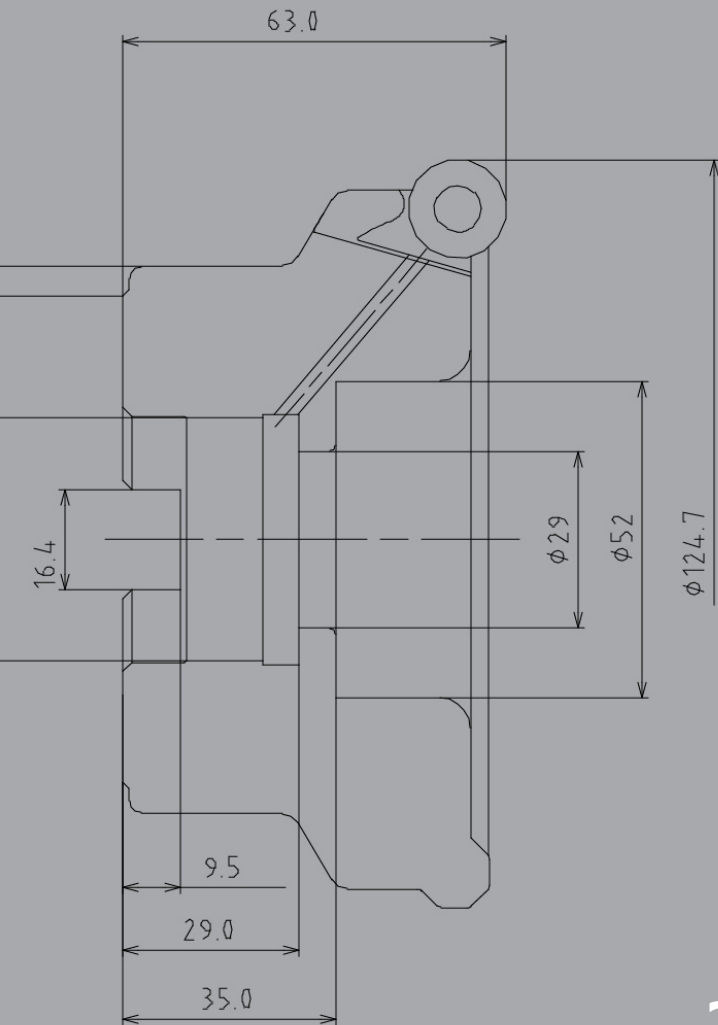
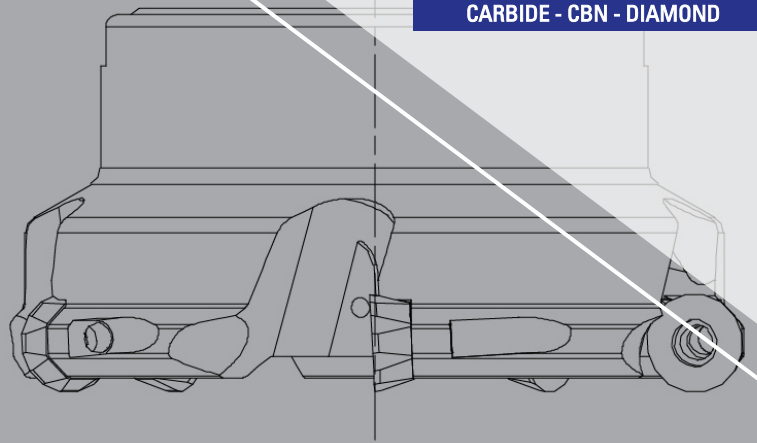


# N-P



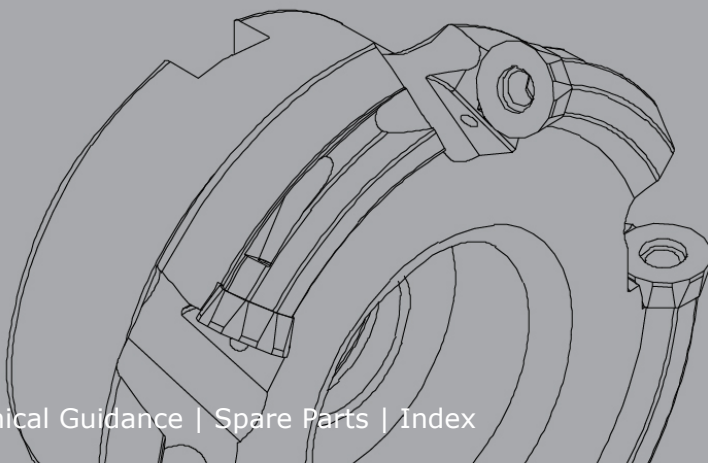
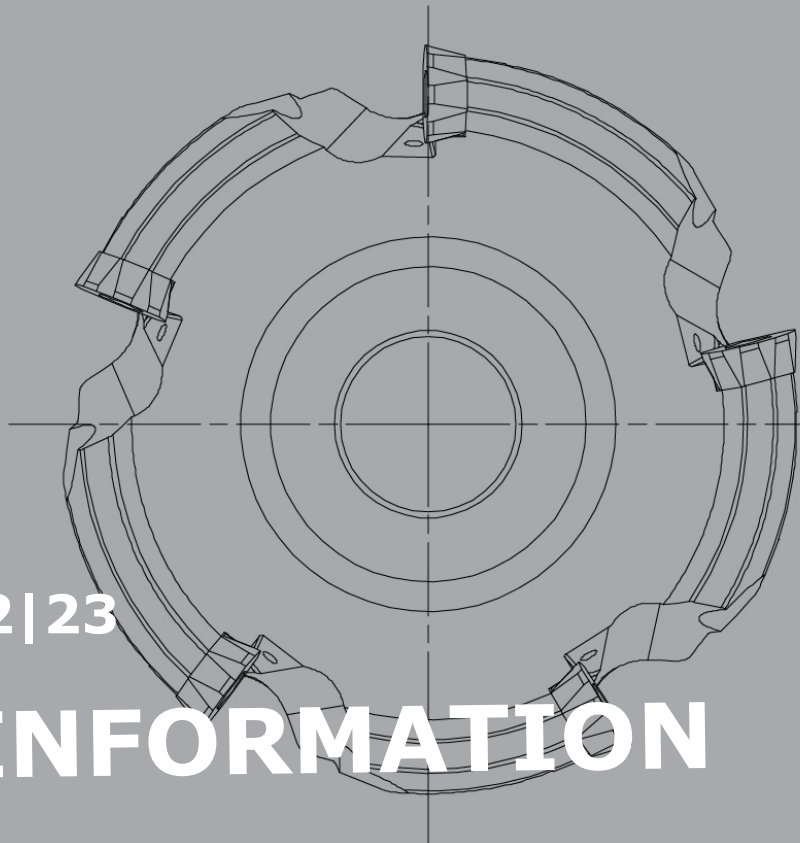
SUMITOMO

CARBIDE - CBN - DIAMOND



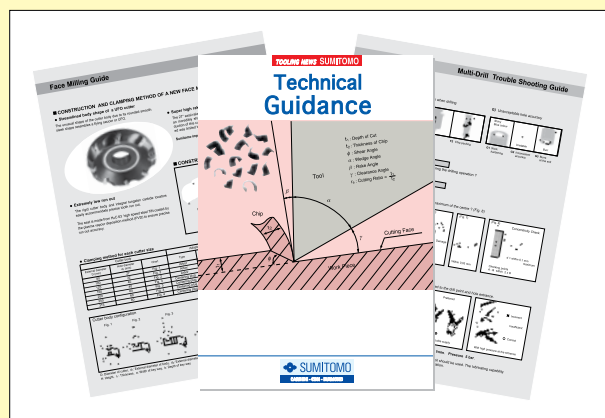
22|23

## TECHNICAL INFORMATION



# Technical Guidance References

N1–N28



|                                                |        |
|------------------------------------------------|--------|
| <b>Basics of Turning</b> .....                 | N2     |
| Tool Failures and Remedies .....               | N3–4   |
| Chip Control.....                              | N5     |
| <b>Basics of Milling</b> .....                 | N6–8   |
| Tool Failures and Remedies.....                | N9     |
| <b>Basics of Endmilling</b> .....              | N10–11 |
| Tool Failures and Remedies.....                | N12    |
| <b>Basics of Drilling</b> .....                | N13–15 |
| Tool Failures and Remedies.....                | N16    |
| <b>SUMIBORON for</b>                           |        |
| Hardened Steel Machining .....                 | N17    |
| Cast Iron Machining .....                      | N18    |
| Hard-to cut Materials Machining .....          | N19    |
| Tool Failure and Remedies .....                | N20    |
| <b>References</b> .....                        |        |
| Steel and Non-Ferrous Metal Symbols Chart .... | N21-25 |
| Hardness Scale Comparison Chart.....           | N26    |
| Finished Surface Roughness .....               | N27    |

Expansion

# Technical Guidance

## Basics of Turning

### ■ Calculating Power Requirement

$$P_c = \frac{a_p \cdot f \cdot v_c \cdot K_c}{60 \times 10^3 \times \eta}$$

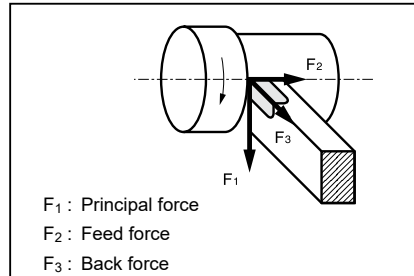
$$H = \frac{P_c}{0,75}$$

$P_c$  : Net power requirement (KW)  
 $v_c$  : Cutting speed (m/min)  
 $f$  : Feed rate (mm/rev)  
 $a_p$  : Depth of cut (mm)  
 $\eta$  : Machine efficiency (0,70 ~ 0,85)  
 $K_c$  : Specific cutting force (N/mm<sup>2</sup>)  
 $H$  : Required horsepower (HP)

#### ● Rough value of specific cutting force ( $K_c$ )

General steel : 2.500 ~ 3.000 N/mm<sup>2</sup>  
 Cast iron : 1.500 N/mm<sup>2</sup>  
 Aluminum : 800 N/mm<sup>2</sup>

### ■ Cutting Force



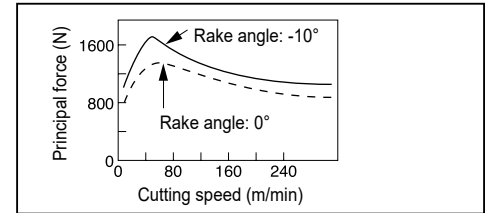
#### ● Calculating cutting force

$$P = K_c \cdot q$$

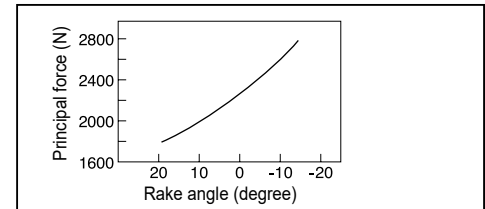
$$= \frac{K_c \times a_p \times f}{1000}$$

$P$  : Cutting force (N)  
 $K_c$  : Specific cutting force (N/mm<sup>2</sup>)  
 $q$  : Chip area (mm<sup>2</sup>)  
 $a_p$  : Depth of cut (mm)  
 $f$  : Feed rate (mm/rev)

### ■ Cutting Speed and Cutting Force



### ■ Rake Angle and Cutting Force



### ■ Calculating Cutting Speed

#### ① Calculating rotational speed from cutting speed

$$n = \frac{1000 \cdot v_c}{\pi \cdot D}$$

$n$  : Spindle speed (min<sup>-1</sup>)  
 $v_c$  : Cutting speed (m/min)  
 $D$  : Diameter of workpiece (mm)  
 $\pi \approx 3,14$

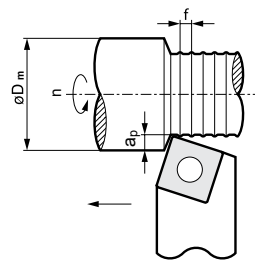
(Eg.)  $v_c = 150$  m/min,  $D = 100$  mm

$$n = \frac{1000 \times 150}{3,14 \times 100} = 478 \text{ (min}^{-1}\text{)}$$

#### ② Calculating cutting speed from rotational speed

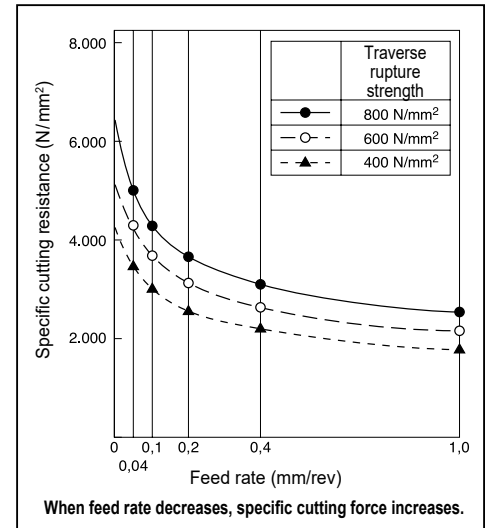
$$v_c = \frac{\pi \cdot D \cdot n}{1.000}$$

Refer to the above table



$n$  : Spindle speed (min<sup>-1</sup>)  
 $v_c$  : Cutting speed (m/min)  
 $f$  : Feed rate (mm/rev)  
 $a_p$  : Depth of cut (mm)  
 $D_m$  : Diameter of workpiece (mm)

### ■ Feed Rate and Specific Cutting Force (For carbon steel)



### ■ Roughness

#### ● Theoretical Surface Finish

$$R_z = \frac{f^2}{8 \times r}$$

$R_z$  : Surface finish (mm)  
 $f$  : Feed rate (mm/rev)  
 $r$  : Nose radius (mm)

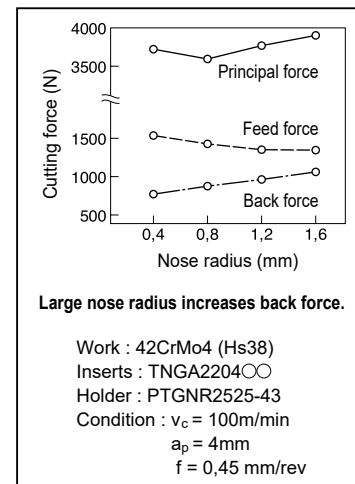
#### ● Actual surface roughness

Steel :  
 Theoretical surface finish x 1,5–3  
 Cast iron :  
 Theoretical surface finish x 3–5

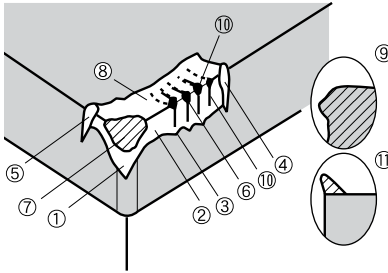
#### ● Ways to Improve Surface Finish

- ① Use an insert with a larger nose radius.
- ② Optimize the cutting speed and feed rate so that built-up edge does not occur.
- ③ Select an appropriate insert grade.
- ④ Use wiper insert.

### ■ Nose Radius and Cutting Force

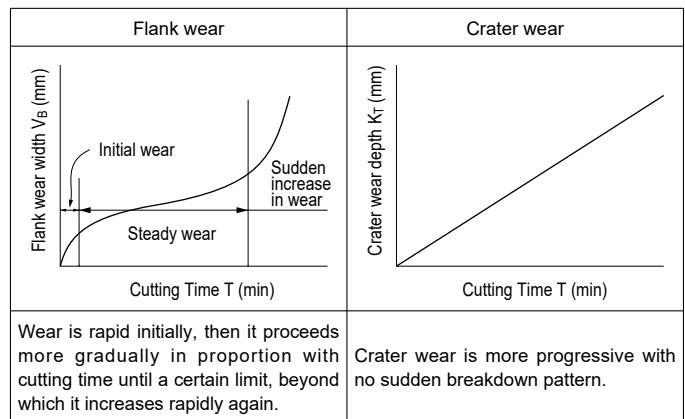
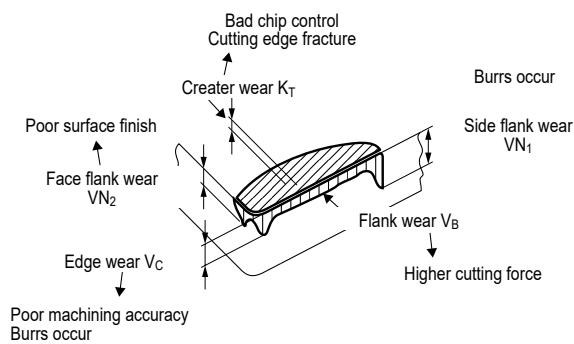


### Forms of Tool Failures

|                                                                                   | Cat.                              | No.                | Name of Failure                                                      | Cause of Failure                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------------------------------|-----------------------------------|--------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Resulting from Mechanical causes  | 1~5<br>6<br>7      | Flank Wear<br>Chipping<br>Fracture                                   | Due to the scratching effect of hard grains contained in the work material.<br>Fine breakages caused by high cutting loads or chattering.<br>Due to the impact of an excessive mechanical force acting on the cutting edge.                                                                                     |
|                                                                                   | Resulting from Chemical reactions | 8<br>9<br>10<br>11 | Crater Wear<br>Plastic Deformation<br>Thermal Crack<br>Built-up Edge | Swift chips removing tool material as it flow over the top face at high temperatures.<br>Cutting edge is depressed due to softening at high temperatures.<br>Fatigue from rapid, repeated heating and cooling cycles during machining.<br>Work material is pressure welded on the top face of the cutting edge. |

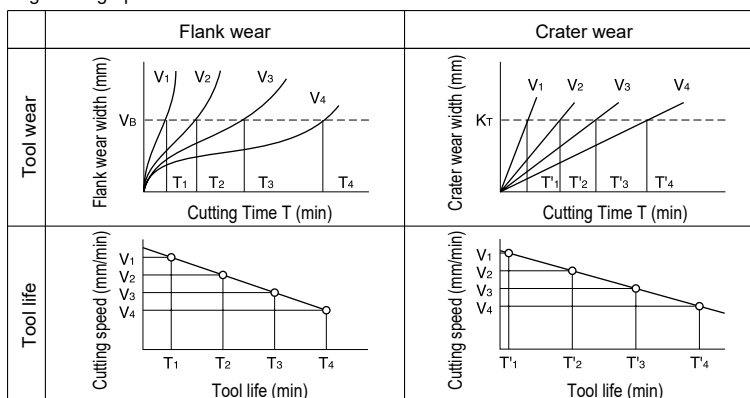
### Tool Wear

#### Forms of Tool Wear



### Tool Life (V-T)

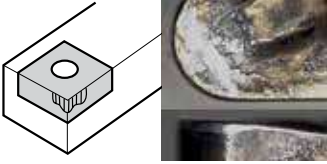
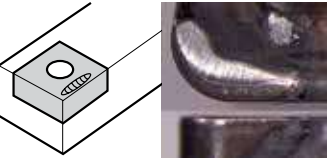
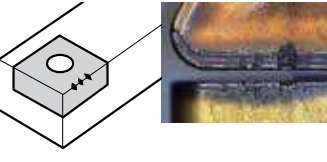
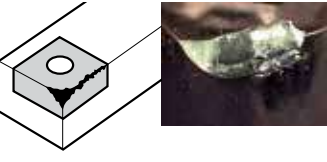
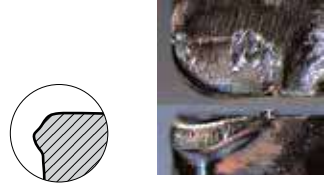
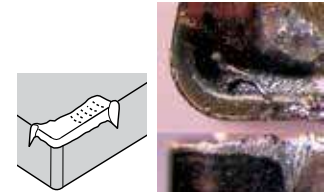
Measure the relative tool lives of the specified wear, over a range of cutting speeds, then plot the tool life along the X-axis and the cutting speed along the Y-axis on a double logarithm graph.



