.8   | 1.0   | 1.2   | 1.6  | 1.6  |
| Aluminium alloy<br>30~100HB                        | JC8003<br>DH103<br>KT9     | 300                                        | 0.25                                          | 0.35 | 0.4  | 0.4   | 0.5   | 0.5   | 0.5   | 0.5  | 0.5  |
|                                                    |                            |                                            | 0.3                                           | 0.4  | 0.5  | 0.6   | 0.8   | 1.0   | 1.2   | 1.6  | 1.6  |
| Graphite                                           | JC8003<br>DH103<br>JC10000 | 300                                        | 0.25                                          | 0.35 | 0.4  | 0.4   | 0.5   | 0.5   | 0.5   | 0.5  | 0.5  |
|                                                    |                            |                                            | 0.3                                           | 0.4  | 0.5  | 0.6   | 0.8   | 1.0   | 1.2   | 1.6  | 1.6  |

Note) This data is applicable to short series tools and middle series tools.

### ★ Instructions for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Please use torque wrenches to tighten the clamp screw.

**Recommend to use Torque control wrenches (6)**

**See the right table for recommended tightening torque.**

| Dimensions (mm)  | Recommended torque |
|------------------|--------------------|
| φ D <sub>c</sub> | (N·m)              |
| 6                | 0.5                |
| 8                | 0.9                |
| 10               | 1.2                |
| 12               | 2.0                |
| 16               | 3.0                |
| 20               | 4.0                |
| 25               | 5.0                |
| 30               | 6.0                |
| 32               | 6.0                |

## Mirror Radius

## HRM/FRM<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS

#### HRM, FRM type insert + Carbide shank holder (C-Body)

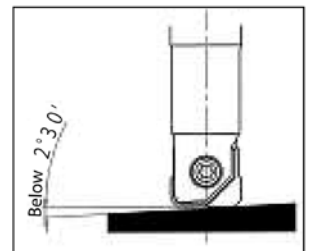
※ Recommended to reduce depth of cut  $a_p$  by corner radius with keeping feed speed  $V_f$ . (Refer the below table)

| Work Materials                                                        | Insert Grades | Tool dia. (mm)                                                                            |               |                   |                             |                   |                                   |               |                   |                             |                   |
|-----------------------------------------------------------------------|---------------|-------------------------------------------------------------------------------------------|---------------|-------------------|-----------------------------|-------------------|-----------------------------------|---------------|-------------------|-----------------------------|-------------------|
|                                                                       |               | $\phi 6\times R1.5$                                                                       |               |                   |                             |                   | $\phi 8\times R2/\phi 9\times R2$ |               |                   |                             |                   |
|                                                                       |               | $\ell$<br>(mm)                                                                            | $a_e$<br>(mm) | $a_p$<br>(mm)     | $n$<br>(min <sup>-1</sup> ) | $V_f$<br>(mm/min) | $\ell$ (mm)                       | $a_e$<br>(mm) | $a_p$<br>(mm)     | $n$<br>(min <sup>-1</sup> ) | $V_f$<br>(mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB               | JC8015        | 15                                                                                        | 2.1           | 0.20              | 9,000                       | 8,000             | 20                                | 2.8           | 0.40              | 7,500                       | 8,200             |
|                                                                       |               | 30                                                                                        | 2.1           | 0.15              | 9,000                       | 7,200             | 40                                | 2.8           | 0.40              | 7,500                       | 6,750             |
|                                                                       |               | —                                                                                         | —             | —                 | —                           | —                 | 60                                | 2.8           | 0.25              | 7,500                       | 6,750             |
|                                                                       |               | —                                                                                         | —             | —                 | —                           | —                 | 80                                | 2.8           | 0.20              | 7,500                       | 6,750             |
| Mold steel<br>HPM7, PX5, NAK80, P20<br>(1.2311, P20)<br>30-43HRC      | JC8015        | 15                                                                                        | 2.1           | 0.20              | 8,500                       | 7,600             | 20                                | 2.8           | 0.40              | 7,100                       | 7,800             |
|                                                                       |               | 30                                                                                        | 2.1           | 0.15              | 8,500                       | 6,800             | 40                                | 2.8           | 0.40              | 7,100                       | 6,400             |
|                                                                       |               | —                                                                                         | —             | —                 | —                           | —                 | 60                                | 2.8           | 0.25              | 7,100                       | 6,400             |
|                                                                       |               | —                                                                                         | —             | —                 | —                           | —                 | 80                                | 2.8           | 0.20              | 7,100                       | 6,400             |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB          | JC8015        | 15                                                                                        | 2.1           | 0.20              | 8,500                       | 7,600             | 20                                | 2.8           | 0.40              | 7,100                       | 7,800             |
|                                                                       |               | 30                                                                                        | 2.1           | 0.15              | 8,500                       | 6,800             | 40                                | 2.8           | 0.40              | 7,100                       | 6,400             |
|                                                                       |               | —                                                                                         | —             | —                 | —                           | —                 | 60                                | 2.8           | 0.25              | 7,100                       | 6,400             |
|                                                                       |               | —                                                                                         | —             | —                 | —                           | —                 | 80                                | 2.8           | 0.20              | 7,100                       | 6,400             |
| Stainless steel<br>SUS304<br>Below 250HB                              | JC8015        | 15                                                                                        | 2.1           | 0.20              | 8,000                       | 6,400             | 20                                | 2.8           | 0.40              | 6,700                       | 7,300             |
|                                                                       |               | 30                                                                                        | 2.1           | 0.15              | 8,000                       | 5,600             | 40                                | 2.8           | 0.40              | 6,700                       | 6,000             |
|                                                                       |               | —                                                                                         | —             | —                 | —                           | —                 | 60                                | 2.8           | 0.25              | 6,700                       | 6,000             |
|                                                                       |               | —                                                                                         | —             | —                 | —                           | —                 | 80                                | 2.8           | 0.20              | 6,700                       | 6,000             |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>40-50HRC | JC8015        | 15                                                                                        | 2.1           | 0.15              | 6,900                       | 5,500             | 20                                | 2.8           | 0.20              | 6,000                       | 6,600             |
|                                                                       |               | 30                                                                                        | 2.1           | 0.10              | 6,900                       | 4,800             | 40                                | 2.8           | 0.20              | 6,000                       | 4,800             |
|                                                                       |               | —                                                                                         | —             | —                 | —                           | —                 | 60                                | 2.8           | 0.15              | 6,000                       | 4,800             |
|                                                                       |               | —                                                                                         | —             | —                 | —                           | —                 | 80                                | 2.8           | 0.10              | 6,000                       | 4,800             |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB       | JC8015        | 15                                                                                        | 2.1           | 0.20              | 7,400                       | 6,600             | 20                                | 2.8           | 0.40              | 6,400                       | 7,600             |
|                                                                       |               | 30                                                                                        | 2.1           | 0.15              | 7,400                       | 5,900             | 40                                | 2.8           | 0.40              | 6,400                       | 5,700             |
|                                                                       |               | —                                                                                         | —             | —                 | —                           | —                 | 60                                | 2.8           | 0.25              | 6,400                       | 5,700             |
|                                                                       |               | —                                                                                         | —             | —                 | —                           | —                 | 80                                | 2.8           | 0.20              | 6,400                       | 5,700             |
| Depth of cut adjustment<br>by corner radius<br>$a_p \times$ ratio     |               | Corner<br>radius                                                                          | R0.5          | $a_p \times 0.65$ |                             |                   | Corner<br>radius                  | R0.5          | $a_p \times 0.60$ |                             |                   |
|                                                                       |               |                                                                                           | R1            | $a_p \times 0.80$ |                             |                   |                                   | R1            | $a_p \times 0.70$ |                             |                   |
|                                                                       |               |                                                                                           | R1.5          | $a_p \times 1.0$  |                             |                   |                                   | R2            | $a_p \times 1.0$  |                             |                   |
|                                                                       |               | ※ Recommend to reduce depth of cut $a_p$ according to above table with keeping feed speed |               |                   |                             |                   |                                   |               |                   |                             |                   |