# Technical Guidance

## Tool Failure and Remedies

### ■ Trouble Shooting Guide for Turning

|                   | Damage                                                                                                           | Cause                                                                                                                                                                                                                                  | Countermeasures                                                                                                                                                                                                                                                                                                                                              |
|-------------------|------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tool Edge Failure | <p>Excessive flank wear</p>     | <ul style="list-style-type: none"> <li>- Grade lacks wear resistance.</li> <li>- Cutting speed is too fast.</li> <li>- Feed rate is far too slow.</li> </ul>                                                                           | <ul style="list-style-type: none"> <li>- Select a wear resistant grade.<br/>P30 ⇄ P20 ⇄ P10<br/>K20 ⇄ K10 ⇄ K01</li> <li>- Use an insert with a larger rake angle.</li> <li>- Decrease the cutting speed.</li> <li>- Increase feed rates.</li> </ul>                                                                                                         |
|                   | <p>Excessive crater wear</p>    | <ul style="list-style-type: none"> <li>- Grade lacks crater wear resistance.</li> <li>- Rake angle is too small.</li> <li>- Cutting speed is too fast.</li> <li>- Feed rate and depth of cut are too large.</li> </ul>                 | <ul style="list-style-type: none"> <li>- Select a more crater-resistant grade.</li> <li>- Use an insert with a larger rake angle.</li> <li>- Select an appropriate chipbreaker.</li> <li>- Decrease the cutting speed.</li> <li>- Decrease the D.O.C. and feed rate.</li> </ul>                                                                              |
|                   | <p>Cutting edge chipping</p>   | <ul style="list-style-type: none"> <li>- Grade lacks toughness.</li> <li>- Insert falls off due to chip build-up.</li> <li>- Cutting edge lacks toughness.</li> <li>- Feed rate and depth of cut are too large.</li> </ul>             | <ul style="list-style-type: none"> <li>- Change to tougher grades.<br/>P10 ⇄ P20 ⇄ P30<br/>K01 ⇄ K10 ⇄ K20</li> <li>- Increase amount of honing on cutting edge.</li> <li>- Reduce rake angle.</li> <li>- Reduce feed rates and depth of cut.</li> </ul>                                                                                                     |
|                   | <p>Cutting edge fracture</p>  | <ul style="list-style-type: none"> <li>- Grades lacks toughness.</li> <li>- Cutting edge lacks toughness.</li> <li>- Holder lacks toughness.</li> <li>- Feed rate is too fast.</li> <li>- Depth of cut is too large.</li> </ul>        | <ul style="list-style-type: none"> <li>- Change to tougher grades.<br/>P10 ⇄ P20 ⇄ P30<br/>K01 ⇄ K10 ⇄ K20</li> <li>- Select a chipbreaker with a strong cutting edge.</li> <li>- Select a holder with a larger approach angle.</li> <li>- Select a holder with a larger shank size.</li> <li>- Decrease the D.O.C. and feed rate.</li> </ul>                |
|                   | <p>Build-up edge</p>          | <ul style="list-style-type: none"> <li>- Inappropriate grade selection.</li> <li>- Dull cutting edge.</li> <li>- Cutting speed is too slow.</li> <li>- Feed rate is too slow.</li> </ul>                                               | <ul style="list-style-type: none"> <li>- Select a grade with less affinity to the work material.<br/>Coated carbide or cermet grades.</li> <li>- Select a grade with a smooth coating.</li> <li>- Use an insert with a larger rake angle.</li> <li>- Reduce amount of honing.</li> <li>- Increase cutting speeds.</li> <li>- Increase feed rates.</li> </ul> |
|                   | <p>Plastic deformation</p>    | <ul style="list-style-type: none"> <li>- Grade lacks thermal resistance.</li> <li>- Cutting speed is too fast.</li> <li>- Feed rate is too fast.</li> <li>- Depth of cut is too large.</li> <li>- Not enough cutting fluid.</li> </ul> | <ul style="list-style-type: none"> <li>- Select a more crater-wear-resistant grade.</li> <li>- Use an insert with a larger rake angle.</li> <li>- Decrease the cutting speed.</li> <li>- Reduce feed rates and depth of cut.</li> <li>- Supply a sufficient amount of coolant.</li> </ul>                                                                    |
|                   | <p>Notch wear</p>             | <ul style="list-style-type: none"> <li>- Grade lacks wear resistance.</li> <li>- Rake angle is too small.</li> <li>- Cutting speed is too fast.</li> </ul>                                                                             | <ul style="list-style-type: none"> <li>- Select a wear resistant grade.<br/>P30 ⇄ P20 ⇄ P10<br/>K20 ⇄ K10 ⇄ K01</li> <li>- Use an insert with a larger rake angle.</li> <li>- Alter depth of cut to shift the notch location.</li> </ul>                                                                                                                     |

## Type of Chip Generation

|                  | a                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | b                                                 | c                                                      | d                                              |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|--------------------------------------------------------|------------------------------------------------|
| Shape            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                   |                                                        |                                                |
| Condition        | Continuous chips with good surface finish.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Chip is sheared and separated by the shear angle. | Chips appear to be torn from the surface.              | Chips crack before reaching the cutting point. |
| Application      | Steel, Stainless steel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Steel, Stainless steel (Low speed)                | Steel, Cast iron (Very low speed, very small feedrate) | Cast iron, Carbon                              |
| Influence factor | <div> <div>Easy</div> <div>Large</div> <div>Small</div> <div>Fast</div> </div> <div> <div>←</div> <div>Work deformation</div> <div>→</div> </div> <div> <div>Large</div> <div>Small</div> <div>Large</div> <div>Slow</div> </div> <div> <div>←</div> <div>Rake angle</div> <div>→</div> </div> <div> <div>Small</div> <div>Large</div> <div>Small</div> <div>Fast</div> </div> <div> <div>←</div> <div>D.O.C.</div> <div>→</div> </div> <div> <div>Fast</div> <div>Slow</div> <div>Fast</div> <div>Slow</div> </div> <div> <div>←</div> <div>Cutting speed</div> <div>→</div> </div> |                                                   |                                                        |                                                |

## Type of Chip Control

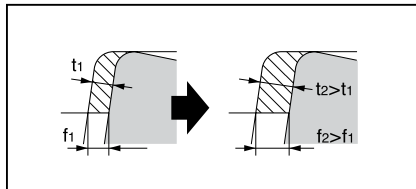
| Feed rate                  | A | B | C | D     | E |
|----------------------------|---|---|---|-------|---|
| Large feed rate            |   |   |   |       |   |
| Small feed rate            |   |   |   |       |   |
| NC lathe (For automation)  | × | × | ○ | ○     | △ |
| General lathe (For safety) | × | ○ | ○ | ○ ~ △ | × |

Good : C type, D type

Poor { A type : Twines around the tool or workpiece, damages the machined surface and affects safety.  
B type : Bulky, causes problems in the automatic chip conveyor and chipping occurs easily.  
E type : Causes spraying of chips, poor machined surface due to chattering, chipping, large cutting force and high temperatures.

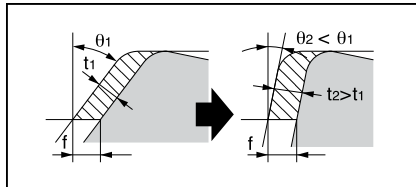
## Factor of Improvement Chip Control

### ① Increase feed rate



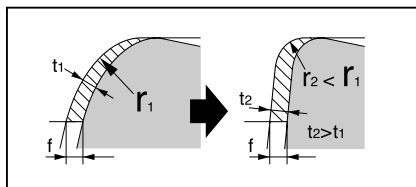
When feedrate increase, chips become thick and chip control improves.

### ② Decrease side cutting edge angle



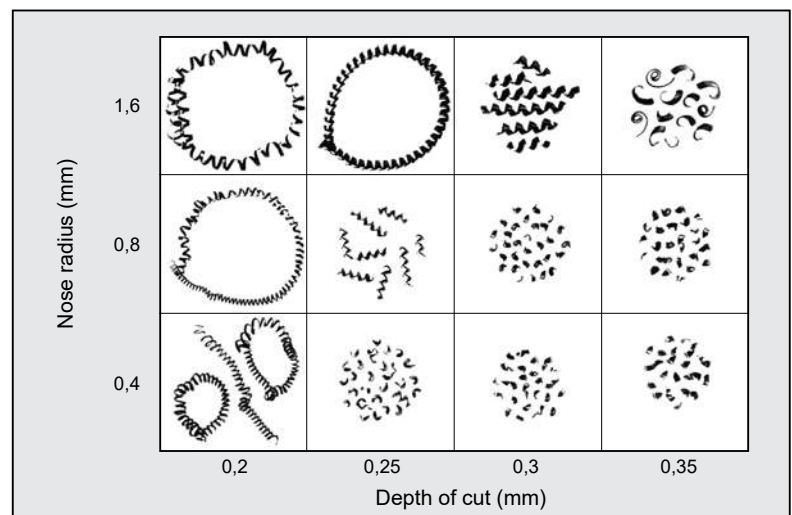
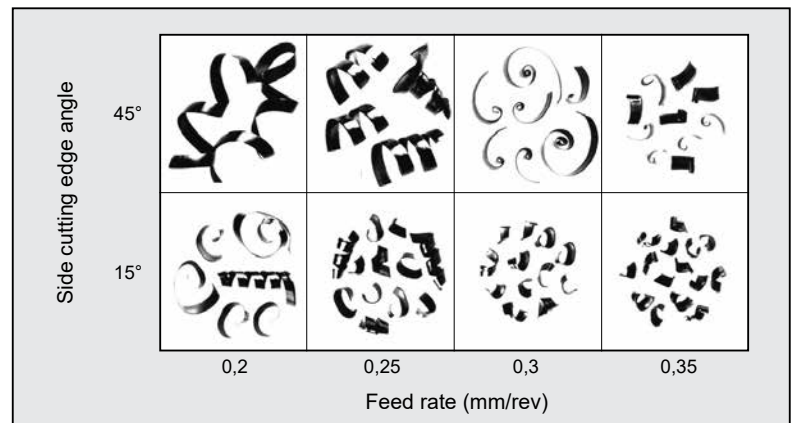
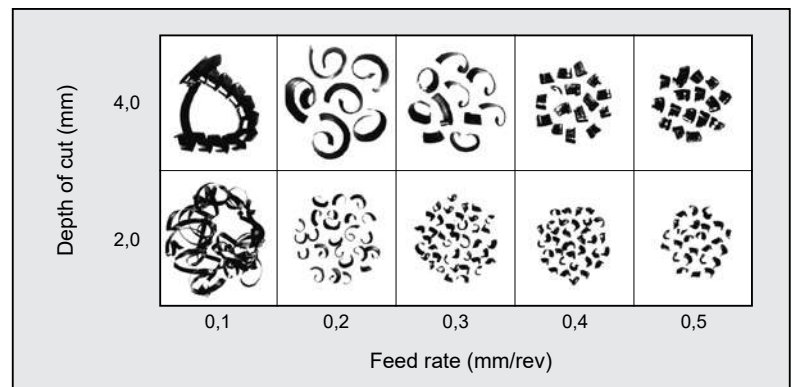
Even if feed rate is the same, smaller side cutting edge angle makes chips thick and chip control improves.

### ③ Decrease nose radius



Even if depth of cut is the same, smaller nose radius makes chip thick and chip control improves.

\* Cutting resistance increases in proportion with the width of the contact surface. Therefore, with a larger nose radius, cutting resistance and back force increases, chattering may also occur. However, with the same feedrate, a smaller nose radius would produce a poorer surface finish.

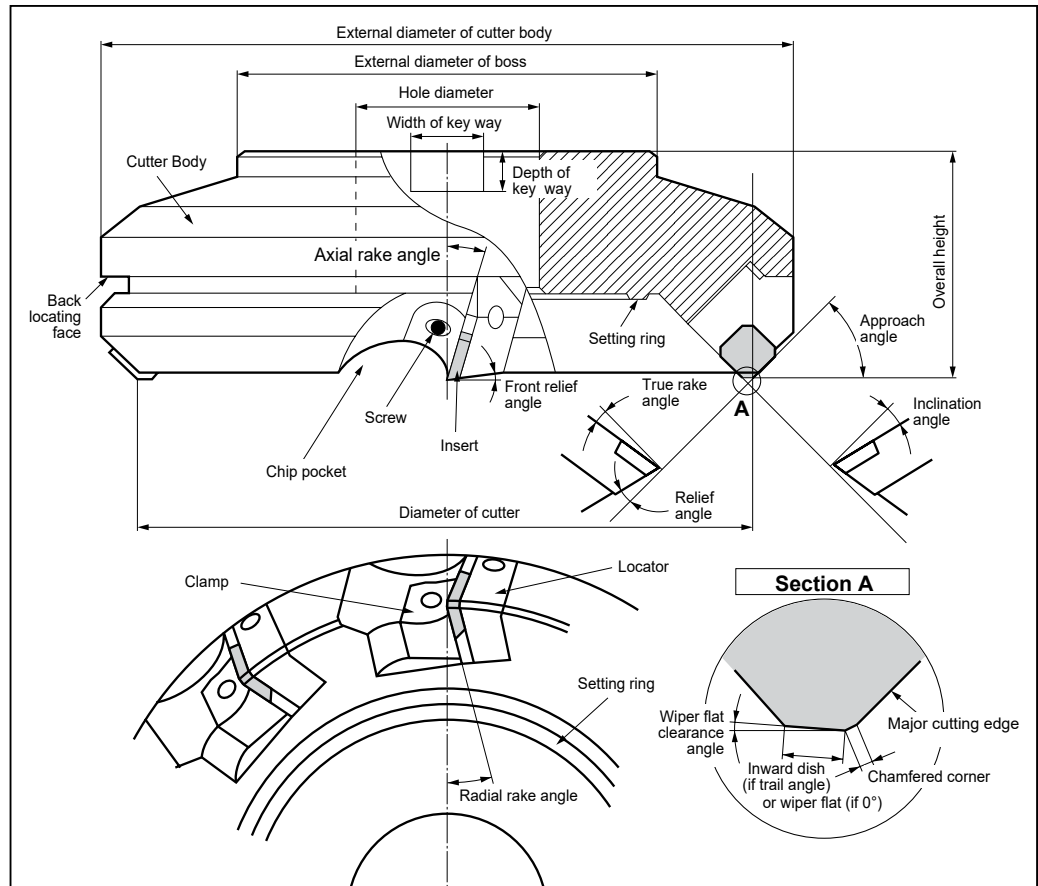




# Technical Guidance

## Basics of Milling

### Parts of a Milling Cutter



### Power Requirement

#### Calculating cutting force

$$P_c = \frac{a_p \cdot a_e \cdot v_f \cdot K_c}{60 \times 10^6 \times \eta} \text{ (kW)}$$

#### Horsepower

$$H = \frac{P_c}{0.75}$$

#### Chip removal amount

$$Q = \frac{a_p \times a_e \times v_f}{1.000} \text{ (cm}^3\text{/min)}$$

$P_c$  : Net power requirement (kW)

$H$  : Horsepower requirement (HP)

$Q$  : Chip removal amount (cm<sup>3</sup>/min)

$a_e$  : Cutting width (mm)

$v_f$  : Feed speed (mm/min)

$a_p$  : Depth of cut (mm)

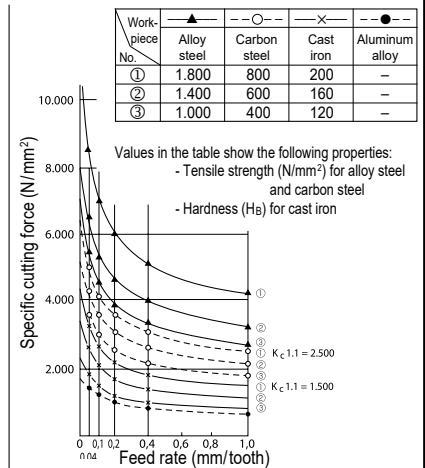
$\eta$  : Machine efficiency (0.70~0.85)

$K_c$  : Specific cutting force (N/mm<sup>2</sup>)

Eg. rough value

Steel : 2.500 ~ 3.000  
Cast iron : 1.500

#### Relation between feed rate, work material, specific cutting force



#### Calculating cutting speed

$$v_c = \frac{\pi \times D \times n}{1.000}$$

$v_c$  : Cutting speed (m/min)

$\pi \approx 3.14$

$D$  : Cutter diameter (mm)

$n$  : Rotation speed (rpm)

$v_f$  : Feed speed (mm/min)

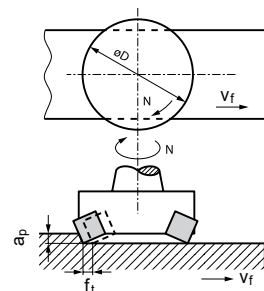
$f_z$  : Feed rate (mm/tooth)

$z$  : Number of teeth

#### Calculating feed rate

$$v_f = f_z \times z \times n$$

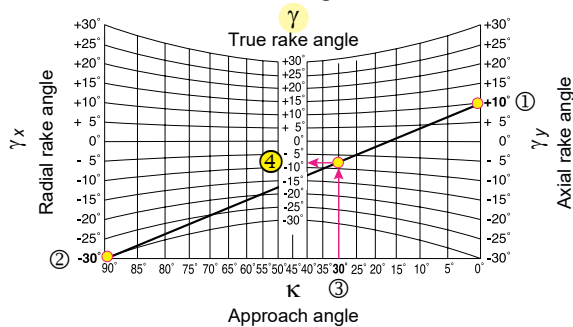
$$f_z = \frac{v_f}{z \times n}$$



### Functions of the Various Cutting Angles

|        | Description                               | Code                     | Functions                                                                            | Influences                                                                                                                                                                                                                                                                                                                |
|--------|-------------------------------------------|--------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ①<br>② | Axial rake angle<br>Radial rake angle     | $\gamma_y$<br>$\gamma_x$ | Controls chip removal direction, effects adhesion of the chips and thrust force etc. | Rake angles can vary from positive to negative (large to small) with typical combinations of positive and negative, positive and positive or negative and negative configurations.                                                                                                                                        |
| ③      | Approach angle                            | $\kappa$                 | Controls chip thickness and chip removal direction                                   | The effect of the small approach angle is to reduce the chip thickness and cutting force.                                                                                                                                                                                                                                 |
| ④      | True rake angle<br>(Effective rake angle) | $\gamma$                 | Controls cutting performance and ability to retain a cutting edge                    | <ul style="list-style-type: none"> <li>- With a positive (large) angle, cutting ability and adhesion resistance are improved but the strength of the cutting edge is weakened.</li> <li>- With negative (small) angle, the strength of the cutting edge is improved but chips will tend to adhere more easily.</li> </ul> |
| ⑤      | Inclination angle                         | $\lambda$                | Controls chip removal direction                                                      | - With a positive (large) angle, the chip removal is satisfactory with less cutting resistance but the strength of the corner is weaker.                                                                                                                                                                                  |
| ⑥      | Wiper flat clearance angle                | $\alpha_f$               | Controls surface finish                                                              | A smaller clearance angle will produce a better surface finish.                                                                                                                                                                                                                                                           |
| ⑦      | Clearance angle                           | $\alpha$                 | Controls edge strength, tool life and chattering, etc                                |                                                                                                                                                                                                                                                                                                                           |

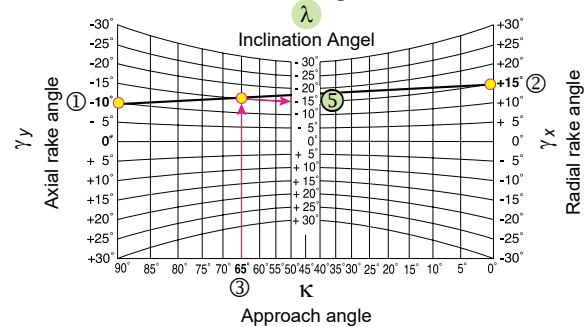
True Rake Angle Chart



|                                         |                       |
|-----------------------------------------|-----------------------|
| Example in using the above chart:       | Solution:             |
| ① $\gamma_y$ : Axial rake angle = +10°  | True rake angle       |
| ② $\gamma_x$ : Radial rake angle = -30° | ④ $\gamma = -8^\circ$ |
| ③ $\kappa$ : Approach angle = 30°       |                       |

Formula :  $\tan \gamma = \tan \gamma_x \cdot \sin \kappa + \tan \gamma_y \cdot \cos \kappa$

Inclination Angle Chart



|                                         |                         |
|-----------------------------------------|-------------------------|
| Example in using the above chart :      | Solution:               |
| ① $\gamma_y$ : Axial rake angle = -10°  | Inclination angle       |
| ② $\gamma_x$ : Radial rake angle = +10° | ⑤ $\lambda = -15^\circ$ |
| ③ $\kappa$ : Approach angle = 65°       |                         |

Formula :  $\tan \lambda = \tan \gamma_y \cdot \sin \kappa - \tan \gamma_x \cdot \cos \kappa$

### Rake Angle Combination

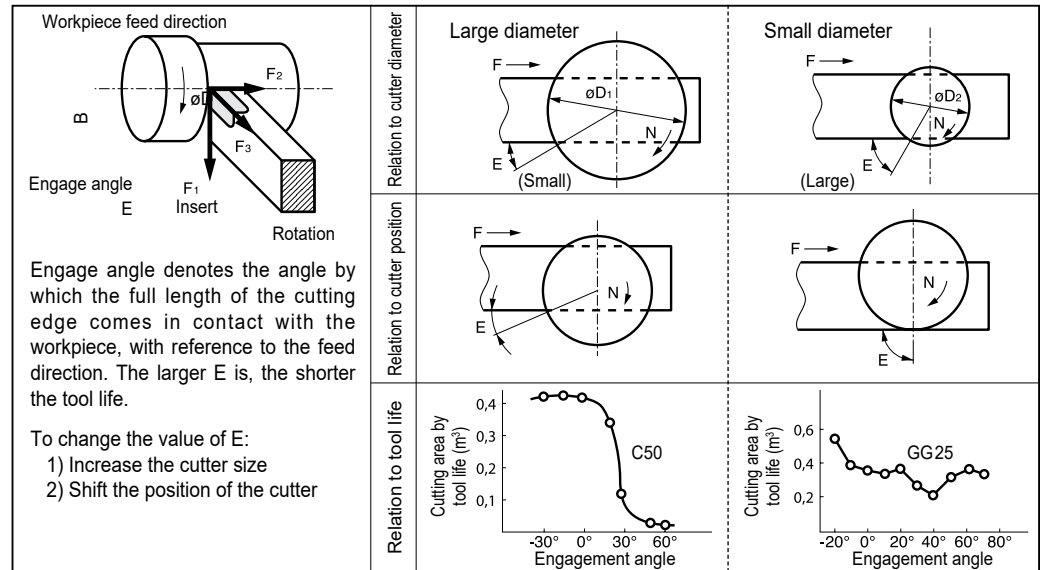
|                                                                                                   | Negative - Positive Type                           | Double Positive Type                                                 | Double Negative Type                                             |
|---------------------------------------------------------------------------------------------------|----------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------------|
| The effects of the various angle configurations with relation to chip formation and chip removal. |                                                    |                                                                      |                                                                  |
| Advantage                                                                                         | Excellent chip removal and good cutting action     | Good cutting action                                                  | Double-sided inserts can be use and higher cutting edge strength |
| Disadvantage                                                                                      | Only single-sided inserts can be use               | Lower cutting edge strength and only single-sided inserts can be use | Dull cutting action                                              |
| Application                                                                                       | For Steel, Cast iron, Stainless steel, Alloy steel | For general milling of steel<br>For low rigidly work piece           | For light milling of cast iron and steel                         |
| Typical cutter                                                                                    | WGX, WGC, UFO                                      | DPG                                                                  | DNX, DGC, DNF                                                    |
| Chips (Eg.)<br>Workpiece: 37Cr4<br>$v_c = 130$ m/min<br>$f_t = 0.23$ mm/tooth<br>$a_p = 3$ mm     |                                                    |                                                                      |                                                                  |



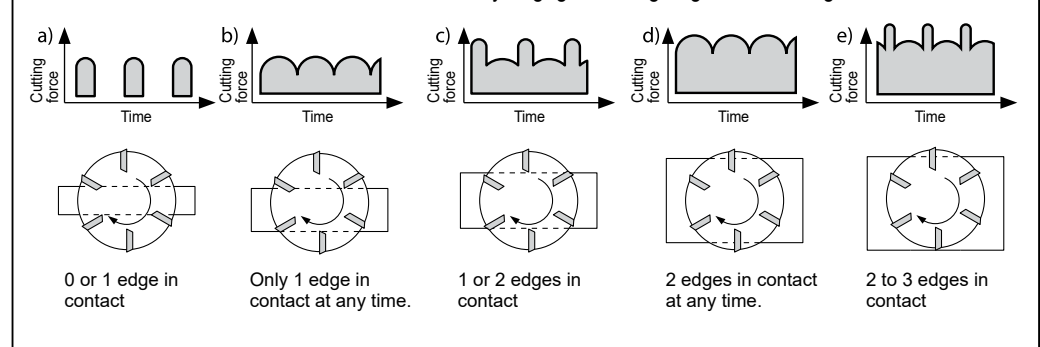
# Technical Guidance

## Basics of Milling

### ■ Relation Between Engage Angle and Tool Life



### ● Relation between the number of simultaneously engaged cutting edges and cutting force:



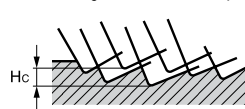
### ■ To Improve Surface Roughness

#### ① Milling inserts with wiper flat

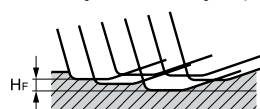
When all the cutting edges have wiper flats, a few teeth are intentionally elevated to play the role of a wiper insert.

- Insert equipped with straight wiper flat (Face angle: Approx 15' - 1°)
- Insert equipped with curved wiper flat (Eg. curvature R500)

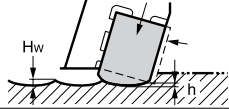
#### ● Surface roughness without wiper flat



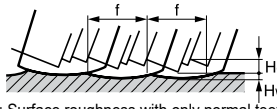
#### ● Surface roughness with straight wiper flat



h : Projected value of wiper insert  
Steels : 0,05 mm  
Al : 0,03 mm

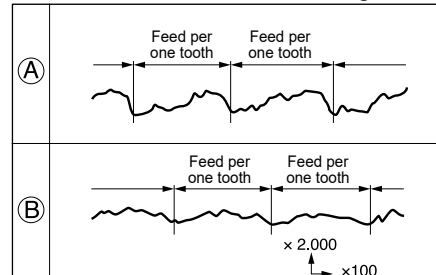


f : Feed rate per revolution



Hc : Surface roughness with only normal teeth  
Hw : Surface roughness with wiper insert

#### ● Influence of different face angles on surface finish



- Workpiece: 34CrMo4  
- Cutter: DPG 5160 R (Single tooth)

-  $v_c = 154$  m/min  
 $f_z = 0,234$  mm/tooth  
 $a_p = 2$  mm

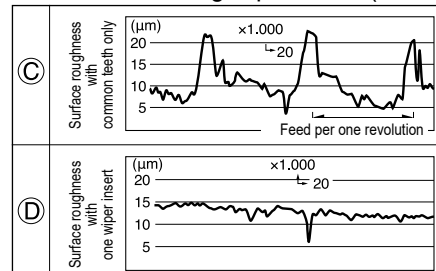
- Face angle  
(A) : 28'  
(B) : 6'

#### ② Integral wiper insert system

A system to protrude one or two inserts (wiper insert) with a smooth curved edge just a little beyond the other teeth to wipe the milled surface.

- (Applies to WGC, RF types etc.)

#### ● Effects of having wiper insert (example)

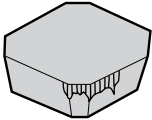
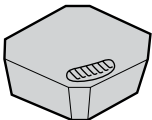
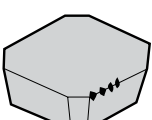
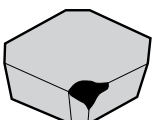


- Workpiece: GG25  
- Cutter: DPG 4100 R  
- Insert: SPKN 1203  
- Axial run-out: 0,015 mm  
- Radial run-out: 0,04 mm

-  $v_c = 105$  m/min  
 $f_z = 0,29$  mm/tooth (1,45 mm/rev)

(C) : Only normal teeth  
(D) : with 1 wiper insert

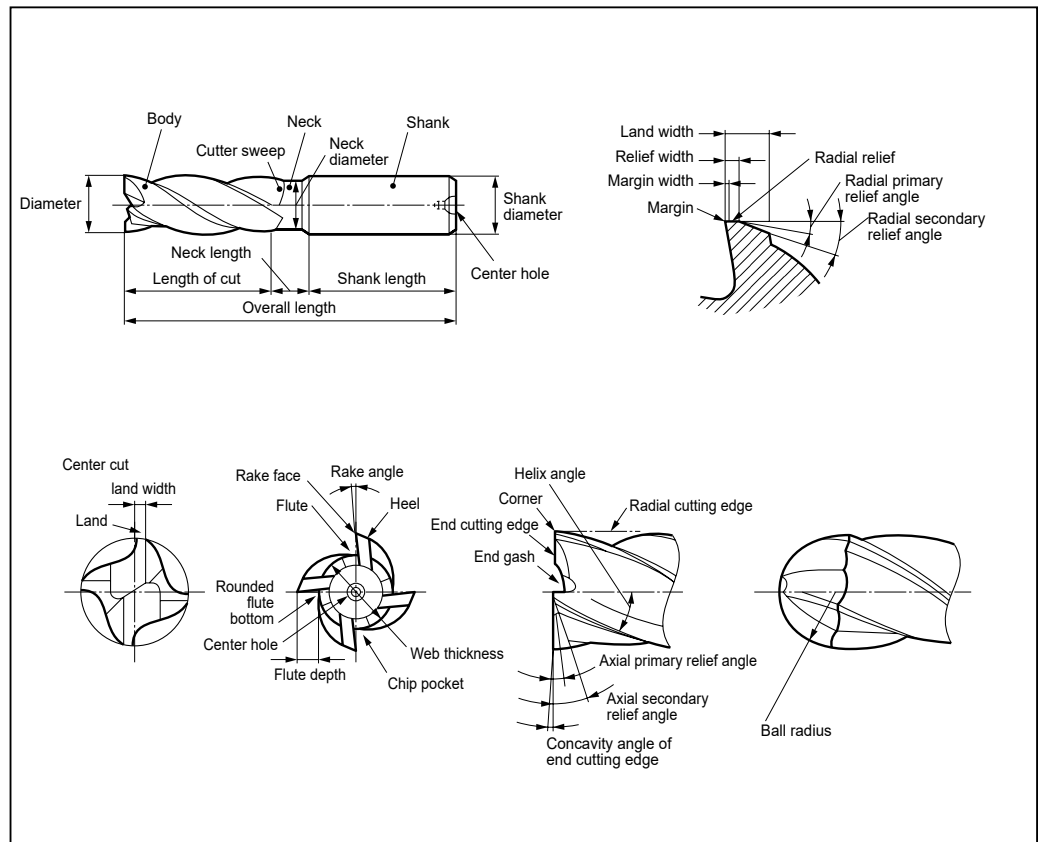
### ■ Trouble Shooting Guide for Milling

| Trouble              |                                                                                                                          | Basic Remedies     |                                                                                                                                                                                                                                                                                                     | Remedy Examples |                                                                                       |  |  |
|----------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------------------------------------------------------------|--|--|
| Cutting Edge Failure | Excessive Flank Wear<br>                | Tool Material      | <ul style="list-style-type: none"> <li>Select a more wear resistant grade. Carbide</li> <li>P30 ⇒ P20 ⇒ P30</li> <li>K20 ⇒ K10 ⇒ { Coated Cermet</li> </ul>                                                                                                                                         |                 | - Recommended insert grades                                                           |  |  |
|                      |                                                                                                                          | Cutting Conditions | <ul style="list-style-type: none"> <li>Reduce cutting speeds.</li> <li>Increase feedrate.</li> </ul>                                                                                                                                                                                                |                 |                                                                                       |  |  |
|                      | Excessive Crater Wear<br>               | Tool Material      | <ul style="list-style-type: none"> <li>Select a crater resistant grade.</li> </ul>                                                                                                                                                                                                                  |                 | - Recommended insert grades                                                           |  |  |
|                      |                                                                                                                          | Cutting Conditions | <ul style="list-style-type: none"> <li>Reduce cutting speeds.</li> <li>Reduce depth-of-cut and feed rate.</li> </ul>                                                                                                                                                                                |                 |                                                                                       |  |  |
| Cutting Edge Failure | Cutting Edge Chipping<br>               | Tool Material      | <ul style="list-style-type: none"> <li>Select tougher grade. P10 ⇒ P20 ⇒ P30</li> <li>K01 ⇒ K10 ⇒ K20</li> </ul>                                                                                                                                                                                    |                 | - Recommended insert grades                                                           |  |  |
|                      |                                                                                                                          | Cutting Conditions | <ul style="list-style-type: none"> <li>Reduce feed rates.</li> </ul>                                                                                                                                                                                                                                |                 |                                                                                       |  |  |
| Cutting Edge Failure | Partial Fracture of Cutting Edges<br> | Tool Material      | <ul style="list-style-type: none"> <li>If it is due to excessive low speeds or very low feed rates, select an adhesion resistant grade.</li> <li>If it is due to thermal cracking, select a thermal impact resistant grade.</li> </ul>                                                              |                 | - Recommended insert grades                                                           |  |  |
|                      |                                                                                                                          | Cutting Conditions | <ul style="list-style-type: none"> <li>Select appropriate conditions with regards to the particular application.</li> </ul>                                                                                                                                                                         |                 |                                                                                       |  |  |
| Cutting Edge Failure |                                                                                                                          | Tool Design        | <ul style="list-style-type: none"> <li>Select a negative-positive (or negative) cutter configuration with a large approach angle.</li> <li>Reinforce the cutting edge (Honing).</li> <li>Select a strong edge insert (G → H).</li> <li>Increase insert size - (Thickness in particular).</li> </ul> |                 | - Recommended cutter: WaveMill WGX type                                               |  |  |
|                      |                                                                                                                          |                    |                                                                                                                                                                                                                                                                                                     |                 | - Cutting conditions: Refer to recommended conditions listed in the general catalogue |  |  |
| Others               | Unsatisfactory Machined Surface Finish                                                                                   | Tool Material      | <ul style="list-style-type: none"> <li>Select an adhesion resistant grade. Carbide → Cermet</li> </ul>                                                                                                                                                                                              |                 | - Recommended insert grades                                                           |  |  |
|                      |                                                                                                                          | Cutting Conditions | <ul style="list-style-type: none"> <li>Increase cutting speeds.</li> </ul>                                                                                                                                                                                                                          |                 |                                                                                       |  |  |
|                      |                                                                                                                          | Tool Design        | <ul style="list-style-type: none"> <li>Improve axial run-out of cutting edges. (Use a cutter with less run-out) (Attach correct inserts)</li> <li>Use wiper inserts.</li> <li>Use special purpose cutters designed for finishing.</li> </ul>                                                        |                 |                                                                                       |  |  |
|                      | Chattering                                                                                                               | Cutting Conditions | <ul style="list-style-type: none"> <li>Reduce feed rates.</li> </ul>                                                                                                                                                                                                                                |                 | - Recommended cutters:                                                                |  |  |
|                      |                                                                                                                          | Tool Design        | <ul style="list-style-type: none"> <li>Select a high rake cutter with sharp cutting edges</li> <li>Use an irregular pitched cutter.</li> <li>Improve workpiece and cutter clamp rigidity.</li> </ul>                                                                                                |                 |                                                                                       |  |  |
| Others               | Unsatisfactory Chip Control                                                                                              | Tool Design        | <ul style="list-style-type: none"> <li>Select cutter with good chip removal features.</li> <li>Reduce number of teeth.</li> <li>Enlarge chip pocket.</li> </ul>                                                                                                                                     |                 | - Recommended cutter: WaveMill WGX type                                               |  |  |
|                      | Edge Chipping on Workpiece                                                                                               | Tool Design        | <ul style="list-style-type: none"> <li>Select a large approach angle.</li> <li>Select a sharp cutting edge insert (G → L).</li> <li>Reduce feed rates.</li> </ul>                                                                                                                                   |                 | - Recommended cutter: WaveMill WGX type                                               |  |  |
|                      | Burr on Workpiece                                                                                                        | Tool Design        | <ul style="list-style-type: none"> <li>Select a cutter with sharp cutting edges.</li> </ul>                                                                                                                                                                                                         |                 | - Recommended cutter: WaveMill WGX type + FG breaker                                  |  |  |
|                      |                                                                                                                          | Cutting Conditions | <ul style="list-style-type: none"> <li>Increase feed rates.</li> </ul>                                                                                                                                                                                                                              |                 | DGC type + FG breaker                                                                 |  |  |