$\ell$ : Overhung length,  $a_p$ : Depth of cut,  $a_e$ : Pick feed,  $n$ : Spindle speed,  $V_f$ : Feed speed

### NOTE

- 1) The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- 2) In case chatter occurs, recommend to reduce depth of cut or feed speed.
- 3) If machine does not have enough power, recommend to reduce depth of cut first and reduce spindle speed and feed speed.
- 4) Use air blow to flush the chips out.
- 5) In case of 50-55HRC (Hardened die steel), recommend to reduce 30% above  $a_p$ ,  $n$ ,  $V_f$ .
- 6) In case of good surface requirement, recommend to reduce feed speed.
- 7) In case of ramping, ramping angle up to  $2^\circ 30'$  is recommended.
- 8) In case of slotting with overhung length exceeding  $5 \times D_c$ , recommend to reduce depth of cut and feed speed.



### ★ Instructions for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Please use torque wrenches to tighten the clamp screw.

**Recommend to use Torque control wrenches (xxx)  
See the right table for recommended tightening torque.**

| Dimensions (mm) | Recommended torque |
|-----------------|--------------------|
| $\phi D_c$      | (N·m)              |
| 6               | 0.5                |
| 8               | 0.9                |
| 10              | 1.2                |
| 12              | 2.0                |
| 16              | 3.0                |
| 20              | 4.0                |

## Mirror Radius

## HRM/FRM<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS

#### HRM, FRM type insert + Carbide shank holder (C-Body)

※ Recommended to reduce depth of cut  $a_p$  by corner radius with keeping feed speed  $V_f$ . (Refer the below table)

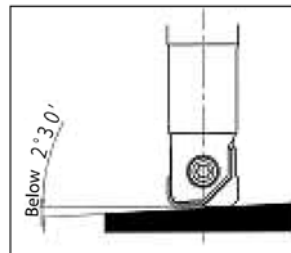
| Work Materials                                                        | Insert Grades | Tool dia. (mm)                          |               |               |                             |                   |                                         |               |               |                             |                   |
|-----------------------------------------------------------------------|---------------|-----------------------------------------|---------------|---------------|-----------------------------|-------------------|-----------------------------------------|---------------|---------------|-----------------------------|-------------------|
|                                                                       |               | $\phi 10 \times R2 / \phi 11 \times R2$ |               |               |                             |                   | $\phi 12 \times R2 / \phi 13 \times R2$ |               |               |                             |                   |
|                                                                       |               | $\ell$<br>(mm)                          | $a_e$<br>(mm) | $a_p$<br>(mm) | $n$<br>(min <sup>-1</sup> ) | $V_f$<br>(mm/min) | $\ell$<br>(mm)                          | $a_e$<br>(mm) | $a_p$<br>(mm) | $n$<br>(min <sup>-1</sup> ) | $V_f$<br>(mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB               | JC8015        | 25                                      | 4.2           | 0.40          | 6,000                       | 7,200             | 30                                      | 5.6           | 0.50          | 5,000                       | 6,000             |
|                                                                       |               | 50                                      | 4.2           | 0.40          | 6,000                       | 6,000             | 60                                      | 5.6           | 0.40          | 5,000                       | 5,000             |
|                                                                       |               | 75                                      | 4.2           | 0.25          | 6,000                       | 6,000             | 90                                      | 5.6           | 0.25          | 5,000                       | 5,000             |
|                                                                       |               | 100                                     | 4.2           | 0.20          | 6,000                       | 6,000             | 120                                     | 5.6           | 0.20          | 5,000                       | 5,000             |
| Mold steel<br>HPM7, PX5, NAK80, P20<br>(1.2311, P20)<br>30-43HRC      | JC8015        | 25                                      | 4.2           | 0.40          | 5,700                       | 6,800             | 30                                      | 5.6           | 0.40          | 4,700                       | 5,600             |
|                                                                       |               | 50                                      | 4.2           | 0.40          | 5,700                       | 5,700             | 60                                      | 5.6           | 0.40          | 4,700                       | 4,700             |
|                                                                       |               | 75                                      | 4.2           | 0.25          | 5,700                       | 5,700             | 90                                      | 5.6           | 0.25          | 4,700                       | 4,700             |
|                                                                       |               | 100                                     | 4.2           | 0.20          | 5,700                       | 5,700             | 120                                     | 5.6           | 0.20          | 4,700                       | 4,700             |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB          | JC8015        | 25                                      | 4.2           | 0.40          | 5,700                       | 6,800             | 30                                      | 5.6           | 0.40          | 4,700                       | 5,600             |
|                                                                       |               | 50                                      | 4.2           | 0.40          | 5,700                       | 5,700             | 60                                      | 5.6           | 0.40          | 4,700                       | 4,700             |
|                                                                       |               | 75                                      | 4.2           | 0.25          | 5,700                       | 5,700             | 90                                      | 5.6           | 0.25          | 4,700                       | 4,700             |
|                                                                       |               | 100                                     | 4.2           | 0.20          | 5,700                       | 5,700             | 120                                     | 5.6           | 0.20          | 4,700                       | 4,700             |
| Stainless steel<br>SUS304<br>Below 250HB                              | JC8015        | 25                                      | 4.2           | 0.40          | 5,400                       | 6,400             | 30                                      | 5.6           | 0.40          | 4,500                       | 5,400             |
|                                                                       |               | 50                                      | 4.2           | 0.40          | 5,400                       | 5,400             | 60                                      | 5.6           | 0.40          | 4,500                       | 4,500             |
|                                                                       |               | 75                                      | 4.2           | 0.25          | 5,400                       | 5,400             | 90                                      | 5.6           | 0.25          | 4,500                       | 4,500             |
|                                                                       |               | 100                                     | 4.2           | 0.20          | 5,400                       | 5,400             | 120                                     | 5.6           | 0.20          | 4,500                       | 4,500             |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>40-50HRC | JC8015        | 25                                      | 4.2           | 0.20          | 4,700                       | 5,600             | 30                                      | 5.6           | 0.20          | 4,000                       | 4,800             |
|                                                                       |               | 50                                      | 4.2           | 0.20          | 4,700                       | 4,700             | 60                                      | 5.6           | 0.20          | 4,000                       | 4,000             |
|                                                                       |               | 75                                      | 4.2           | 0.15          | 4,700                       | 4,700             | 90                                      | 5.6           | 0.15          | 4,000                       | 4,000             |
|                                                                       |               | 100                                     | 4.2           | 0.10          | 4,700                       | 4,700             | 120                                     | 5.6           | 0.10          | 4,000                       | 4,000             |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB       | JC8015        | 25                                      | 4.2           | 0.40          | 5,100                       | 6,100             | 30                                      | 5.6           | 0.40          | 4,200                       | 5,000             |
|                                                                       |               | 50                                      | 4.2           | 0.40          | 5,100                       | 5,100             | 60                                      | 5.6           | 0.40          | 4,200                       | 4,200             |
|                                                                       |               | 75                                      | 4.2           | 0.25          | 5,100                       | 5,100             | 90                                      | 5.6           | 0.25          | 4,200                       | 4,200             |
|                                                                       |               | 100                                     | 4.2           | 0.20          | 5,100                       | 5,100             | 120                                     | 5.6           | 0.20          | 4,200                       | 4,200             |