# Technical Guidance

## Basics of Endmilling

### Parts of an Endmill



### Calculating Cutting Conditions

#### ● Cutting speed

$$v_c = \frac{\pi \cdot D \cdot n}{1.000} \quad n = \frac{1.000 \cdot v_c}{\pi \cdot D}$$

#### ● Feed rate

$$v_f = f \times n$$

$$v_f = f_z \times z \times n \quad f_z = \frac{v_f}{z \times n}$$

#### ● Depth of cut (D.O.C)

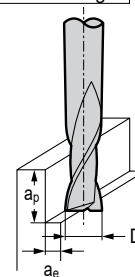
$a_p$  : Axial D.O.C. (depth)  
 $a_e$  : Radial D.O.C. (width)

#### ● Notch width ( $D_1$ )

$$D_1 = 2 \times \sqrt{2 \times R \times a_p - a_p^2}$$

#### ● Cutting speed and feedrate are calculated using the same formula as square endmill.

Side milling



$v_c$  : Cutting speed (m/min)

$\pi \approx 3,14$

$D$  : Endmill diameter (mm)

$n$  : Rotational speed ( $\text{min}^{-1}$ )

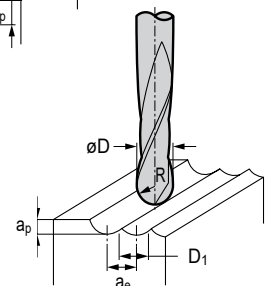
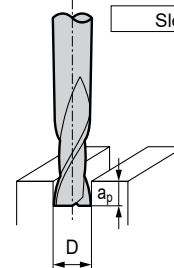
$v_f$  : Feed speed (mm/min)

$f_r$  : Feed rate per revolution (mm/rev)

$f_z$  : Feed rate per tooth (mm/tooth)

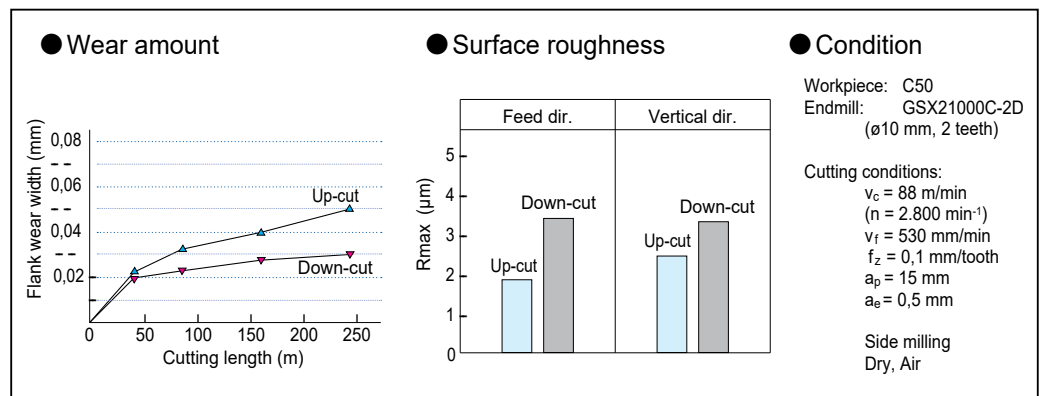
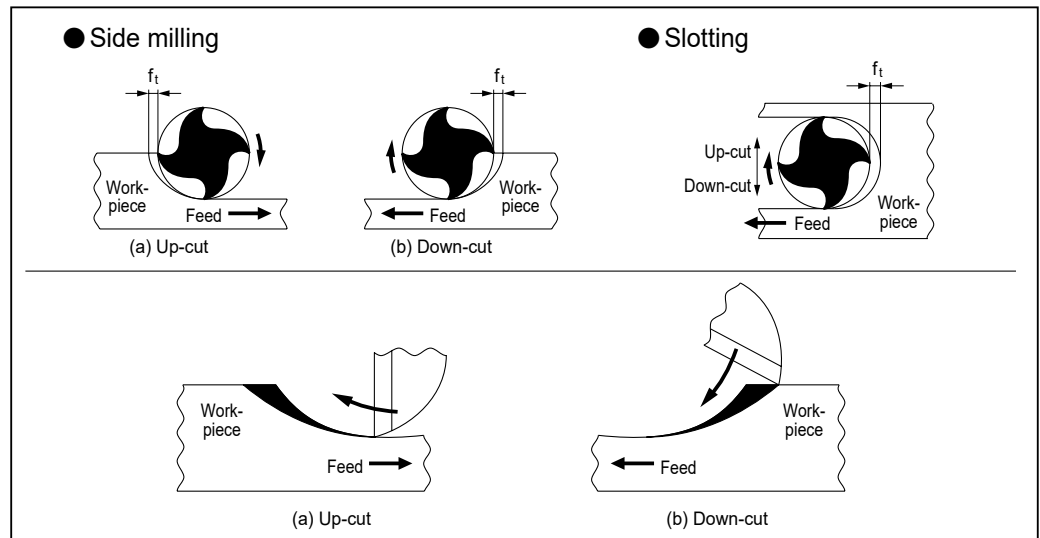
$z$  : Number of teeth

Slotting



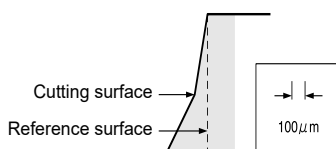
(Ball Endmill)

### Up-cut and Down-cut



### Relation Between Cutting Condition and Deflection

| Endmill  |                 |             | Side milling                                                                                                                              |          |                                                                                                                                        |          | Slotting    |          |               |          |
|----------|-----------------|-------------|-------------------------------------------------------------------------------------------------------------------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------|----------|-------------|----------|---------------|----------|
|          |                 |             | Work material:<br>Pre-hardened steel (40HRC)<br>Cutting data: $v_c = 25 \text{ m/min}$<br>$a_p = 12 \text{ mm}$<br>$a_e = 0,8 \text{ mm}$ |          | Work material:<br>Pre-hardened steel (40HRC)<br>Cutting data: $v_c = 25 \text{ m/min}$<br>$a_p = 8 \text{ mm}$<br>$a_e = 8 \text{ mm}$ |          | Up-cut side |          | Down-cut side |          |
| Cat. No. | Number of teeth | Helix angle | Feed rate                                                                                                                                 |          | Feed rate                                                                                                                              |          | Feed rate   |          | Feed rate     |          |
|          |                 |             | 0,16 mm/rev                                                                                                                               |          | 0,11 mm/rev                                                                                                                            |          | 0,05 mm/rev |          | 0,03 mm/rev   |          |
|          |                 |             | Style                                                                                                                                     |          | Style                                                                                                                                  |          | Style       |          | Style         |          |
|          |                 |             | Up-cut                                                                                                                                    | Down-cut | Up-cut                                                                                                                                 | Down-cut | Up-cut      | Down-cut | Up-cut        | Down-cut |
| SSM 2080 | 2               | 30°         |                                                                                                                                           |          |                                                                                                                                        |          |             |          |               |          |
| SSM 4080 | 4               | 30°         |                                                                                                                                           |          |                                                                                                                                        |          |             |          |               |          |



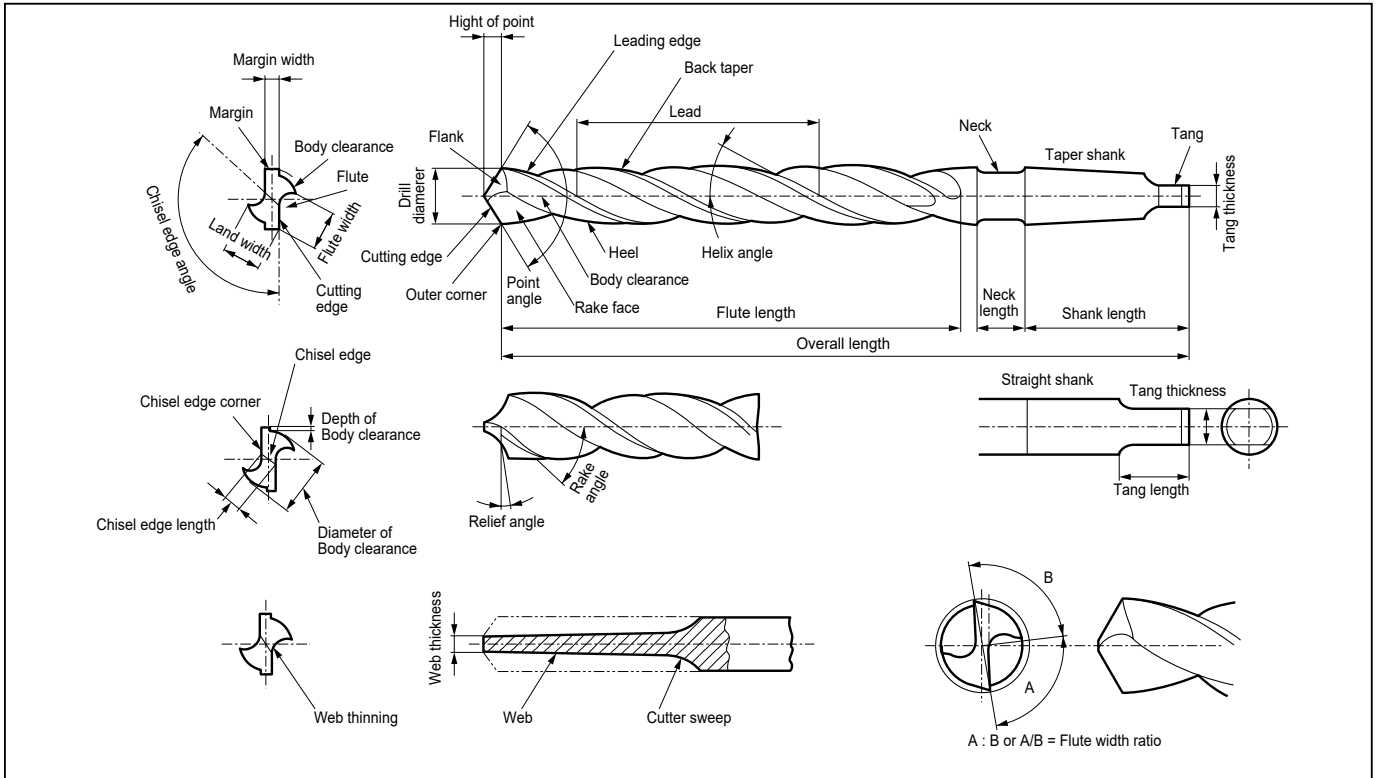
# Technical Guidance

## Tool Failure and Remedies

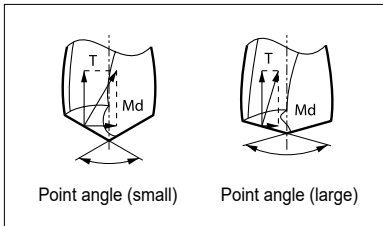
### ■ Trouble Shooting Guide for Endmilling

| Failure              |                                        | Cause                                                                                                                                                                                                                             |  | Remedies                                                                                                                                                                                                                                          |
|----------------------|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cutting Edge Failure | Excessive Wear                         | Cutting Conditions<br>- Cutting speed is too fast<br>- Feed rate is too fast<br><br>Tool Shape<br>Tool Material<br>- The flank relief angle ist too small<br>- Insufficient wear resistance                                       |  | - Decrease cutting speed and feed rate.<br><br>- Change to an appropriate flank relief angle.<br>- Select a substrate with more wear resistance<br>- Use a coated tool                                                                            |
|                      | Chipping                               | Cutting Conditions<br>- Feed rate ist too fast<br>- Cutting depth is too deep<br>- Tool overhang ist too long<br><br>Machine Area<br>- Work clamps are weak<br>- Tool is not firmly attached                                      |  | - Decrease cutting speed.<br>- Reduce depth of cut<br>- Adjust tool overhang for correct length<br>- Clamp the work piece firmly<br>- Make sure the tool is seated in the chuck properly                                                          |
|                      | Tool Fracture                          | Cutting Conditions<br>- Feed rate ist too fast<br>- Cutting depth is too deep<br>- Tool overhang ist too long<br>- Cutting edge is too long                                                                                       |  | - Decrease cutting speed.<br>- Reduce depth of cut<br>- Reduce tool overhang as much as possible<br>- Select a tool with a shorter cutting edge                                                                                                   |
| Others               | Shoulder Deflection                    | Cutting Conditions<br>- Feed rate is too fast<br>- Cutting depth is too deep<br>- Tool overhang is too long<br>- Cutting on the down-cut<br><br>Tool Shape<br>- Helix angle is large                                              |  | - Decrease cutting speed.<br>- Reduce depth of cut<br>- Adjust tool overhang for correct length<br>- Change directions to up-cut<br>- Use a tool with a smaller helix angle                                                                       |
|                      | Unsatisfactory Machined Surface Finish | Cutting Conditions<br>- Feed rate is too fast<br><br>- Packing of chips                                                                                                                                                           |  | - Decrease cutting speed.<br><br>- Use air blow<br>- Use an insert with a larger relief pocket.                                                                                                                                                   |
|                      | Chattering                             | Cutting Conditions<br>- Cutting speed is too fast<br>- Cutting on the up-cut<br>- Tool overhang is too long<br><br>Tool Shape<br>Machine Area<br>- Rake angle is large<br>- Work clamps are weak<br>- Tool is not firmly attached |  | - Decrease cutting speed.<br>- Change directions to down-cut<br>- Adjust tool overhang for correct length<br>- Use a tool with an appropriate rake angle<br>- Clamp the work piece firmly<br>- Make sure the tool is seated in the chuck properly |
|                      | Packing of Chip                        | Cutting Conditions<br>- Feed rate is too fast<br>- Cutting depth is too deep<br><br>Tool Shape<br>- Too many teeth<br>- Packing of chips                                                                                          |  | - Decrease cutting speed.<br>- Reduce depth of cut<br>- Reduce number of teeth<br>- Use air blow                                                                                                                                                  |

### Parts of a Drill

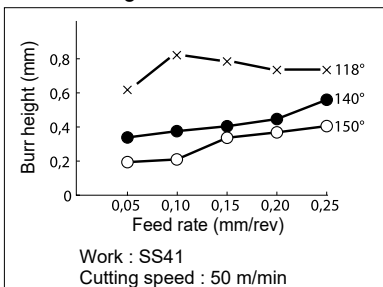


### Point Angle and Force



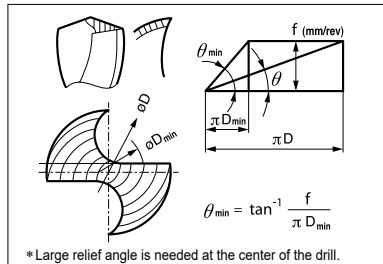
When point angle is large, thrust becomes large but torque becomes small.

### Point Angle and Burr

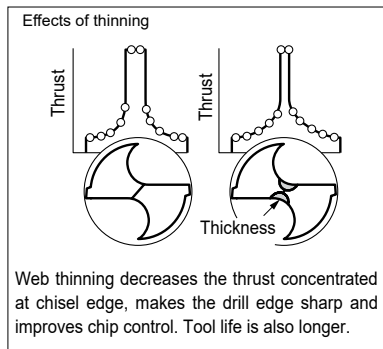


When point angle is large, burr height becomes low.