|                                                                      |                                                                                           |      |                   |                  |      |                   |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------|------|-------------------|------------------|------|-------------------|
| Depth of cut adjustment<br>by corner radius<br>( $a_p \times$ ratio) | Corner<br>radius                                                                          | R0.5 | $a_p \times 0.60$ | Corner<br>radius | R0.5 | $a_p \times 0.60$ |
|                                                                      |                                                                                           | R1   | $a_p \times 0.70$ |                  | R1   | $a_p \times 0.70$ |
|                                                                      |                                                                                           | R2   | $a_p \times 1.0$  |                  | R1.5 | $a_p \times 0.85$ |
|                                                                      |                                                                                           |      |                   |                  | R2   | $a_p \times 1.0$  |
|                                                                      | ※ Recommend to reduce depth of cut $a_p$ according to above table with keeping feed speed |      |                   |                  |      |                   |

$\ell$ : Overhung length,  $a_p$ : Depth of cut,  $a_e$ : Pick feed,  $n$ : Spindle speed,  $V_f$ : Feed speed

### NOTE

- 1) The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- 2) In case chatter occurs, recommend to reduce depth of cut or feed speed.
- 3) If machine does not have enough power, recommend to reduce depth of cut first and reduce spindle speed and feed speed.
- 4) Use air blow to flush the chips out.
- 5) In case of 50-55HRC (Hardened die steel), recommend to reduce 30% above  $a_p$ ,  $n$ ,  $V_f$ .
- 6) In case of good surface requirement, recommend to reduce feed speed.
- 7) In case of ramping, ramping angle up to  $2^\circ 30'$  is recommended.
- 8) In case of slotting with overhung length exceeding  $5 \times D_c$ , recommend to reduce depth of cut and feed speed.



### ★ Instructions for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Please use torque wrenches to tighten the clamp screw.

**Recommend to use Torque control wrenches (xxx)  
See the right table for recommended tightening torque.**

| Dimensions (mm) | Recommended torque |
|-----------------|--------------------|
| $\phi D_c$      | (N·m)              |
| 6               | 0.5                |
| 8               | 0.9                |
| 10              | 1.2                |
| 12              | 2.0                |
| 16              | 3.0                |
| 20              | 4.0                |



## Mirror Radius

## HRM/FRM<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS

#### HRM, FRM type insert + Carbide shank holder (C-Body)

※ Recommended to reduce depth of cut  $a_p$  by corner radius with keeping feed speed  $V_f$ . (Refer the below table)

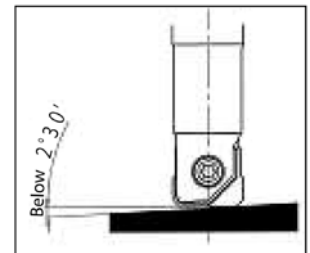
| Work Materials                                                        | Insert Grades | Tool dia. (mm)                          |               |               |                             |                   |                                         |               |               |                             |                   |
|-----------------------------------------------------------------------|---------------|-----------------------------------------|---------------|---------------|-----------------------------|-------------------|-----------------------------------------|---------------|---------------|-----------------------------|-------------------|
|                                                                       |               | $\phi 16 \times R3 / \phi 17 \times R3$ |               |               |                             |                   | $\phi 20 \times R3 / \phi 22 \times R3$ |               |               |                             |                   |
|                                                                       |               | $\ell$<br>(mm)                          | $a_e$<br>(mm) | $a_p$<br>(mm) | $n$<br>(min <sup>-1</sup> ) | $V_f$<br>(mm/min) | $\ell$<br>(mm)                          | $a_e$<br>(mm) | $a_p$<br>(mm) | $n$<br>(min <sup>-1</sup> ) | $V_f$<br>(mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB               | JC8015        | 35                                      | 7.0           | 0.60          | 3,800                       | 4,500             | 40                                      | 9.8           | 0.60          | 3,000                       | 3,600             |
|                                                                       |               | 80                                      | 7.0           | 0.60          | 3,800                       | 3,800             | 100                                     | 9.8           | 0.60          | 3,000                       | 3,000             |
|                                                                       |               | 120                                     | 7.0           | 0.40          | 3,800                       | 3,800             | 150                                     | 9.8           | 0.40          | 3,000                       | 3,000             |
|                                                                       |               | 160                                     | 7.0           | 0.30          | 3,800                       | 3,800             | 200                                     | 9.8           | 0.30          | 3,000                       | 3,000             |
| Mold steel<br>HPM7, PX5, NAK80, P20<br>(1.2311, P20)<br>30-43HRC      | JC8015        | 35                                      | 7.0           | 0.60          | 3,500                       | 4,200             | 40                                      | 9.8           | 0.60          | 2,800                       | 3,300             |
|                                                                       |               | 80                                      | 7.0           | 0.60          | 3,500                       | 3,500             | 100                                     | 9.8           | 0.60          | 2,800                       | 2,800             |
|                                                                       |               | 120                                     | 7.0           | 0.40          | 3,500                       | 3,500             | 150                                     | 9.8           | 0.40          | 2,800                       | 2,800             |
|                                                                       |               | 160                                     | 7.0           | 0.30          | 3,500                       | 3,500             | 200                                     | 9.8           | 0.30          | 2,800                       | 2,800             |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB          | JC8015        | 35                                      | 7.0           | 0.60          | 3,500                       | 4,200             | 40                                      | 9.8           | 0.60          | 2,800                       | 3,300             |
|                                                                       |               | 80                                      | 7.0           | 0.60          | 3,500                       | 3,500             | 100                                     | 9.8           | 0.60          | 2,800                       | 2,800             |
|                                                                       |               | 120                                     | 7.0           | 0.40          | 3,500                       | 3,500             | 150                                     | 9.8           | 0.40          | 2,800                       | 2,800             |
|                                                                       |               | 160                                     | 7.0           | 0.30          | 3,500                       | 3,500             | 200                                     | 9.8           | 0.30          | 2,800                       | 2,800             |
| Stainless steel<br>SUS304<br>Below 250HB                              | JC8015        | 35                                      | 7.0           | 0.60          | 3,400                       | 4,000             | 40                                      | 9.8           | 0.60          | 2,700                       | 3,200             |
|                                                                       |               | 80                                      | 7.0           | 0.60          | 3,400                       | 3,400             | 100                                     | 9.8           | 0.60          | 2,700                       | 2,700             |
|                                                                       |               | 120                                     | 7.0           | 0.40          | 3,400                       | 3,400             | 150                                     | 9.8           | 0.40          | 2,700                       | 2,700             |
|                                                                       |               | 160                                     | 7.0           | 0.30          | 3,400                       | 3,400             | 200                                     | 9.8           | 0.30          | 2,700                       | 2,700             |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>40-50HRC | JC8015        | 35                                      | 7.0           | 0.30          | 3,000                       | 3,600             | 40                                      | 9.8           | 0.30          | 2,400                       | 2,800             |
|                                                                       |               | 80                                      | 7.0           | 0.30          | 3,000                       | 3,000             | 100                                     | 9.8           | 0.30          | 2,400                       | 2,400             |
|                                                                       |               | 120                                     | 7.0           | 0.25          | 3,000                       | 3,000             | 150                                     | 9.8           | 0.25          | 2,400                       | 2,400             |
|                                                                       |               | 160                                     | 7.0           | 0.20          | 3,000                       | 3,000             | 200                                     | 9.8           | 0.20          | 2,400                       | 2,400             |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB       | JC8015        | 35                                      | 7.0           | 0.60          | 3,200                       | 3,800             | 40                                      | 9.8           | 0.60          | 2,500                       | 3,000             |
|                                                                       |               | 80                                      | 7.0           | 0.60          | 3,200                       | 3,200             | 100                                     | 9.8           | 0.60          | 2,500                       | 2,500             |
|                                                                       |               | 120                                     | 7.0           | 0.40          | 3,200                       | 3,200             | 150                                     | 9.8           | 0.40          | 2,500                       | 2,500             |
|                                                                       |               | 160                                     | 7.0           | 0.30          | 3,200                       | 3,200             | 200                                     | 9.8           | 0.30          | 2,500                       | 2,500             |

|                                                                      |                                                                                           |      |                   |                  |      |                   |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------|------|-------------------|------------------|------|-------------------|
| Depth of cut adjustment<br>by corner radius<br>( $a_p \times$ ratio) | Corner<br>radius                                                                          | R1   | $a_p \times 0.50$ | Corner<br>radius | R1   | $a_p \times 0.50$ |
|                                                                      |                                                                                           | R1.5 | $a_p \times 0.60$ |                  | R1.5 | $a_p \times 0.60$ |
|                                                                      |                                                                                           | R2   | $a_p \times 0.75$ |                  | R2   | $a_p \times 0.75$ |
|                                                                      |                                                                                           | R3   | $a_p \times 1.0$  |                  | R3   | $a_p \times 1.0$  |
|                                                                      | ※ Recommend to reduce depth of cut $a_p$ according to above table with keeping feed speed |      |                   |                  |      |                   |

$\ell$ : Overhung length,  $a_p$ : Depth of cut,  $a_e$ : Pick feed,  $n$ : Spindle speed,  $V_f$ : Feed speed

### NOTE

- 1) The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- 2) In case chatter occurs, recommend to reduce depth of cut or feed speed.
- 3) If machine does not have enough power, recommend to reduce depth of cut first and reduce spindle speed and feed speed.
- 4) Use air blow to flush the chips out.
- 5) In case of 50-55HRC (Hardened die steel), recommend to reduce 30% above  $a_p$ ,  $n$ ,  $V_f$ .
- 6) In case of good surface requirement, recommend to reduce feed speed.
- 7) In case of ramping, ramping angle up to  $2^\circ 30'$  is recommended.
- 8) In case of slotting with overhung length exceeding  $5 \times D_c$ , recommend to reduce depth of cut and feed speed.



### ★ Instructions for mounting insert

1. Clean the insert seat carefully.
2. Clean the insert, especially hole and location face.
3. Change the clamp screw when the screw gets worn out.
4. Please use torque wrenches to tighten the clamp screw.

**Recommend to use Torque control wrenches (xxx)**  
**See the right table for recommended tightening torque.**

| Dimensions (mm) | Recommended torque |
|-----------------|--------------------|
| $\phi D_c$      | (N·m)              |
| 6               | 0.5                |
| 8               | 0.9                |
| 10              | 1.2                |
| 12              | 2.0                |
| 16              | 3.0                |
| 20              | 4.0                |