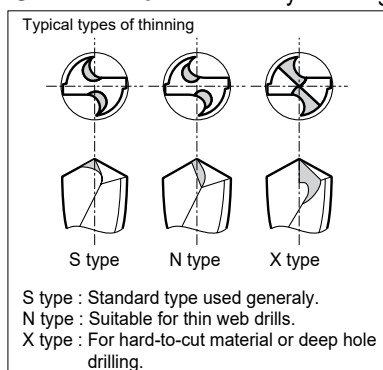
### Min. Requirement Relief Angle



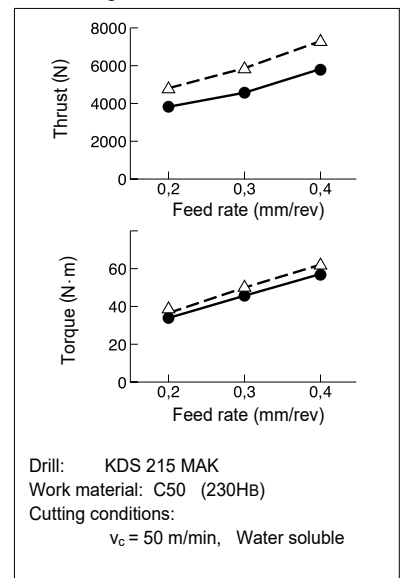
### Web Thickness and Thrust



### Decrease Chisel Width by Thinning



### Width of Edge Throatment and Cutting Force

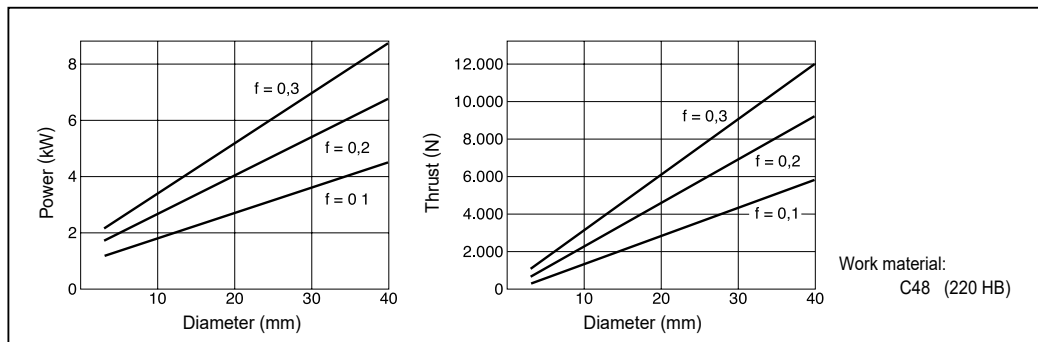




# Technical Guidance

## Basics of Drilling

### Reference of Power Requirement and Thrust



### Cutting Condition Selection

- Control cutting force for low rigid machine

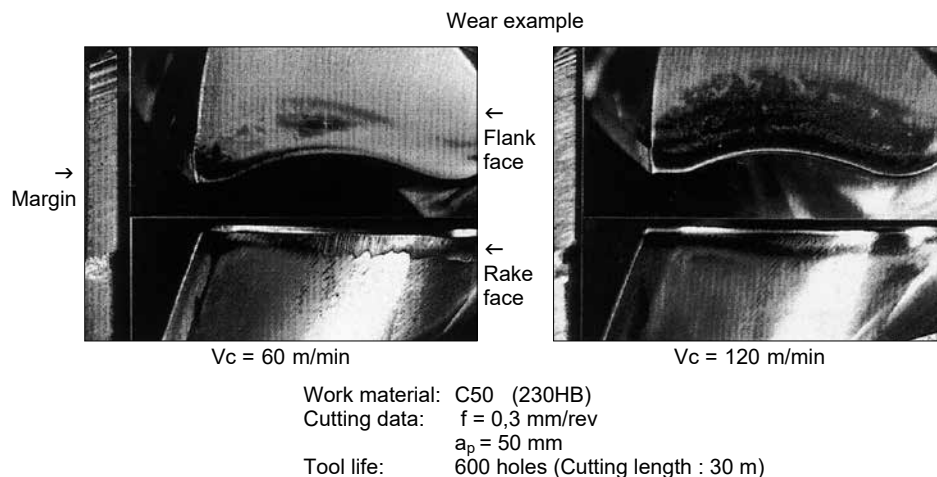
The following table shows the relation between edge treatment width and cutting force. If a problem caused by cutting force occurs, reduce either the feedrate or the edge treatment width.

| Condition     |              | Edge treatment width |            |              |            |
|---------------|--------------|----------------------|------------|--------------|------------|
|               |              | 0,15 mm              |            | 0,05 mm      |            |
| $V_c$ (m/min) | $f$ (mm/rev) | Torque (N•m)         | Thrust (N) | Torque (N•m) | Thrust (N) |
| 40            | 0,38         | 12,8                 | 2820       | 12,0         | 2520       |
| 50            | 0,30         | 10,8                 | 2520       | 9,4          | 1920       |
| 60            | 0,25         | 9,2                  | 2320       | 7,6          | 1640       |
| 60            | 0,15         | 6,4                  | 1640       | 5,2          | 1.100      |

Drill :  $\phi 10$   
Work material:  
C50 (230 HB)

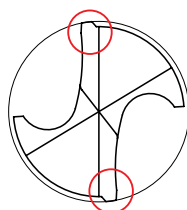
- High speed machining recommendation

When there is surplus capacity with enough machine power and rigidity drilling at normal recommended cutting conditions, we recommend higher drilling speeds.



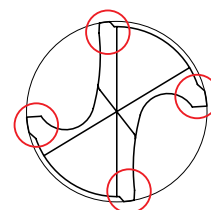
### Explanation of Margins (Difference between single and double margins)

- Single Margin (2 guides: circled parts)



- Shape used on most drills

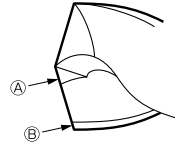
- D Double Margin (4 guides: circled parts)



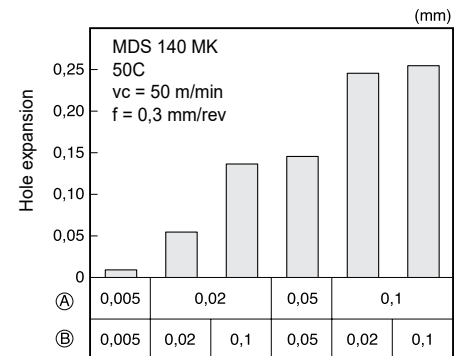
- 4-point guiding reduces hole bending and undulation for improved stability and accuracy during deep hole drilling.

### Run-out Accuracy

Run-out of the lip height B and thinning point A are important.

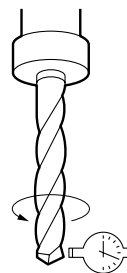


(A) : The run-out accuracy of thinning point  
(B) : The difference of lip height



### Peripheral Run-out Accuracy when Tool Rotates

Drill run-out when mounted on the machine spindle must be within 0,03 mm. If the run-out is large, the drilled hole will also be large causing an increase in the horizontal cutting force, which may result in drill breakage if the machine or work clamping is not rigid.



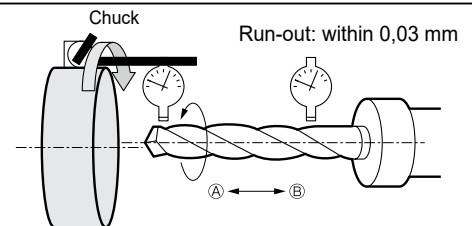
Run-out: within 0,03 mm

| Peripheral run-out (mm) | Hole expansion (mm) | Horizontal cutting force (kg) |
|-------------------------|---------------------|-------------------------------|
| 0,005                   | 0,05                | 10                            |
| 0,09                    | 0,15                | 10                            |

Drill: MDS120MK  
Work material: C50 (230HB)  
Cutting data:  $v_c = 50 \text{ m/min}$ ,  $f = 0,3 \text{ mm/rev}$ ,  $a_p = 38 \text{ mm}$   
Water soluble

### Peripheral Run-out Accuracy when Workpiece Rotates

When use on a lathe, run-out at point A must be within 0,03 mm, this value must be similar when taken at position B.

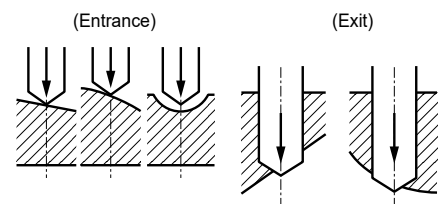


Run-out: within 0,03 mm

### Influence of Workpiece Surface

#### Workpiece with slanted or uneven surface

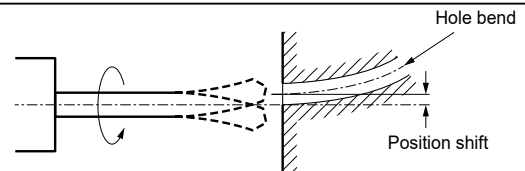
If the surface of the hole entrance or exit is slanted or uneven, decrease the feedrate to 0,1–0,15 mm/rev at these points.



### How to Use Long Drill

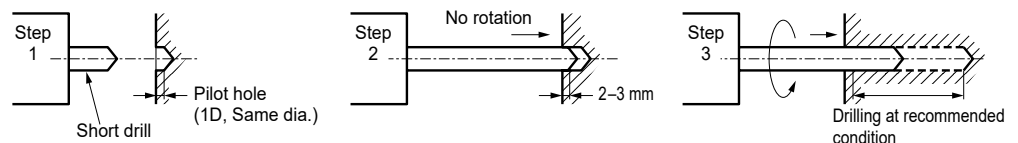
#### Problem

When using a long drill (e.g. XHGS type and XHT type), DAK type or SMDH-D type drills at high rotational speeds, the run-out of the drill tip may cause a position shift at the entry point making the drill hole bent and resulting in drill breakage.

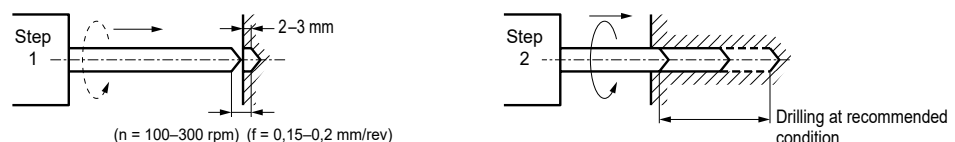


#### Remedies

##### Method 1.



##### Method 2. Low rotational speed minimizes centrifugal forces and prevents drill bending.



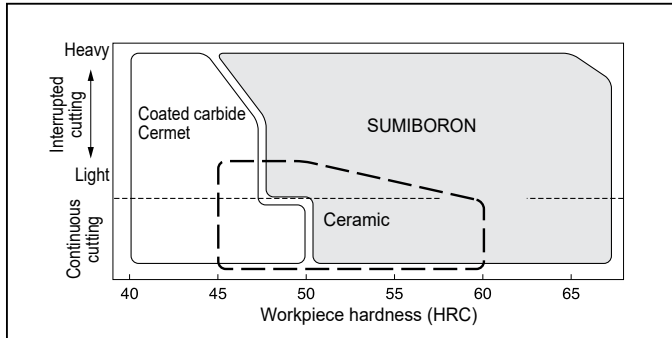
# Technical Guidance

## Tool Failure and Remedies

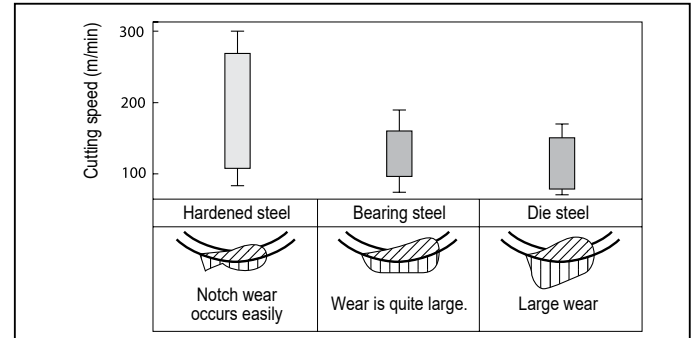
### ■ Trouble Shooting Guide for Drilling

| Failure                      |                                     | Basic Remedies                                               |                                                                                                                                                                                                                                                                                                                                                                  | Remedies Examples                                                                                                                                                                                                                                                                  |
|------------------------------|-------------------------------------|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Drill Failure                | Excessive Wear on Cutting Edge      | Cutting Conditions<br>Cutting Fluid                          | <ul style="list-style-type: none"> <li>- Use higher cutting speeds.</li> <li>- Increase feed rates.</li> <li>- Reduce pressure if using internal coolant.</li> <li>- Use cutting fluid with more lubricity.</li> </ul>                                                                                                                                           | <ul style="list-style-type: none"> <li>- <math>V_c = 80\text{--}100\text{ m/min}</math></li> <li>- Refer to recommended cutting conditions listed in the general catalogue.</li> <li>- Below 1,5 MPa.</li> </ul>                                                                   |
|                              | Chisel Point Chipping               | Tool Design<br>Cutting Conditions<br>Others                  | <ul style="list-style-type: none"> <li>- Increase size of chisel width.</li> <li>- Increase amount of honing on cutting edge.</li> <li>- Reduce depth-of cut.</li> <li>- Reduce feed rate at entry point.</li> <li>- Improve workpiece clamping rigidity.</li> </ul>                                                                                             | <ul style="list-style-type: none"> <li>- <math>f = 0,05\text{--}0,1\text{ mm/rev}</math></li> </ul>                                                                                                                                                                                |
|                              | Chipping on Peripheral Cutting Edge | Tool Design<br>Cutting Conditions<br>Cutting Fluid<br>Others | <ul style="list-style-type: none"> <li>- Increase amount of honing on cutting edge.</li> <li>- Reduce the amount of front flank angle.</li> <li>- Reduce cutting speeds.</li> <li>- Increase feed rates.</li> <li>- Use cutting fluid with more lubricity.</li> <li>- Improve workpiece clamp rigidity.</li> </ul>                                               | <ul style="list-style-type: none"> <li>- Refer to recommended cutting conditions listed in the general catalogue.</li> </ul>                                                                                                                                                       |
|                              | Margin Wear                         | Tool Design<br>Cutting Conditions<br>Cutting Fluid<br>Others | <ul style="list-style-type: none"> <li>- Increase amount of back taper.</li> <li>- Reduce margin width.</li> <li>- Reduce cutting speeds.</li> <li>- Increase feed rates.</li> <li>- Use cutting fluid with more lubricity.</li> <li>- Schedule for earlier regrind.</li> </ul>                                                                                  | <ul style="list-style-type: none"> <li>- Refer to recommended cutting conditions listed in the general catalogue.</li> </ul>                                                                                                                                                       |
|                              | Drill Breakage                      | Tool Design<br>Cutting Conditions<br>Cutting Fluid<br>Others | <ul style="list-style-type: none"> <li>- Increase amount of back taper.</li> <li>- Reduce margin width.</li> <li>- Reduce cutting speeds.</li> <li>- Use cutting fluid with more lubricity.</li> <li>- Improve workpiece clamp rigidity.</li> </ul>                                                                                                              | <ul style="list-style-type: none"> <li>- Refer to recommended cutting conditions listed in the general catalogue.</li> </ul>                                                                                                                                                       |
| Unsatisfactory Hole Accuracy | Oversized Holes                     | Tool Design<br>Cutting Conditions<br>Cutting Fluid<br>Others | <ul style="list-style-type: none"> <li>- Improve overall drill rigidity. (large web, small flute).</li> <li>- Reduce drill point angle.</li> <li>- Reduce feed rate at entry phase.</li> <li>- Reduce cutting speeds.</li> <li>- Improve workpiece clamp rigidity.</li> <li>- Improve drill clamp precision.</li> <li>- Improve drill clamp rigidity.</li> </ul> | <ul style="list-style-type: none"> <li>- <math>130^\circ\text{--}120^\circ</math></li> <li>- <math>f = 0,05\text{--}0,1\text{ mm/rev}</math></li> <li>- Refer to recommended cutting conditions listed in the general catalogue.</li> <li>- Drill run-out below 0,02 mm</li> </ul> |
|                              | Poor Surface Finish                 | Tool Design<br>Cutting Conditions<br>Cutting Fluid           | <ul style="list-style-type: none"> <li>- Increase amount of back taper.</li> <li>- Increase cutting speeds.</li> <li>- Use cutting fluid with more lubricity.</li> </ul>                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>- Refer to recommended cutting conditions listed in the general catalogue.</li> </ul>                                                                                                                                                       |
|                              | Holes are Not Straight              | Tool Design<br>Cutting Conditions<br>Others                  | <ul style="list-style-type: none"> <li>- Reduce amount of edge honing.</li> <li>- Reduce feedrates.</li> <li>- Improve workpiece clamp rigidity.</li> <li>- Improve drill clamp precision.</li> <li>- Improve drill clamp rigidity.</li> </ul>                                                                                                                   | <ul style="list-style-type: none"> <li>- Refer to recommended cutting conditions listed in the general catalogue.</li> <li>- Drill run-out below 0,02 mm</li> </ul>                                                                                                                |
| Unsatisfactory Chip Control  | Packing of Chips                    | Cutting Conditions<br>Cutting Fluid                          | <ul style="list-style-type: none"> <li>- Increase cutting speeds.</li> <li>- Increase feed rates.</li> <li>- Reduce pressure if using internal coolant.</li> </ul>                                                                                                                                                                                               | <ul style="list-style-type: none"> <li>- Refer to recommended cutting conditions listed in the general catalogue.</li> <li>- Below 1,5 MPa.</li> </ul>                                                                                                                             |
|                              | Long Stringy Chips                  | Tool Design<br>Cutting Conditions<br>Cutting Fluid           | <ul style="list-style-type: none"> <li>- Reduce amount of edge honing.</li> <li>- Increase feed rates.</li> <li>- Reduce pressure if using internal coolant.</li> </ul>                                                                                                                                                                                          | <ul style="list-style-type: none"> <li>- Refer to recommended cutting conditions listed in the general catalogue.</li> <li>- Below 1,5 MPa.</li> </ul>                                                                                                                             |

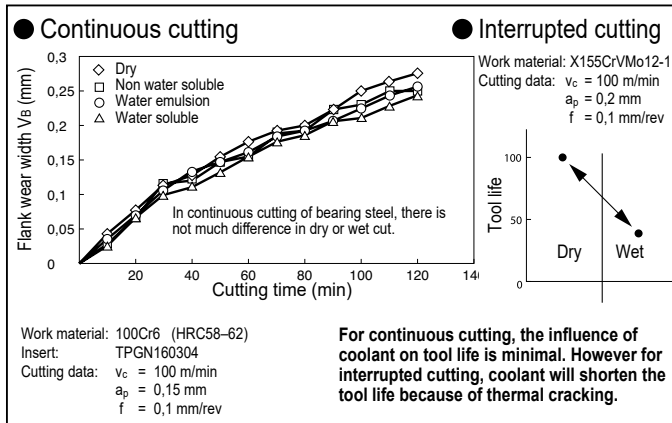
## Application Map of the Various Tool Materials



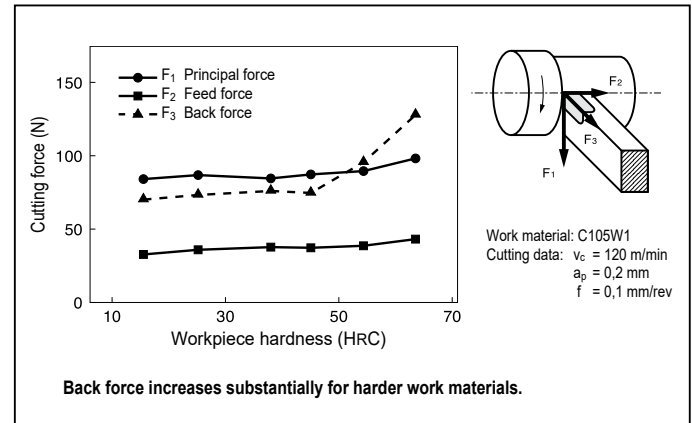
## Work Materials and Cutting Speed Recommendations