## Mirror Radius

FRM<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS/SIDE FACE FINISHING

#### FRM type insert + Carbide shank holder (C-Body)

| Work Materials                                                         | Insert Grades   | Type of machining | Cutting speed Vc (m/min) | Tool dia. (mm)           |                |                          |                |                          |                |
|------------------------------------------------------------------------|-----------------|-------------------|--------------------------|--------------------------|----------------|--------------------------|----------------|--------------------------|----------------|
|                                                                        |                 |                   |                          | $\phi 8$                 |                | $\phi 10$                |                | $\phi 12$                |                |
|                                                                        |                 |                   |                          | $n$ (min <sup>-1</sup> ) | $V_f$ (mm/min) | $n$ (min <sup>-1</sup> ) | $V_f$ (mm/min) | $n$ (min <sup>-1</sup> ) | $V_f$ (mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB                | JC8015          |                   | 300                      | 11,940                   | 3,580          | 9,550                    | 2,860          | 7,960                    | 2,380          |
|                                                                        |                 |                   | $a_p$ (mm)               | 0.20                     |                | 0.25                     |                | 0.30                     |                |
|                                                                        |                 |                   | $a_e$ (mm)               | 0.08                     |                | 0.10                     |                | 0.12                     |                |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB           | JC8015          |                   | 300                      | 11,940                   | 3,580          | 9,550                    | 2,860          | 7,960                    | 2,380          |
|                                                                        |                 |                   | $a_p$ (mm)               | 0.20                     |                | 0.25                     |                | 0.30                     |                |
|                                                                        |                 |                   | $a_e$ (mm)               | 0.08                     |                | 0.10                     |                | 0.12                     |                |
| Stainless steel<br>SUS304<br>Below 250HB                               | JC8015          |                   | 280                      | 11,150                   | 3,350          | 8,910                    | 2,670          | 7,420                    | 2,220          |
|                                                                        |                 |                   | $a_p$ (mm)               | 0.20                     |                | 0.25                     |                | 0.30                     |                |
|                                                                        |                 |                   | $a_e$ (mm)               | 0.08                     |                | 0.10                     |                | 0.12                     |                |
| Mold steel<br>HPM7, PX5, P20<br>(1.2311, P20)<br>30-36HRC              | JC8015<br>DH102 |                   | 300                      | 11,940                   | 3,580          | 9,550                    | 2,860          | 7,960                    | 2,380          |
|                                                                        |                 |                   | $a_p$ (mm)               | 0.20                     |                | 0.25                     |                | 0.30                     |                |
|                                                                        |                 |                   | $a_e$ (mm)               | 0.08                     |                | 0.10                     |                | 0.12                     |                |
| Mold steel<br>NAK80, HPM1, P21<br>(1.2311, P21)<br>38-43HRC            | DH102           |                   | 280                      | 11,150                   | 3,350          | 8,910                    | 2,670          | 7,420                    | 2,220          |
|                                                                        |                 |                   | $a_p$ (mm)               | 0.20                     |                | 0.25                     |                | 0.30                     |                |
|                                                                        |                 |                   | $a_e$ (mm)               | 0.08                     |                | 0.10                     |                | 0.12                     |                |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>42-52HRC  | DH102           |                   | 250                      | 9,950                    | 1,000          | 7,960                    | 800            | 6,630                    | 800            |
|                                                                        |                 |                   | $a_p$ (mm)               | 0.20                     |                | 0.25                     |                | 0.30                     |                |
|                                                                        |                 |                   | $a_e$ (mm)               | 0.08                     |                | 0.10                     |                | 0.12                     |                |
| Hardened die steel<br>SKD11, SLD, DC11<br>(1.2344, 1.2379)<br>55-62HRC | DH102           |                   | 200                      | 7,950                    | 800            | 6,360                    | 640            | 5,300                    | 640            |
|                                                                        |                 |                   | $a_p$ (mm)               | 0.20                     |                | 0.25                     |                | 0.30                     |                |
|                                                                        |                 |                   | $a_e$ (mm)               | 0.08                     |                | 0.10                     |                | 0.12                     |                |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB        | JC8015<br>DH102 |                   | 350                      | 13,930                   | 4,180          | 11,140                   | 3,900          | 9,280                    | 3,710          |
|                                                                        |                 |                   | $a_p$ (mm)               | 0.20                     |                | 0.25                     |                | 0.30                     |                |
|                                                                        |                 |                   | $a_e$ (mm)               | 0.10                     |                | 0.15                     |                | 0.20                     |                |

$l$ : Overhung length,  $a_p$ : Depth of cut,  $a_e$ : Pick feed,  $V_c$ : Cutting speed,  $n$ : Spindle speed,  $V_f$ : Feed speed

#### NOTE

- The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- In case chatter occurs, recommend to reduce depth of cut or feed speed.
- In case of overhung length over 3 x Dc, cutting speed and feed speed to be reduced according to the right table.
- Use air blow to flash out the chips out.

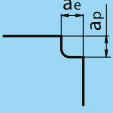
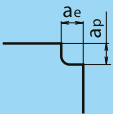
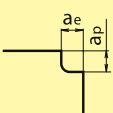
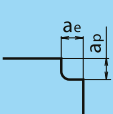
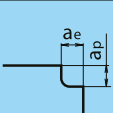
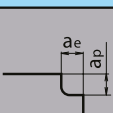
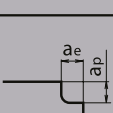
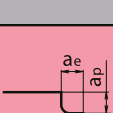
| Overhung length<br>$l/D_c$                | $V_c$<br>(m/min) | $V_f$<br>(mm/min) |
|-------------------------------------------|------------------|-------------------|
| $\sim 3D_c$<br>3Dc or less                | 100%             | 100%              |
| $3D_c \sim 5D_c$<br>Over 3Dc, up to 5Dc   | 70%              | 70%               |
| $5D_c \sim 10D_c$<br>Over 5Dc, up to 10Dc | 50%              | 50%               |

## Mirror Radius

FRM<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS/SIDE FACE FINISHING

#### FRM type insert + Carbide shank holder (C-Body)

| Work Materials                                                         | Insert Grades   | Type of machining                                                                   | Cutting speed Vc (m/min) | Tool dia. (mm)         |                         |                        |                         |                        |                         |
|------------------------------------------------------------------------|-----------------|-------------------------------------------------------------------------------------|--------------------------|------------------------|-------------------------|------------------------|-------------------------|------------------------|-------------------------|
|                                                                        |                 |                                                                                     |                          | $\phi 16$              |                         | $\phi 20$              |                         | $\phi 21$              |                         |
|                                                                        |                 |                                                                                     |                          | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB                | JC8015          |    | 300                      | 5,970                  | 2,390                   | 4,770                  | 1,910                   | 4,550                  | 1,820                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.40                   |                         | 0.50                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.16                   |                         | 0.20                   |                         | 0.10                   |                         |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB           | JC8015          |    | 300                      | 5,970                  | 2,390                   | 4,770                  | 1,910                   | 4,550                  | 1,820                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.40                   |                         | 0.50                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.16                   |                         | 0.20                   |                         | 0.10                   |                         |
| Stainless steel<br>SUS304<br>Below 250HB                               | JC8015          |    | 280                      | 5,570                  | 2,230                   | 4,560                  | 1,820                   | 4,240                  | 1,700                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.40                   |                         | 0.50                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.16                   |                         | 0.20                   |                         | 0.10                   |                         |
| Mold steel<br>HPM7, PX5, P20<br>(1.2311, P20)<br>30-36HRC              | JC8015<br>DH102 |  | 300                      | 5,970                  | 2,390                   | 4,770                  | 1,910                   | 4,550                  | 1,820                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.40                   |                         | 0.50                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.16                   |                         | 0.20                   |                         | 0.10                   |                         |
| Mold steel<br>NAK80, HPM1, P21<br>(1.2311, P21)<br>38-43HRC            | DH102           |  | 280                      | 5,570                  | 1,670                   | 4,560                  | 1,370                   | 4,240                  | 1,270                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.40                   |                         | 0.50                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.16                   |                         | 0.20                   |                         | 0.10                   |                         |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>42-52HRC  | DH102           |  | 250                      | 4,970                  | 750                     | 3,980                  | 600                     | 3,790                  | 570                     |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.40                   |                         | 0.50                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.16                   |                         | 0.20                   |                         | 0.10                   |                         |
| Hardened die steel<br>SKD11, SLD, DC11<br>(1.2344, 1.2379)<br>55-62HRC | DH102           |  | 200                      | 3,980                  | 600                     | 3,180                  | 480                     | 3,000                  | 450                     |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.40                   |                         | 0.50                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.16                   |                         | 0.20                   |                         | 0.10                   |                         |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB        | JC8015<br>DH102 |  | 350                      | 6,960                  | 3,480                   | 5,570                  | 3,340                   | 5,300                  | 3,180                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.40                   |                         | 0.50                   |                         | 0.50                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.20                   |                         | 0.25                   |                         | 0.20                   |                         |

ℓ: Overhung length, a<sub>p</sub>: Depth of cut, a<sub>e</sub>: Pick feed, Vc: Cutting speed, n: Spindle speed, V<sub>f</sub>: Feed speed

#### NOTE

- 1) The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- 2) In case chatter occurs, recommend to reduce depth of cut or feed speed.
- 3) In case of overhung length over 3 x Dc, cutting speed and feed speed to be reduced according to the right table.
- 4) Use air blow to flash out the chips out.

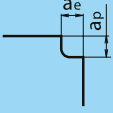
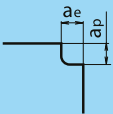
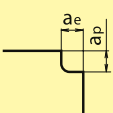
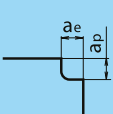
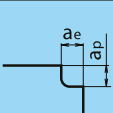
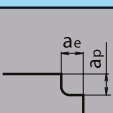
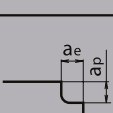
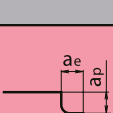
| Overhung length<br>ℓ/Dc         | Vc<br>(m/min) | V <sub>f</sub><br>(mm/min) |
|---------------------------------|---------------|----------------------------|
| ~3Dc<br>3Dc or less             | 100%          | 100%                       |
| 3Dc~5Dc<br>Over 3Dc, upto 5Dc   | 70%           | 70%                        |
| 5Dc~10Dc<br>Over 5Dc, upto 10Dc | 50%           | 50%                        |

## Mirror Radius

FRM<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS/SIDE FACE FINISHING

#### FRM type insert + Carbide shank holder (C-Body)

| Work Materials                                                         | Insert Grades   | Type of machining                                                                   | Cutting speed Vc (m/min) | Tool dia. (mm)         |                         |                        |                         |                        |                         |
|------------------------------------------------------------------------|-----------------|-------------------------------------------------------------------------------------|--------------------------|------------------------|-------------------------|------------------------|-------------------------|------------------------|-------------------------|
|                                                                        |                 |                                                                                     |                          | $\phi 25$              |                         | $\phi 30$              |                         | $\phi 32$              |                         |
|                                                                        |                 |                                                                                     |                          | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB                | JC8015          |    | 300                      | 3,820                  | 1,530                   | 3,180                  | 1,270                   | 2,980                  | 1,190                   |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                                        |                 |                                                                                     | ae (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB           | JC8015          |    | 300                      | 3,820                  | 1,530                   | 3,180                  | 1,270                   | 2,980                  | 1,190                   |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                                        |                 |                                                                                     | ae (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Stainless steel<br>SUS304<br>Below 250HB                               | JC8015          |    | 280                      | 3,560                  | 1,420                   | 2,970                  | 1,190                   | 2,780                  | 1,110                   |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                                        |                 |                                                                                     | ae (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Mold steel<br>HPM7, PX5, P20<br>(1.2311, P20)<br>30-36HRC              | JC8015<br>DH102 |  | 300                      | 3,820                  | 1,530                   | 3,180                  | 1,270                   | 2,980                  | 1,190                   |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                                        |                 |                                                                                     | ae (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Mold steel<br>NAK80, HPM1, P21<br>(1.2311, P21)<br>38-43HRC            | DH102           |  | 280                      | 3,560                  | 1,070                   | 2,970                  | 890                     | 2,780                  | 830                     |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                                        |                 |                                                                                     | ae (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>42-52HRC  | DH102           |  | 250                      | 3,180                  | 480                     | 2,650                  | 400                     | 2,480                  | 370                     |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.60                   |                         | 0.80                   |                         | 1.0                    |                         |
|                                                                        |                 |                                                                                     | ae (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Hardened die steel<br>SKD11, SLD, DC11<br>(1.2344, 1.2379)<br>55-62HRC | DH102           |  | 200                      | 2,540                  | 380                     | 2,120                  | 320                     | 1,990                  | 300                     |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.60                   |                         | 0.80                   |                         | 1.0                    |                         |
|                                                                        |                 |                                                                                     | ae (mm)                  | 0.10                   |                         | 0.10                   |                         | 0.10                   |                         |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB        | JC8015<br>DH102 |  | 350                      | 4,450                  | 2,670                   | 3,710                  | 2,230                   | 3,480                  | 2,090                   |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.80                   |                         | 1.0                    |                         | 1.2                    |                         |
|                                                                        |                 |                                                                                     | ae (mm)                  | 0.20                   |                         | 0.20                   |                         | 0.20                   |                         |

ℓ: Overhung length, ap: Depth of cut, ae: Pick feed, Vc: Cutting speed, n: Spindle speed, Vf: Feed speed

#### NOTE

- The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- In case chatter occurs, recommend to reduce depth of cut or feed speed.
- In case of overhung length over 3 x Dc, cutting speed and feed speed to be reduced according to the right table.
- Use air blow to flash out the chips out.

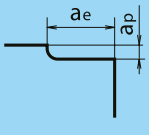
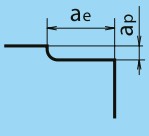
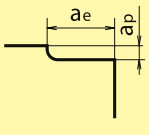
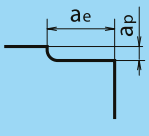
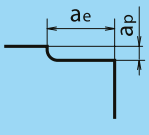
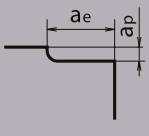
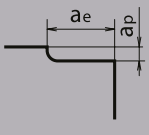
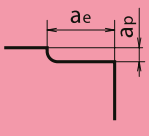
| Overhung length<br>ℓ/Dc          | Vc<br>(m/min) | Vf<br>(mm/min) |
|----------------------------------|---------------|----------------|
| ~3Dc<br>3Dc or less              | 100%          | 100%           |
| 3Dc~5Dc<br>Over 3Dc, up to 5Dc   | 70%           | 70%            |
| 5Dc~10Dc<br>Over 5Dc, up to 10Dc | 50%           | 50%            |

## Mirror Radius

FRM<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS / BOTTOM FACE FINISHING