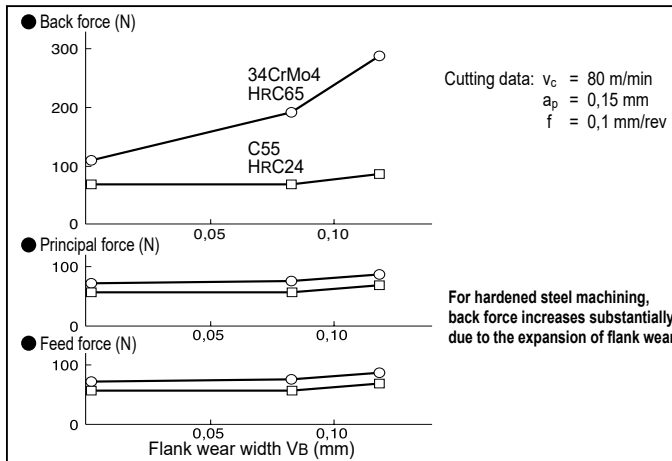
## Influence of Coolant on Tool Life



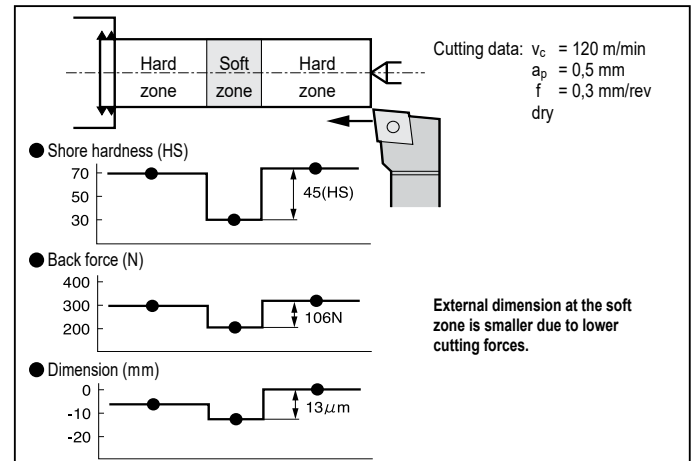
## Relation Workpiece Hardness and Cutting Forces



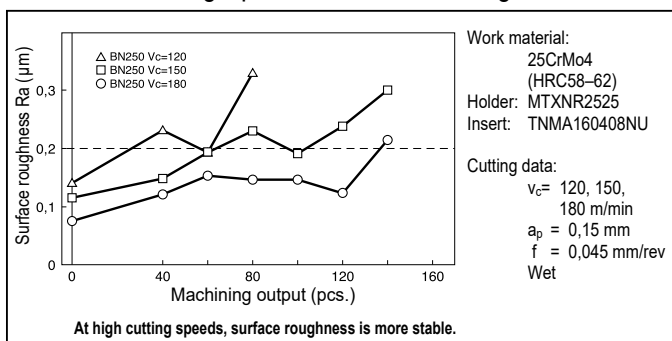
## Relation between Flank Wear and Cutting Force



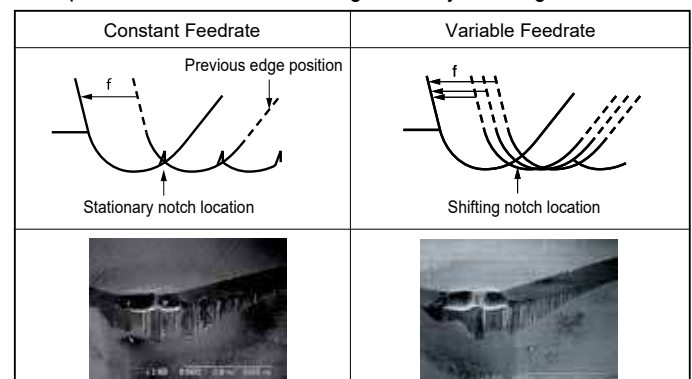
## Workpiece Hardness on Cutting Force and Accuracy



## Relation Cutting Speed and Surface Roughness

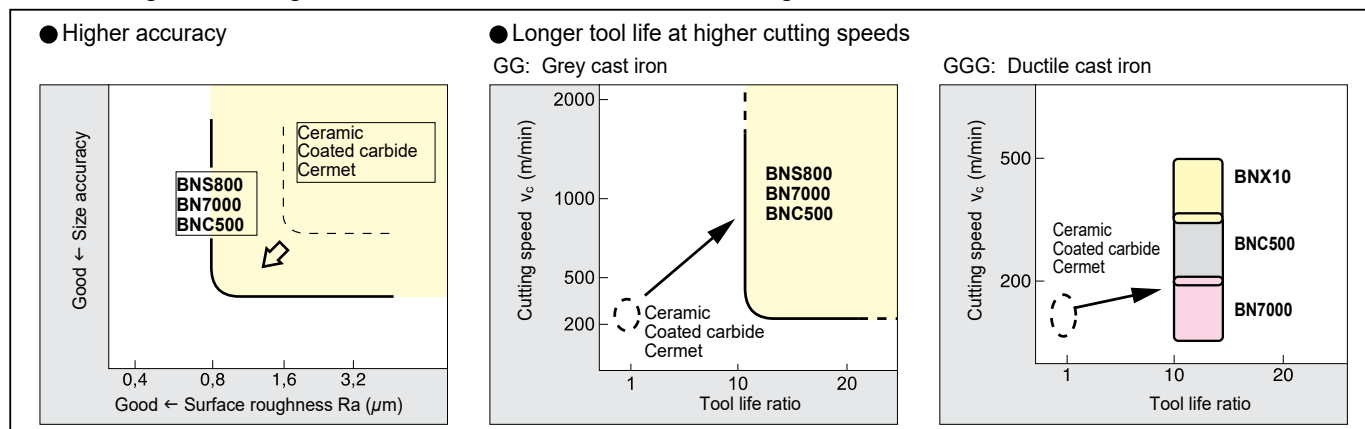


## Improvement of Surface Roughness by Altering the Feedrate

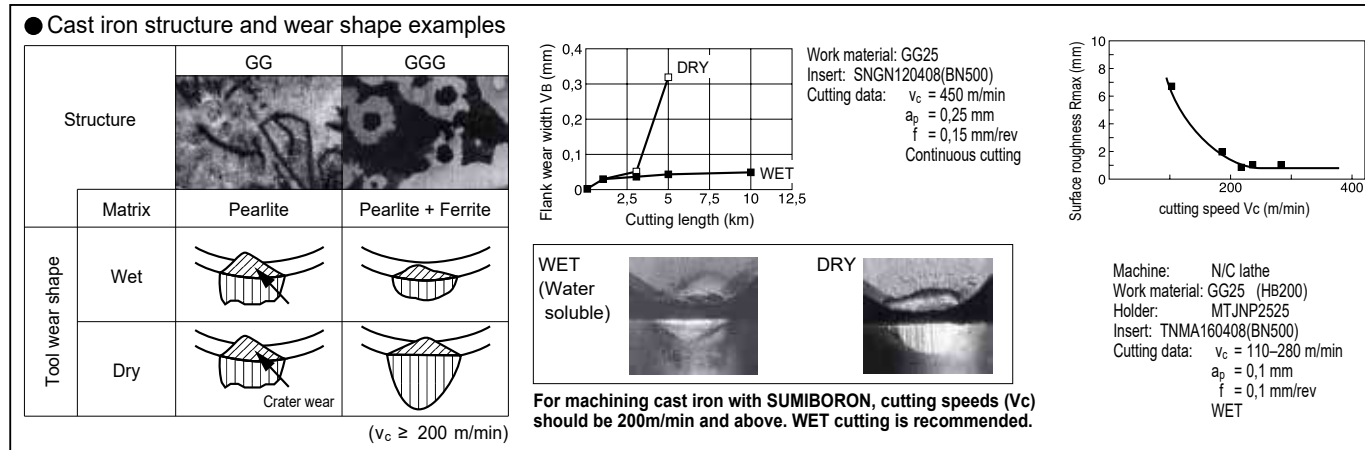


Varying the feedrate spreads the notch location over a larger area, surface finish improves and notch wear decreases.

### Advantages of Using SUMIBORON for Cast Iron Machining



### Turning

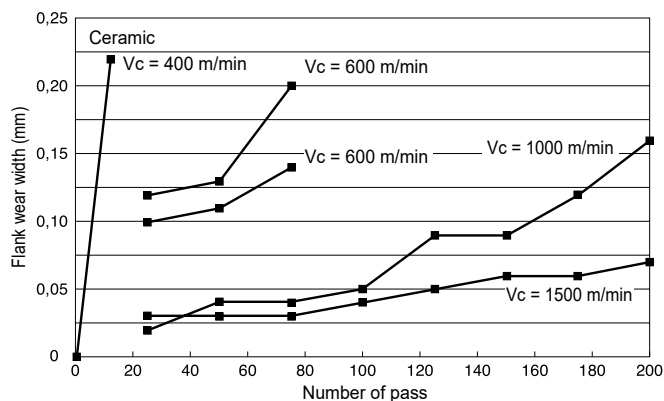


### Milling

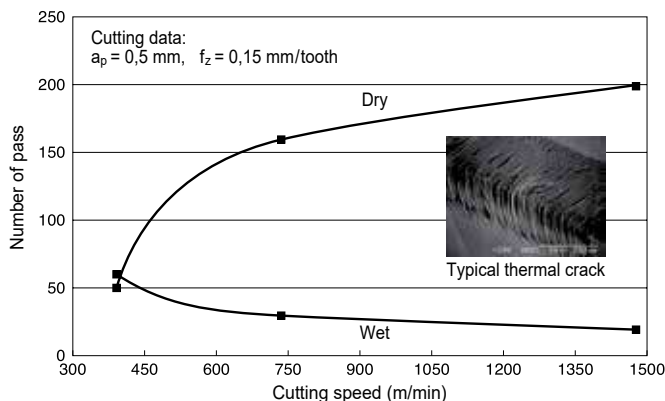
#### SUMIBORON BN Finish Mill EASY



- High speed machining  $V_c = 2000$  m/min
- Surface Roughness  $R_z = 3,2$  ( $R_a = 1,0$ )
- Running cost is reduced because of economical insert
- Easy insert setting with the aid of a setting gauge
- Safe, anti-centrifugal force construction for high speed conditions

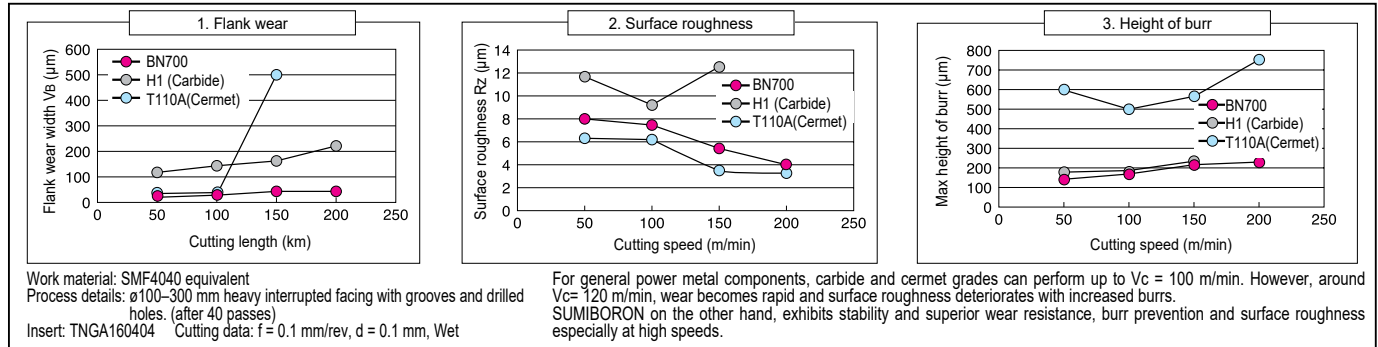


Work material: GG25  
Tool material: BN700  
Cutting data:  $a_p = 0,5$  mm,  $f_z = 0,1$  mm/tooth, DRY



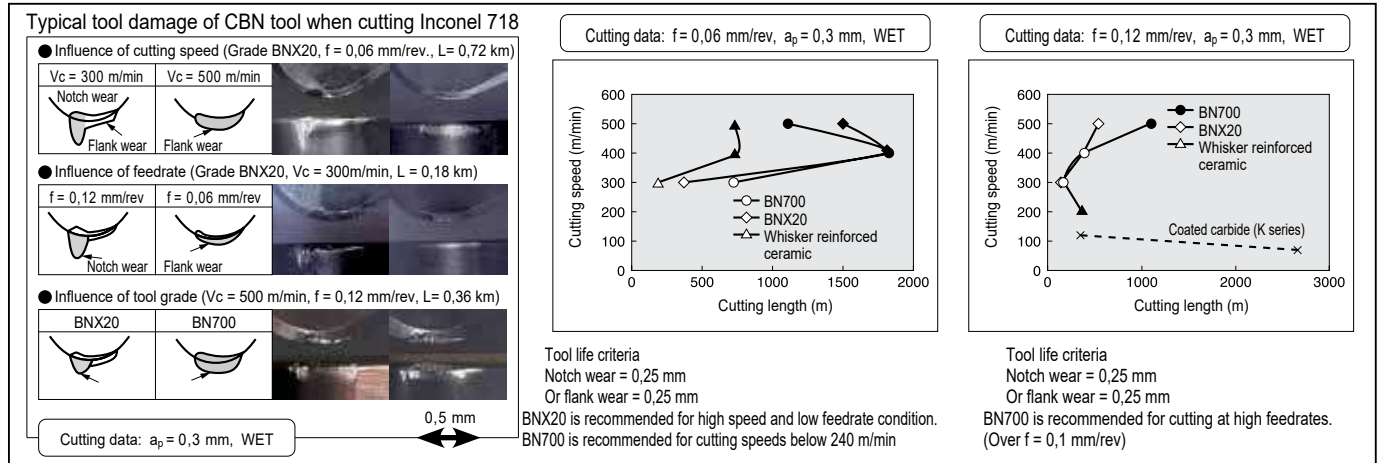
Dry cutting is recommended for high speed milling of cast iron with SUMIBORON.