#### FRM type insert + Carbide shank holder (C-Body)

| Work Materials                                                         | Insert Grades   | Type of machining                                                                   | Cutting speed Vc (m/min) | Tool dia. (mm)         |                         |                        |                         |                        |                         |
|------------------------------------------------------------------------|-----------------|-------------------------------------------------------------------------------------|--------------------------|------------------------|-------------------------|------------------------|-------------------------|------------------------|-------------------------|
|                                                                        |                 |                                                                                     |                          | $\phi 8$               |                         | $\phi 10$              |                         | $\phi 12$              |                         |
|                                                                        |                 |                                                                                     |                          | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB                | JC8015          |    | 260                      | 10,340                 | 3,100                   | 8,280                  | 2,480                   | 6,900                  | 2,070                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.15                   |                         | 0.15                   |                         | 0.20                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 1.0                    |                         | 1.2                    |                         | 1.5                    |                         |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB           | JC8015          |    | 260                      | 10,340                 | 3,100                   | 8,280                  | 2,480                   | 6,900                  | 2,070                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.15                   |                         | 0.15                   |                         | 0.20                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 1.0                    |                         | 1.2                    |                         | 1.5                    |                         |
| Stainless steel<br>SUS304<br>Below 250HB                               | JC8015          |   | 240                      | 9,550                  | 2,860                   | 7,640                  | 2,290                   | 6,360                  | 1,900                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.15                   |                         | 0.15                   |                         | 0.20                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 1.0                    |                         | 1.2                    |                         | 1.5                    |                         |
| Mold steel<br>HPM7, PX5, P20<br>(1.2311, P20)<br>30-36HRC              | JC8015<br>DH102 |  | 260                      | 10,340                 | 3,100                   | 8,280                  | 2,480                   | 6,900                  | 2,060                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.15                   |                         | 0.15                   |                         | 0.20                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 1.0                    |                         | 1.2                    |                         | 1.5                    |                         |
| Mold steel<br>NAK80, HPM1, P21<br>(1.2311, P21)<br>38-43HRC            | DH102           |  | 240                      | 9,550                  | 2,860                   | 7,640                  | 2,290                   | 6,360                  | 1,900                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.15                   |                         | 0.15                   |                         | 0.20                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 1.0                    |                         | 1.2                    |                         | 1.5                    |                         |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>42-52HRC  | DH102           |  | 190                      | 7,560                  | 760                     | 6,050                  | 610                     | 5,040                  | 600                     |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.10                   |                         | 0.10                   |                         | 0.15                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.70                   |                         | 0.90                   |                         | 1.1                    |                         |
| Hardened die steel<br>SKD11, SLD, DC11<br>(1.2344, 1.2379)<br>55-62HRC | DH102           |  | 130                      | 5,170                  | 520                     | 4,140                  | 410                     | 3,450                  | 410                     |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.10                   |                         | 0.10                   |                         | 0.15                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 0.60                   |                         | 0.90                   |                         | 1.2                    |                         |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB        | JC8015<br>DH102 |  | 300                      | 11,940                 | 3,580                   | 9,450                  | 3,310                   | 7,960                  | 3,180                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.15                   |                         | 0.15                   |                         | 0.20                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 1.2                    |                         | 1.5                    |                         | 1.8                    |                         |

ℓ: Overhang length, a<sub>p</sub>: Depth of cut, a<sub>e</sub>: Pick feed, Vc: Cutting speed, N: Spindle speed, V<sub>f</sub>: Feed speed

#### NOTE

- The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- In case chatter occurs, recommend to reduce depth of cut or feed speed.
- In case of overhang length over 3 x Dc, cutting speed and feed speed to be reduced according to the right table.
- Use air blow to flash out the chips out.

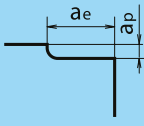
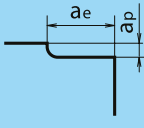
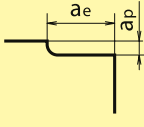
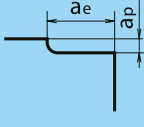
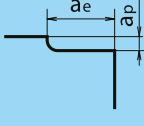
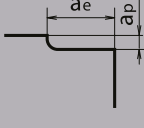
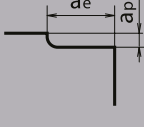
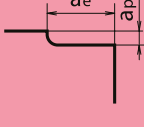
| Overhang length<br>ℓ/Dc          | Vc<br>(m/min) | V <sub>f</sub><br>(mm/min) |
|----------------------------------|---------------|----------------------------|
| ~3Dc<br>3Dc or less              | 100%          | 100%                       |
| 3Dc~5Dc<br>Over 3Dc, up to 5Dc   | 70%           | 70%                        |
| 5Dc~10Dc<br>Over 5Dc, up to 10Dc | 50%           | 50%                        |

## Mirror Radius

FRM<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS / BOTTOM FACE FINISHING

#### FRM type insert + Carbide shank holder (C-Body)

| Work Materials                                                         | Insert Grades   | Type of machining                                                                   | Cutting speed Vc (m/min) | Tool dia. (mm)         |             |                        |             |                        |             |
|------------------------------------------------------------------------|-----------------|-------------------------------------------------------------------------------------|--------------------------|------------------------|-------------|------------------------|-------------|------------------------|-------------|
|                                                                        |                 |                                                                                     |                          | $\phi 16$              |             | $\phi 20$              |             | $\phi 21$              |             |
|                                                                        |                 |                                                                                     |                          | n (min <sup>-1</sup> ) | Vf (mm/min) | n (min <sup>-1</sup> ) | Vf (mm/min) | n (min <sup>-1</sup> ) | Vf (mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB                | JC8015          |    | 260                      | 5,170                  | 2,070       | 4,140                  | 1,660       | 3,940                  | 1,570       |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.20                   |             | 0.20                   |             | 0.20                   |             |
|                                                                        |                 |                                                                                     | ae (mm)                  | 2.0                    |             | 2.5                    |             | 2.5                    |             |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB           | JC8015          |    | 260                      | 5,170                  | 2,070       | 4,140                  | 1,660       | 3,940                  | 1,570       |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.20                   |             | 0.20                   |             | 0.20                   |             |
|                                                                        |                 |                                                                                     | ae (mm)                  | 2.0                    |             | 2.5                    |             | 2.5                    |             |
| Stainless steel<br>SUS304<br>Below 250HB                               | JC8015          |   | 240                      | 4,770                  | 1,910       | 3,810                  | 1,520       | 3,640                  | 1,450       |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.20                   |             | 0.20                   |             | 0.20                   |             |
|                                                                        |                 |                                                                                     | ae (mm)                  | 2.0                    |             | 2.5                    |             | 2.5                    |             |
| Mold steel<br>HPM7, PX5, P20<br>(1.2311, P20)<br>30-36HRC              | JC8015<br>DH102 |  | 260                      | 5,170                  | 2,070       | 4,140                  | 1,660       | 3,940                  | 1,570       |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.20                   |             | 0.20                   |             | 0.20                   |             |
|                                                                        |                 |                                                                                     | ae (mm)                  | 2.0                    |             | 2.5                    |             | 2.5                    |             |
| Mold steel<br>NAK80, HPM1, P21<br>(1.2311, P21)<br>38-43HRC            | DH102           |  | 240                      | 4,770                  | 1,430       | 3,810                  | 1,140       | 3,640                  | 1,090       |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.20                   |             | 0.20                   |             | 0.20                   |             |
|                                                                        |                 |                                                                                     | ae (mm)                  | 2.0                    |             | 2.5                    |             | 2.5                    |             |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>42-52HRC  | DH102           |  | 190                      | 3,780                  | 570         | 3,020                  | 450         | 2,880                  | 430         |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.15                   |             | 0.15                   |             | 0.15                   |             |
|                                                                        |                 |                                                                                     | ae (mm)                  | 1.4                    |             | 1.8                    |             | 1.8                    |             |
| Hardened die steel<br>SKD11, SLD, DC11<br>(1.2344, 1.2379)<br>55-62HRC | DH102           |  | 130                      | 2,590                  | 390         | 2,070                  | 310         | 1,970                  | 290         |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.15                   |             | 0.15                   |             | 0.15                   |             |
|                                                                        |                 |                                                                                     | ae (mm)                  | 1.2                    |             | 1.5                    |             | 1.5                    |             |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB        | JC8015<br>DH102 |  | 300                      | 5,970                  | 2,390       | 4,770                  | 1,910       | 4,550                  | 1,820       |
|                                                                        |                 |                                                                                     | ap (mm)                  | 0.20                   |             | 0.20                   |             | 0.20                   |             |
|                                                                        |                 |                                                                                     | ae (mm)                  | 2.4                    |             | 3.0                    |             | 3.0                    |             |