## Powder Metal

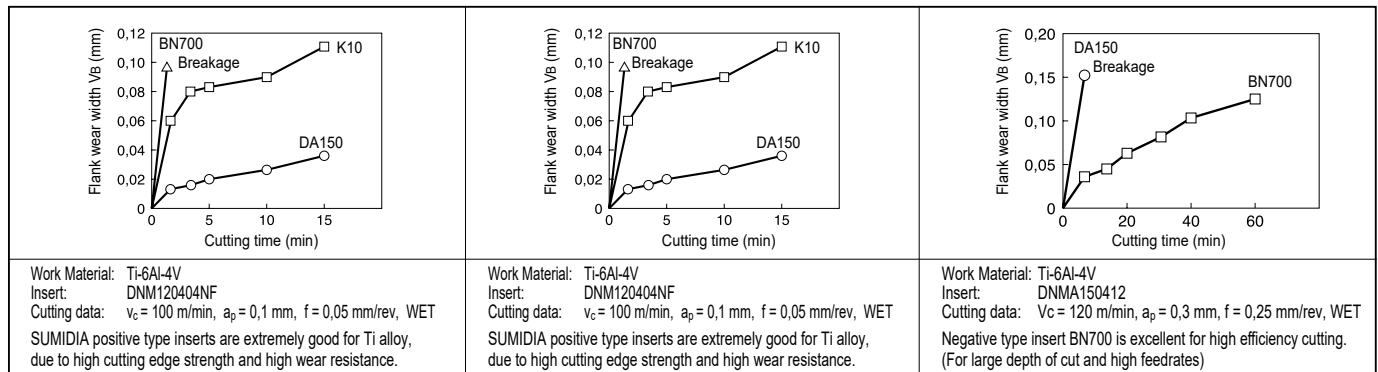


## Heat Resistant Alloy

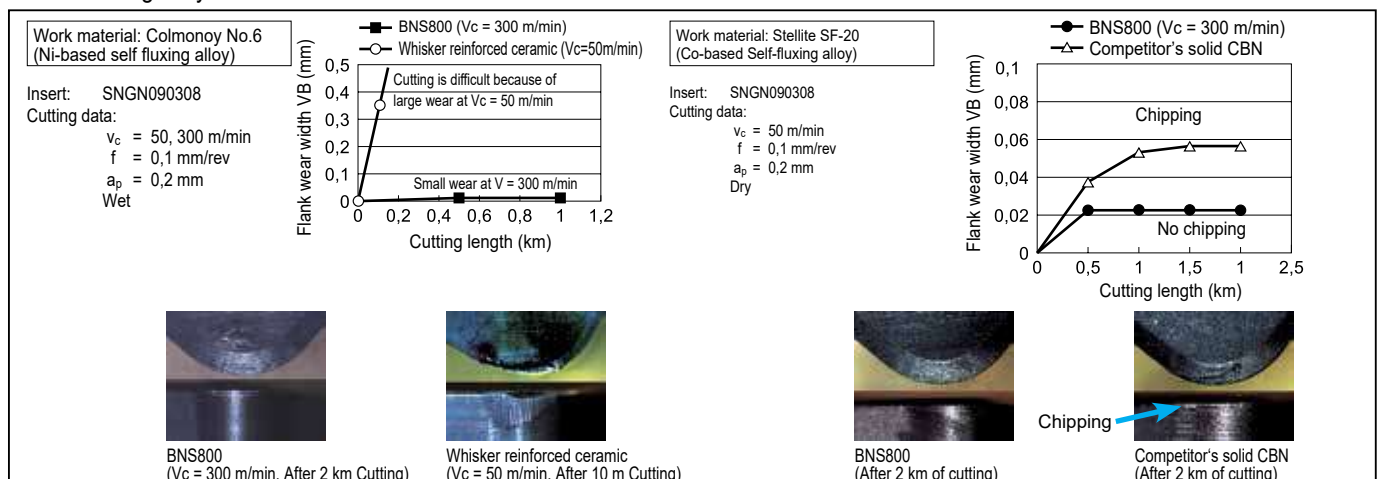
### Ni based alloy



### Ti based alloy



### Hard facing alloys





| Damage                                                                                                                | Remedies                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Large flank wear</p>              | <p>Tool material</p> <p>Tool design</p> <p>Cutting condition</p> | <ul style="list-style-type: none"> <li>- Select a more wear resistant grade.</li> <li>- Reduce the cutting force.</li> <li>- Reduce the NL width and angle.</li> <li>- Positive inserts preferred</li> <li>- Check the cutting speed.</li> <li>- Reduce the cutting speed to less than 200 m/min.</li> <li>- Higher feed rate reduces the overall tool-to-work contact time.</li> </ul>                                                                                                            |
| <p>Large crater wear</p>             | <p>Tool material</p> <p>Tool design</p>                          | <ul style="list-style-type: none"> <li>- Crater wear resistant grades are recommended.</li> <li>- Continuous ~ Light interrupted cutting = BNC2010</li> <li>- Light ~ Medium interrupted cutting = BNX20</li> <li>- Medium ~ Heavy interrupted cutting = BNX25</li> <li>- Determine the cutting edge geometry after inspecting the used inserts closely.</li> <li>- Sharpen the cutting edge to prevent crater wear.</li> <li>- Strengthen the cutting edge to prevent crater breakage.</li> </ul> |
| <p>Breakage at bottom of crater</p>  | <p>Cutting condition</p>                                         | <ul style="list-style-type: none"> <li>- Check the cutting speed.</li> <li>- Reduce the cutting speed to less than 200 m/min.</li> <li>- Higher feed rates are recommended.</li> </ul>                                                                                                                                                                                                                                                                                                             |
| <p>Flaking</p>                     | <p>Tool material</p> <p>Tool design</p> <p>Cutting condition</p> | <ul style="list-style-type: none"> <li>- Flaking is caused by high back forces and back force is related to flank wear.</li> <li>- Select a more wear resistant grade.</li> <li>- A sharper cutting edge helps prevent flaking.</li> <li>- Reduce the NL angle and width</li> <li>- Positive inserts preferred</li> <li>- Reduce flank wear with lower speed and higher feed rates.</li> <li>- Reducing tool-to-work contact time effectively reduces flank wear.</li> </ul>                       |
| <p>Chipping at notch position</p>  | <p>Cutting condition</p>                                         | <ul style="list-style-type: none"> <li>- If surface finish is affected, consider using the "Variable Feed rate" method to improve finishing.</li> <li>- For other cases, use remedies similar to that for normal wear.</li> </ul>                                                                                                                                                                                                                                                                  |
| <p>Chipping at notch position</p>  | <p>Tool material</p> <p>Tool design</p> <p>Cutting condition</p> | <ul style="list-style-type: none"> <li>- Caused by impact shocks to the cutting edge.</li> <li>- Chattering may also be a contributing factor.</li> <li>- Select a tougher grade.</li> <li>- Strengthen the cutting edge.</li> <li>- Large NL angle, Honing.</li> <li>- Higher feed rates are recommended to lessen the number of impacts.</li> </ul>                                                                                                                                              |
| <p>Chipping at nose position</p>   | <p>Tool material</p> <p>Tool design</p> <p>Cutting condition</p> | <ul style="list-style-type: none"> <li>- Caused by impact shocks to the cutting edge.</li> <li>- Chattering may also be a contributing factor.</li> <li>- Select a tougher grade.</li> <li>- Strengthen the cutting edge.</li> <li>- Large NL angle, Honing.</li> <li>- Higher feedrates are recommended to lessen the number of impacts.</li> </ul>                                                                                                                                               |
| <p>Thermal crack</p>               | <p>Cutting condition</p> <p>Tool design</p> <p>Tool material</p> | <ul style="list-style-type: none"> <li>- Thermal shocks generate vertical crack lines across the cutting edge.</li> <li>- Completely dry condition is recommended.</li> <li>- If dry condition machining is already observed, then reduction of cutting temperatures and cutting force is necessary.</li> <li>- Decrease cutting speed, feedrate, depth of cut.</li> <li>- Sharpen cutting edge.</li> <li>- Select more thermal conductivity grade.</li> </ul>                                     |



## ■ Steel and Non-Ferrous Metal Symbols Chart

### ● Carbon Steels

| JIS  | AISI | DIN |
|------|------|-----|
| S10C | 1010 | C10 |
| S15C | 1015 | C15 |
| S20C | 1020 | C22 |
| S25C | 1025 | C25 |
| S30C | 1030 | C30 |
| S35C | 1035 | C35 |
| S40C | 1040 | C40 |
| S45C | 1045 | C45 |
| S50C | 1049 | C50 |
| S55C | 1055 | C55 |

### ● Ni-Cr-Mo Steels

|        |      |           |
|--------|------|-----------|
| SNM220 | 8620 | 21NiCrMo2 |
| SNM240 | 8640 | —         |
| SNM415 | —    | —         |
| SNM420 | 4320 | —         |
| SNM439 | 4340 | 40NiCrMo6 |
| SNM447 | —    | 34NiCrMo6 |

### ● Cr Steels

|        |      |         |
|--------|------|---------|
| SCr415 | —    | 15CrMo5 |
| SCr420 | 5120 | 20Cr4   |
| SCr430 | 5130 | 34Cr4   |
| SCr435 | 5132 | 37Cr4   |
| SCr440 | 5140 | 41Cr4   |
| SCr445 | 5147 | —       |

### ● Cr-Mo Steels

|        |      |         |
|--------|------|---------|
| SCM415 | —    | 15CrMo5 |
| SCM420 | —    | 20CrMo5 |
| SCM430 | 4131 | 25CrMo4 |
| SCM435 | 4137 | 34CrMo4 |
| SCM440 | 4140 | 42CrMo4 |
| SCM445 | 4145 | —       |

### ● Mn Steels and Mn-Cr Steels for Structural Use

|         |      |   |
|---------|------|---|
| SMn420  | 1522 | — |
| SMn433  | 1534 | — |
| SMn438  | 1541 | — |
| SMn443  | 1541 | — |
| SMnC420 | —    | — |
| SMnC443 | —    | — |

### ● Cr-Mo Steels

|     |           |        |
|-----|-----------|--------|
| SK1 | —         | —      |
| SK2 | W1-11 1/2 | —      |
| SK3 | W1-10     | C105W1 |
| SK4 | W1-9      | —      |
| SK5 | W1-8      | C80W1  |
| SK6 | —         | C80W1  |
| SK7 | —         | C70W2  |

### ● High Speed Steels

| JIS   | AISI | DIN       |
|-------|------|-----------|
| SKH2  | T1   | —         |
| SKH3  | T4   | S18-1-2-5 |
| SKH10 | T15  | S12-1-4-5 |
| SKH51 | M2   | S6-5-2    |
| SKH52 | M3-1 | —         |
| SKH53 | M3-2 | S6-5-3    |
| SKH54 | M4   | —         |
| SKH56 | M36  | —         |

### ● Alloy Tool Steels

|       |          |               |
|-------|----------|---------------|
| SKS11 | F2       | —             |
| SKS51 | L6       | —             |
| SKS43 | W2-9 1/2 | —             |
| SKD1  | D3       | X210Cr12      |
| SKD11 | D2       | X155CrVMo12-1 |
| SKD61 | —        | X40CrVMo5-1   |

### ● Grey Cast Iron

|       |        |       |
|-------|--------|-------|
| FC100 | No 20B | GG-10 |
| FC150 | No 25B | GG-15 |
| FC200 | No 30B | GG-20 |
| FC250 | No 35B | GG-25 |
| FC300 | No 45B | GG-30 |
| FC350 | No 50B | GG-35 |

### ● Nodular Cast Iron

|        |           |          |
|--------|-----------|----------|
| FCD400 | 60-40-18  | GGG-40   |
| FCD450 | —         | GGG-40.3 |
| FCD500 | 80-55-06  | GGG-50   |
| FCD600 | —         | GGG-60   |
| FCD700 | 100-70-03 | GGG-70   |

### ● Ferritic Stainless Steels

|         |      |            |
|---------|------|------------|
| SUS405  | 405  | X10CrAl13  |
| SUS429  | 429  | —          |
| SUS430  | 430  | X6Cr17     |
| SUS430F | 430F | X7CrMo18   |
| SUS434  | 434  | X6CrMo17 1 |

### ● Martensitic Stainless Steels

|          |      |             |
|----------|------|-------------|
| SUS403   | 403  | —           |
| SUS410   | 410  | X10Cr13     |
| SUS416   | 416  | —           |
| SUS420J1 | 420  | X20Cr13     |
| SUS420F  | 420F | —           |
| SUS431   | 431  | X20CrNi17 2 |
| SUS440A  | 440A | —           |
| SUS440B  | 440B | —           |
| SUS440C  | 440C | —           |

### ● Austenitic Stainless Steels

| JIS      | AISI  | DIN             |
|----------|-------|-----------------|
| SUS201   | 201   | —               |
| SUS202   | 202   | —               |
| SUS301   | 301   | X12CrNi17 7     |
| SUS302   | 302   | —               |
| SUS302B  | 302B  | —               |
| SUS303   | 303   | X10CrNiS18 9    |
| SUS303Se | 303Se | —               |
| SUS304   | 304   | X5CrNiS18 10    |
| SUS304L  | 304L  | X2CrNi19 11     |
| SUS304NI | 304N  | —               |
| SUS305   | 305   | X5CrNi18 12     |
| SUS308   | 308   | —               |
| SUS309S  | 309S  | —               |
| SUS310S  | 310S  | —               |
| SUS316   | 316   | X5CrMo17 12 2   |
| SUS316L  | 316L  | X2CrNiMo17 13 2 |
| SUS316N  | 316N  | —               |
| SUS317   | 317   | —               |
| SUS317L  | 317L  | X2CrNiMo18 16 4 |
| SUS321   | 321   | X6CrNiTi18 10   |
| SUS347   | 347   | X6CrNiNb18 10   |
| SUS384   | 384   | —               |

### ● Heat Resisting Steels

|        |        |               |
|--------|--------|---------------|
| SUH31  | —      | —             |
| SUH35  | —      | —             |
| SUH36  | —      | X53CrMnNi21 9 |
| SUH37  | —      | —             |
| SUH38  | —      | —             |
| SUH309 | 309    | —             |
| SUH310 | 310    | CrNi2520      |
| SUH330 | N08330 | —             |

### ● Ferritic Heat Resisting Steels

|        |     |          |
|--------|-----|----------|
| SUH21  | —   | CrAl1205 |
| SUH409 | 409 | X6CrTi12 |
| SUH446 | 446 | —        |

### ● Martensitic Heat Resisting Steels

|        |   |            |
|--------|---|------------|
| SUH1   | — | X45CrSi9 3 |
| SUH3   | — | —          |
| SUH4   | — | —          |
| SUH11  | — | —          |
| SUH600 | — | —          |

Steel and Non-Ferrous Metal Symbols Chart

Carbon Steel for Structural Use

| JIS   | AISI/ASTM     | DIN/EN                                  | GB         | BS                         | AFNOR            | ГОСТ     |
|-------|---------------|-----------------------------------------|------------|----------------------------|------------------|----------|
| S10C  | 1008<br>1010  | C10E<br>C10R<br>1.1122                  | 08<br>10   | 040A10<br>045A10<br>045M10 | XC10             | 08<br>10 |
| S12C  | 1012          | —                                       | —          | 040A12                     | XC12             | —        |
| S15C  | 1015          | C15E<br>C15R<br>1.1132                  | 15         | 055M15                     | —                | 15       |
| S20C  | 1020          | C22<br>CK22                             | 20         | 070M20                     | —                | 20       |
| S25C  | 1025          | C25<br>C25E<br>C25R<br>C16D<br>1.0415   | 25         | —                          | —                | 25       |
| S30C  | 1030          | C30<br>C30E<br>C30R                     | 30         | 080A30<br>080M30           | —                | 30       |
| S35C  | 1035          | C35<br>C35E<br>C35R<br>1.1172           | 35         | 080A35<br>080M36           | —                | 35       |
| S40C  | 1040<br>C40E  | C40<br>C40E<br>C40R<br>1.1186           | 40         | 060A40<br>080A40<br>080M40 | —                | 40       |
| S43C  | 1042<br>1043  | —                                       | —          | 080A42                     | XC42H1<br>XC42H2 | 40Г      |
| S45C  | 1045<br>1045H | C45<br>C45E<br>C45R<br>1.1191<br>1.1192 | 45         | 060A45<br>080M46           | XC45             | 45       |
| S50C  | 1049          | C50<br>C50E<br>C50R<br>1.1206           | 50         | 080M50                     | XC50             | 50       |
| S53C  | 1050<br>1053  | —                                       | 50Mn       | 080A52                     | XC54             | —        |
| S55C  | 1055          | C55<br>C55E<br>C55R<br>1.1203           | 55         | 070M55                     | XC55H1<br>XC55H2 | 55       |
| S58C  | 1060          | C60<br>C60E<br>C60R                     | 60         | 060A57<br>080A57           | XC60             | —        |
| S60C  | 1059          | C60E<br>1.1221                          | 60<br>60Mn | —                          | —                | 60       |
| S09CK | 1010          | C10E<br>C10R                            | —          | 045A10<br>045M10           | XC10             | —        |
| S15CK | 1015          | C15E<br>C15R                            | —          | —                          | XC12             | —        |
| S20CK | —             | CK22                                    | —          | —                          | XC18             | —        |

Cr-Mo Steel

| JIS    | AISI/ASTM    | DIN/EN                         | GB            | BS                                             | AFNOR                   | ГОСТ  |
|--------|--------------|--------------------------------|---------------|------------------------------------------------|-------------------------|-------|
| SCM415 | —            | 18CrMo4<br>1.7243              | 15CrMo        | —                                              | —                       | 15XM  |
| SCM420 | —            | 20MoCr4<br>1.7321              | 20CrMo        | 708M20                                         | —                       | 20XM  |
| SCM421 | 4121         | 18CrMo4<br>22CrMoS35<br>1.7243 | 20CrMn-<br>Mo | —                                              | —                       | 25XГМ |
| SCM425 | —            | 25CrMo<br>1.7218               | 25CrMo        | —                                              | —                       | —     |
| SCM430 | 4130         | —                              | 30CrMo        | 708A30                                         | 30CD4                   | 30XM  |
| SCM435 | 4135<br>4137 | 34CrMo4<br>1.7220              | 35CrMo        | 708A37<br>709A37                               | 34CD4<br>38CD4<br>35CD4 | 35XM  |
| SCM440 | 4142<br>4140 | 42CrMo4<br>42CrMoS4<br>1.7225  | 42CrMo        | 708M40<br>708A40<br>708A42<br>709A42<br>709M40 | 42CD4                   | 38XM  |
| SCM445 | 4145<br>4150 | 50CrMo4<br>1.7228              | 50CrMo        | 708A47                                         | —                       | —     |

Manganese Chromium Steel/Manganese Steel

|         |                      |                   |                |                  |      |              |
|---------|----------------------|-------------------|----------------|------------------|------|--------------|
| SMn420  | 1522<br>1524         | 18Mn5<br>1.0436   | 20Mn2          | 150M19<br>120M19 | 20M5 | 20Г          |
| SMn433  | 1330                 | 28Mn6<br>1.1170   | 30Mn2          | —                | —    | 30Г2         |
| SMn438  | 1335<br>1541         | —                 | 35Mn2          | 150M36           | 40M6 | 35Г2         |
| SMn443  | 1340<br>1345<br>1541 | —                 | 40Mn2<br>45Mn2 | 135M40<br>150M36 | 35M5 | 35Г2<br>45Г2 |
| SMnC420 | 5120                 | 20MnCr5<br>1.7147 | 20CrMn         | —                | —    | 18ХГ         |
| SMnC443 | 5140                 | 41Cr4<br>1.7035   | 40CrMn         | —                | —    | —            |

Carbon Tool Steel

|              |                    |                           |      |      |                                        |     |
|--------------|--------------------|---------------------------|------|------|----------------------------------------|-----|
| SK140<br>SK1 | W2-13A<br>W1-13    | —                         | T13  | —    | Y <sub>2</sub> 140                     | —   |
| SK120<br>SK2 | W1-11 1/2          | C120U<br>1.1555           | T12  | BW1C | Y <sub>2</sub> 120                     | y12 |
| SK105<br>SK3 | W1-10<br>W1-10 1/2 | C105U<br>1.1545<br>C105W1 | T11  | BW1B | Y <sub>1</sub> 105                     | —   |
| SK95<br>SK4  | W1-9<br>W1-9 1/2   | C105U<br>1.1545           | T10  | BW1A | Y <sub>1</sub> 90<br>Y <sub>1</sub> 80 | y10 |
| SK85<br>SK5  | W1-8C<br>W1-8      | C80W1                     | T8Mn | BW1A | —                                      | y8Г |
| SK80         | W1-8A              | C80U<br>1.1525            | T8   | —    | —                                      | y8  |
| SK70         | 1070               | C70U<br>1.1520            | T7   | —    | —                                      | y7  |

## P Cr Steel

| JIS    | AISI/ASTM    | DIN/EN                    | GB   | BS               | AFNOR | ГОСТ |
|--------|--------------|---------------------------|------|------------------|-------|------|
| SCr415 | 5115         | 17Cr3<br>1.7016           | 15Cr | —                | —     | 15X  |
| SCr420 | 5120         | —                         | 20Cr | —                | 20MC5 | 20X  |
| SCr430 | 5130<br>5132 | 34Cr4<br>34CrS4<br>1.7033 | 30Cr | 530A30<br>530A32 | 32C4  | 30X  |
| SCr435 | 5135         | 37Cr4<br>1.7034           | 35Cr | 530A36           | 38C4  | 35X  |
| SCr440 | 5140         | 41Cr4<br>41CrS4<br>1.7035 | 40Cr | 530M40<br>530A40 | 42C4  | 40X  |
| SCr445 | 5147         | —                         | 45Cr | —                | —     | 45X  |

## P Nickel Chromium Steel

|        |              |                                                                     |                               |   |   |              |
|--------|--------------|---------------------------------------------------------------------|-------------------------------|---|---|--------------|
| SNC415 | 4720<br>4715 | 20NiCrMo2-2<br>10NiCr5-4<br>17CrNi6-6<br>1.5918<br>1.5805<br>1.6523 | 20CrNi<br>12CrNi2<br>15CrNi6K | — | — | 20XH<br>12XH |
| SNC236 | 3140<br>4337 | 41CrCrMo7-3-2<br>34CrNiMo6                                          | 40CrNi<br>34CrNi2             | — | — | 40XH         |
| SNC246 | 8645         | —                                                                   | 45CrNi                        | — | — | 45XH         |
| SNC815 | E3310        | 15NiCr13<br>1.5752                                                  | 12CrNi3                       | — | — | 12XH3A       |
| SNC620 | —            | 20NiCrMo13-4<br>1.6660                                              | 20CrNi3                       | — | — | 20XH3A       |
| SNC631 | —            | 30NiCrMo16-6<br>1.6747                                              | 30CrNi3                       | — | — | 30XH3A       |
| SNC836 | —            | 35NiCrMo16<br>1.6773                                                | 37CrNi3                       | — | — | —            |