ℓ: Overhang length, ap: Depth of cut, ae: Pick feed, Vc: Cutting speed, n: Spindle speed, Vf: Feed speed

#### NOTE

- 1) The cutting parameters to be adjusted according to the machine rigidity or work rigidity.
- 2) In case chatter occurs, recommend to reduce depth of cut or feed speed.
- 3) In case of overhang length over 3 x Dc, cutting speed and feed speed to be reduced according to the right table.
- 4) Use air blow to flash out the chips out.

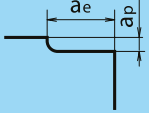
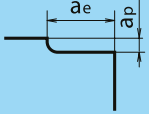
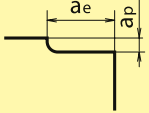
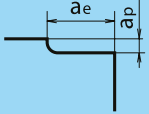
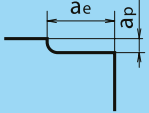
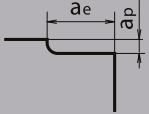
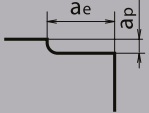
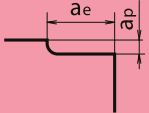
| Overhang length<br>ℓ/Dc          | Vc<br>(m/min) | Vf<br>(mm/min) |
|----------------------------------|---------------|----------------|
| ~3Dc<br>3Dc or less              | 100%          | 100%           |
| 3Dc~5Dc<br>Over 3Dc, up to 5Dc   | 70%           | 70%            |
| 5Dc~10Dc<br>Over 5Dc, up to 10Dc | 50%           | 50%            |

## Mirror Radius

FRM<sub>TYPE</sub>

### RECOMMENDED CUTTING CONDITIONS / BOTTOM FACE FINISHING

#### FRM type insert + Carbide shank holder (C-Body)

| Work Materials                                                         | Insert Grades   | Type of machining                                                                   | Cutting speed Vc (m/min) | Tool dia. (mm)         |                         |                        |                         |                        |                         |
|------------------------------------------------------------------------|-----------------|-------------------------------------------------------------------------------------|--------------------------|------------------------|-------------------------|------------------------|-------------------------|------------------------|-------------------------|
|                                                                        |                 |                                                                                     |                          | $\phi 25$              |                         | $\phi 30$              |                         | $\phi 32$              |                         |
|                                                                        |                 |                                                                                     |                          | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) | n (min <sup>-1</sup> ) | V <sub>f</sub> (mm/min) |
| Carbon steel<br>S50C, S55C<br>(C50, C55)<br>Below 250HB                | JC8015          |    | 260                      | 3,310                  | 1,320                   | 2,750                  | 1,100                   | 2,580                  | 1,030                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.20                   |                         | 0.20                   |                         | 0.20                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 3.0                    |                         | 4.0                    |                         | 4.2                    |                         |
| Die steel<br>SKD61, SKD11<br>(1.2344, 1.2379)<br>Below 255HB           | JC8015          |    | 260                      | 3,310                  | 1,320                   | 2,750                  | 1,100                   | 2,580                  | 1,030                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.20                   |                         | 0.20                   |                         | 0.20                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 3.0                    |                         | 4.0                    |                         | 4.2                    |                         |
| Stainless steel<br>SUS304<br>Below 250HB                               | JC8015          |   | 240                      | 3,050                  | 1,220                   | 2,540                  | 1,020                   | 2,380                  | 950                     |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.20                   |                         | 0.20                   |                         | 0.20                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 3.0                    |                         | 4.0                    |                         | 4.2                    |                         |
| Mold steel<br>HPM7, PX5, P20<br>(1.2311, P20)<br>30-36HRC              | JC8015<br>DH102 |  | 260                      | 3,310                  | 1,320                   | 2,750                  | 1,100                   | 2,580                  | 1,030                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.20                   |                         | 0.20                   |                         | 0.20                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 3.0                    |                         | 4.0                    |                         | 4.2                    |                         |
| Mold steel<br>NAK80, HPM1, P21<br>(1.2311, P21)<br>38-43HRC            | DH102           |  | 240                      | 3,050                  | 910                     | 2,540                  | 760                     | 2,380                  | 710                     |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.20                   |                         | 0.20                   |                         | 0.20                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 3.0                    |                         | 4.0                    |                         | 4.2                    |                         |
| Hardened die steel<br>SKD61, DAC, DHA<br>(1.2344, 1.2379)<br>42-52HRC  | DH102           |  | 190                      | 2,420                  | 360                     | 2,010                  | 300                     | 1,890                  | 280                     |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.15                   |                         | 0.15                   |                         | 0.15                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 2.2                    |                         | 2.7                    |                         | 2.8                    |                         |
| Hardened die steel<br>SKD11, SLD, DC11<br>(1.2344, 1.2379)<br>55-62HRC | DH102           |  | 130                      | 1,650                  | 250                     | 1,380                  | 200                     | 1,290                  | 190                     |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.15                   |                         | 0.15                   |                         | 0.15                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 1.8                    |                         | 2.2                    |                         | 2.3                    |                         |
| Grey & Nodular<br>cast iron<br>FC, FCD (GG, GGG)<br>Below 300HB        | JC8015<br>DH102 |  | 300                      | 3,820                  | 1,900                   | 3,180                  | 1,590                   | 2,980                  | 1,490                   |
|                                                                        |                 |                                                                                     | a <sub>p</sub> (mm)      | 0.20                   |                         | 0.20                   |                         | 0.20                   |                         |
|                                                                        |                 |                                                                                     | a <sub>e</sub> (mm)      | 3.0                    |                         | 4.0                    |                         | 4.2                    |                         |

ℓ: Overhang length, a<sub>p</sub>: Depth of cut, a<sub>e</sub>: Pick feed, Vc: Cutting speed, n: Spindle speed, V<sub>f</sub>: Feed speed

#### NOTE

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| Overhang length<br>ℓ/Dc          | Vc<br>(m/min) | V <sub>f</sub><br>(mm/min) |
|----------------------------------|---------------|----------------------------|
| ~3Dc<br>3Dc or less              | 100%          | 100%                       |
| 3Dc~5Dc<br>Over 3Dc, up to 5Dc   | 70%           | 70%                        |
| 5Dc~10Dc<br>Over 5Dc, up to 10Dc | 50%           | 50%                        |



JQA-2089



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