## P Ni-Cr-Mo Steel

|         |                                      |                                                              |                                     |                                      |         |                    |
|---------|--------------------------------------|--------------------------------------------------------------|-------------------------------------|--------------------------------------|---------|--------------------|
| SNCM220 | 8615<br>8617<br>8620<br>8622<br>4718 | 20NiCrMo2-2<br>20NiCrMoS2-2<br>17NiCrMo6<br>1.6566<br>1.6523 | 20CrNiMo<br>18CrMnNiMo<br>20NiCrMoK | 805A20<br>805M20<br>805A22<br>805M22 | 20NCD 2 | 20XH2M<br>18XHfM   |
| SNCM240 | 8637<br>8640                         | 39NiCrMo3<br>1.6510                                          | 40CrNiMo                            | —                                    | —       | 40XH2MA            |
| SNCM415 | —                                    | —                                                            | —                                   | —                                    | —       | —                  |
| SNCM420 | 4320                                 | 17NiCrMo6-4                                                  | 20CrNi2Mo                           | —                                    | —       | 20XH2M<br>(20XHfM) |
| SNCM439 | 4340                                 | 41NiCrMo7-3-2<br>1.6563                                      | 40CrNi2Mo                           | —                                    | —       | 40XH2MA            |
| SNCM447 | 4340                                 | 41NiCrMo7-3-2<br>1.6563                                      | 45CrNiMoV                           | —                                    | —       | —                  |

## P High Speed Steel

| JIS   | AISI/ASTM  | DIN/EN                          | GB              | BS   | AFNOR                       | ГОСТ    |
|-------|------------|---------------------------------|-----------------|------|-----------------------------|---------|
| SKH2  | T1         | HS18-0-1<br>1.3355              | W18Cr4V         | BT1  | Z80WCV<br>18-04-01          | P18     |
| SKH3  | T4         | S18-1-2-5                       | —               | BT4  | Z80WKC<br>18-05-04-01       | —       |
| SKH4  | T5         | —                               | —               | BT5  | Z80WKC<br>18-10-04-02       | —       |
| SKH10 | T15        | S12-1-4-5                       | W12Cr4V5Co5     | BT15 | Z160WKC<br>12-05-05-04      | P12K5V5 |
| SKH51 | M2         | S6-5-2<br>1.3339                | W6Mo5Cr4V2      | BM2  | Z160WDCV<br>06-05-04-02     | P6M5ø2  |
| SKH52 | M3-1       | HS6-6-2<br>1.3350               | W6Mo6Cr4V2      | —    | —                           | —       |
| SKH53 | M3-2       | S6-5-3<br>HS6-5-3<br>1.3344     | W6Mo5Cr4V3      | —    | Z160WDCV<br>06-05-04-03     | P6M5ø3  |
| SKH54 | M4         | —                               | W6Mo5Cr4V4      | BM4  | Z130WDCV<br>06-05-04-04     | —       |
| SKH55 | M35<br>M41 | S6-5-2-5<br>HS6-5-2-5<br>1.3243 | W6Mo5Cr4V2Co5   | BM35 | Z190WDCV<br>06-05-05-04-02  | P6M5K5  |
| SKH56 | M36        | —                               | —               | —    | —                           | —       |
| SKH57 | M48        | HS10-4-3-10<br>1.3207           | W10Mo4Cr4V3Co10 | —    | Z130WKCDV<br>10-10-04-04-03 | —       |
| SKH58 | M7         | HS2-8-2<br>1.3348               | W2Mo9Cr4V2      | —    | Z100DCWV<br>09-04-02-02     | —       |
| SKH59 | M42        | HS2-10-1-8<br>1.3247            | W2Mo9Cr4VCo8    | BM42 | Z130DKCWV<br>09-08-04-02-01 | P2M9K8ø |

## P Alloy Tool Steel

|       |          |                            |             |      |             |         |
|-------|----------|----------------------------|-------------|------|-------------|---------|
| SKS11 | F2       | —                          | —           | —    | —           | —       |
| SKS2  | —        | 105WCr6                    | —           | —    | 105WC13     | —       |
| SKS51 | L6       | —                          | —           | —    | —           | —       |
| SKS41 | —        | —                          | 4CrW2Si     | —    | —           | 4XB2C   |
| SKS43 | W2-9 1/2 | —                          | —           | BW2  | Y1105V      | —       |
| SKS44 | W2-8 1/2 | —                          | —           | —    | —           | —       |
| SKS3  | O1       | 95MnWCr5<br>1.2825         | 9CrWMn      | —    | —           | 9XBf    |
| SKS31 | O7       | 105WCr6                    | CrWMn       | —    | 105WC31     | XBf     |
| SKD1  | D3       | X210Cr12<br>1.2080         | Cr12        | BD3  | X200Cr12    | X12     |
| SKD4  | —        | —                          | 30W4Cr2V    | BH21 | Z32WCV5     | —       |
| SKD5  | H21      | X30WCrV9-3<br>1.2581       | 3Cr2W8V     | BH21 | Z30WCV9     | 3X2B8ø  |
| SKD6  | H11      | X37CrMoV5-1<br>1.2343      | 4Cr5MoSiV   | BH11 | X38CrMoV5   | 4X5MøC  |
| SKD61 | H13      | X40CrMoV5-1<br>1.2344      | 4Cr5MoSiV1  | BH13 | Z40CDV5     | 4X5Mø1C |
| SKD7  | H10      | X32CrMoV33<br>1.2365       | 3Cr3Mo3V    | BH10 | 32DCV28     | —       |
| SKD8  | H19      | 38CrCoWV18-17-17<br>1.2661 | 3Cr3Mo3VCo3 | BH19 | —           | —       |
| SKD10 | D2       | X153CrMoV12<br>1.2379      | Cr12Mo1V1   | —    | —           | X12M1ø1 |
| SKD11 | D2<br>D4 | —                          | Cr12MoV     | BD2  | X160CrMoV12 | X12Mø   |
| SKD12 | A2       | X100CrMoV5<br>1.2363       | Cr5Mo1V     | BA2  | Z100CDV5    | —       |

Steel and Non-Ferrous Metal Symbols Chart

Ferritic Stainless Steels

| JIS     | AISI/ASTM      | DIN/EN               | GB                             | BS     | AFNOR     | ГОСТ  |
|---------|----------------|----------------------|--------------------------------|--------|-----------|-------|
| SUS405  | 405<br>S40500  | X10CrAl13<br>1.4002  | 0Cr13Al<br>06Cr13Al            | 405S17 | 26CA13    | —     |
| SUS429  | 429<br>S42900  | —                    | 1Cr15<br>10Cr15<br>022Cr15NbTi | —      | —         | —     |
| SUS430  | 430<br>S43000  | X6Cr17<br>1.4016     | 1Cr17<br>10Cr15<br>S11710      | 430S17 | Z8C17     | 12X17 |
| SUS430F | 430F<br>S43020 | X12CrMoS17           | Y1Cr17<br>Y10Cr17              | —      | Z10CF17   | —     |
| SUS434  | 434<br>S43400  | X6CrMo17-1<br>1.4113 | 1Cr17Mo<br>10Cr17Mo            | 434S17 | Z8CD17.01 | —     |

Martensitic Stainless Steels

|          |                |                        |                             |        |          |       |
|----------|----------------|------------------------|-----------------------------|--------|----------|-------|
| SUS410   | 410<br>S41010  | X10Cr13<br>1.4006      | 12Cr13<br>1Cr13             | 410S21 | Z13C13   | 12X13 |
| SUS403   | 403<br>S40300  | —                      | 12Cr12<br>1Cr12             | —      | —        | —     |
| SUS444   | 444<br>S44400  | X2CrMoTi18-2<br>1.4521 | 019Cr19Mo2NbTi<br>00Cr18Mo2 | —      | —        | —     |
| SUS416   | 416<br>S41600  | X12CrS13<br>1.4005     | Y12Cr13<br>Y1Cr13           | 416S21 | Z12CF13  | —     |
| SUS420J1 | 420<br>S42000  | X20Cr13<br>1.4021      | 20Cr13<br>2Cr13             | 420S29 | Z20C13   | 20X13 |
| SUS420J2 | 420<br>S42000  | X30Cr13<br>1.4028      | 30Cr13<br>3Cr13             | 420S45 | Z30C13   | 30X13 |
| SUS420F  | 420G<br>S42020 | X29Cr13<br>1.4029      | Y30Cr13<br>Y3Cr13           | —      | Z30CF13  | —     |
| SUS431   | 431<br>S43100  | X17CrNi16-2            | 17Cr16Ni2                   | 431S29 | —        | —     |
| SUS440C  | 440C<br>S44004 | —                      | 108Cr17<br>11Cr17           | —      | Z100CD17 | —     |

Stainless Steel (Precipitation Hardened Structure)

|        |               |                          |                                 |   |            |            |
|--------|---------------|--------------------------|---------------------------------|---|------------|------------|
| SUS630 | 630<br>S17400 | X5CrNiCuNb16-4<br>1.4542 | 0Cr17Ni4Cu4Nb<br>05Cr17Ni4Cu4Nb | — | Z6CNU17.04 | —          |
| SUS631 | 631<br>S17700 | X7CrNiAl17-7<br>1.4568   | 0Cr17Ni7Al<br>07Cr17Ni7Al       | — | Z8CNA17.07 | 09X17H7 IO |

Austenitic Stainless Steels

| JIS      | AISI/ASTM       | DIN/EN                               | GB                              | BS     | AFNOR         | ГОСТ       |
|----------|-----------------|--------------------------------------|---------------------------------|--------|---------------|------------|
| SUS201   | 201<br>S20100   | X12CrMnNiN17-7-5<br>1.4372           | 1Cr17Mn6Ni5N<br>12Cr17Mn6Ni5N   | —      | Z12CMN17-07Az | —          |
| SUS202   | 202<br>S20200   | X12CrMnNiN18-9-5<br>1.4373           | 1Cr18Mn9Ni5N<br>12Cr18Mn9Ni5N   | 284S16 | —             | —          |
| SUS301   | 301<br>S30100   | X12CrNi17 7<br>1.4319<br>1.4310      | 1Cr17Ni7<br>12Cr17Ni7           | —      | Z12CN17.07    | 17X18H9    |
| SUS302   | 302<br>S30200   | X9CrNi18-9<br>1.4325                 | 1Cr18Ni9<br>12Cr18Ni9           | 302S25 | Z10CN18.09    | 12X18H9    |
| SUS302B  | 302B<br>S30215  | —                                    | 1Cr18Ni9Si3<br>12Cr18Ni9Si3     | —      | —             | —          |
| SUS303   | 303<br>S30300   | X8CrNiS18-9<br>X10CrNiS189<br>1.4305 | Y1Cr18Ni9<br>Y12Cr18Ni9         | 303S21 | Z10CNF18.09   | —          |
| SUS303Se | 303Se<br>S30323 | —                                    | Y12Cr18Ni9Se<br>Y1Cr18Ni9Se     | 303S41 | —             | 12X18H10E  |
| SUS304   | 304<br>S30400   | X5CrNi18-10<br>1.4301                | 0Cr18Ni9<br>06Cr19Ni10          | 304S31 | Z6CN18.09     | 08X18H10   |
| SUS304L  | 304L<br>S30403  | X2CrNi19-11<br>1.4306                | 00Cr19Ni10<br>022Cr19Ni10       | 304S11 | Z2CN18.10     | 03X18H11   |
| SUS304N1 | 304N<br>S30451  | X5CrNiN19-9<br>1.4315                | 06Cr19Ni10N<br>06Cr19Ni10NbN    | —      | Z6CN19-09Az   | —          |
| SUS305   | 305<br>S30500   | X2CrNiN18-10<br>1.4311               | 1Cr18Ni12<br>10Cr18Ni12         | 305S19 | Z8CN18.12     | —          |
| SUS309S  | 309S<br>S30908  | X6CrNi23-13<br>1.4950                | 0Cr23Ni13<br>06Cr23Ni13         | —      | —             | 0X23H12    |
| SUS310S  | 310S<br>S31008  | X6CrNi25-20<br>1.4951                | 0Cr25Ni20<br>06Cr25Ni20         | —      | —             | 08X23H20   |
| SUS316   | 316<br>S31600   | X5CrNiMo17-12-2<br>1.4401            | 0Cr17Ni12Mo2<br>06Cr17Ni12Mo2   | 316S31 | Z7CND17.12    | —          |
| SUS316L  | 316L<br>S31603  | X2CrNiMo17-12-2<br>1.4404            | 00Cr17Ni12Mo2<br>022Cr17Ni12Mo2 | 316S11 | Z2CND17.12    | 03X17H14M2 |
| SUS316N  | 316N<br>S31651  | —                                    | 0Cr17Ni12Mo2N<br>06Cr17Ni12Mo2N | —      | —             | —          |
| SUS317   | 317<br>S31700   | —                                    | 0Cr19Ni13Mo3<br>06Cr19Ni13Mo3   | 317S16 | —             | —          |
| SUS317L  | 317L<br>S31703  | X2CrNiMo18-15-4<br>1.4438            | 00Cr19Ni13Mo3<br>022Cr19Ni13Mo3 | 317S12 | Z2CND19.15    | 03X19H13M3 |
| SUS321   | 321<br>S32100   | X6CrNiTi18-10<br>1.4541              | 0Cr18Ni10Ti<br>06Cr18Ni1Ti      | 321S31 | Z6CNT18.10    | 08X18H10T  |
| SUS347   | 347<br>S34700   | X6CrNiNb18-10<br>1.4550              | 0Cr18Ni11Nb<br>06Cr18Ni11Nb     | 347S31 | Z6CNNb18.10   | 08X18H12B  |

## S Ferritic Heat Resistant Steels

| JIS    | AISI/ASTM     | DIN/EN   | GB                   | BS     | AFNOR  | ГОСТ |
|--------|---------------|----------|----------------------|--------|--------|------|
| SUH409 | 409<br>S40900 | X6CrTi12 | 06Cr11Ti<br>0Cr11Ti1 | 409S19 | Z6CT12 | —    |
| SUH446 | 446<br>S44600 | —        | 2Cr25N<br>16Cr25N    | —      | Z12C24 | —    |

## S Martensitic Heat Resistant Steel

|        |               |   |                             |        |             |          |
|--------|---------------|---|-----------------------------|--------|-------------|----------|
| SUH1   | —             | — | 45Cr9Si3                    | 401S45 | Z45CS9      | —        |
| SUH3   | —             | — | 4Cr10Si2Mo<br>40Cr10Si2Mo   | —      | Z40CSD10    | 40X10C2M |
| SUH4   | —             | — | 8Cr20Si2Ni<br>80Cr20Si2Ni   | 443S65 | Z80CSN20.02 | —        |
| SUH11  | —             | — | 4Cr9Si2<br>42Cr9Si2         | —      | —           | 40X 9C2  |
| SUH600 | —             | — | 2Cr12MoVNbN<br>18Cr12MoVNbN | —      | —           | —        |
| SUH616 | 616<br>S42200 | — | 2Cr12NiMoWV<br>22Cr12NiWMoV | —      | —           | —        |

## S Austenitic Heat Resistant Steel

|        |               |                               |                               |        |               |             |
|--------|---------------|-------------------------------|-------------------------------|--------|---------------|-------------|
| SUH31  | —             | —                             | 4Cr14Ni14W2Mo                 | 331S42 | —             | 45X14H14B2M |
| SUH35  | —             | X53CrMnNiN21-9-4<br>1.4871    | 5Cr21Mn9Ni4N<br>53Cr21Mn9Ni4N | 349S52 | Z52CMN21.09   | 55X20F9AH4  |
| SUH36  | —             | X53CrMnNi21 9                 | —                             | 349S54 | Z55CMN21-09Az | 55X20F9AH4  |
| SUH37  | —             | X15CrNiSi20-12<br>1.4828      | 22Cr21Ni12N<br>2Cr21Ni12N     | 381S34 | —             | —           |
| SUH38  | —             | —                             | —                             | —      | —             | —           |
| SUH309 | 309<br>S30900 | X12CrNi23-13<br>1.4833        | 16Cr23Ni13<br>2Cr23Ni13       | 309S24 | Z15CN24.13    | 20X23H12    |
| SUH310 | 310<br>S31000 | —                             | 2Cr25Ni21<br>20Cr25Ni20       | 310S24 | Z15CN25.20    | —           |
| SUH330 | —             | X12CrNiMoN25-18-6-5<br>1.4565 | 1Cr16Ni35<br>12Cr16Ni35       | —      | Z12NCS35.16   | —           |

## K Gray Cast Iron

|       |        |       |       |     |        |      |
|-------|--------|-------|-------|-----|--------|------|
| FC100 | No 20B | GG-10 | HT100 | 100 | —      | Cy10 |
| FC150 | No 25B | GG-15 | HT150 | 150 | FGL150 | Cy15 |
| FC200 | No 30B | GG-20 | HT200 | 200 | FGL200 | Cy20 |
| FC250 | No 35B | GG-25 | HT250 | 250 | FGL250 | Cy25 |
| FC300 | No 45B | GG-30 | HT300 | 300 | FGL300 | Cy30 |
| FC350 | No 50B | GG-35 | HT350 | 350 | FGL350 | Cy35 |

## K Nodular Cast Iron

|        |           |          |          |        |           |      |
|--------|-----------|----------|----------|--------|-----------|------|
| FCD400 | 60-40-18  | GGG-40   | QT400-18 | 400/17 | FGS370-17 | By40 |
| FCD450 | —         | GGG-40.3 | QT450-10 | 420/12 | FGS400-12 | By45 |
| FCD500 | 80-55-06  | GGG-50   | QT500-7  | 500/7  | FGS500-7  | By50 |
| FCD600 | —         | GGG-60   | QT600-3  | 600/7  | FGS600-2  | By60 |
| FCD700 | 100-70-03 | GGG-70   | QT700-2  | 700/2  | FGS700-2  | By70 |
| FCD800 | 120-90-02 | GGG-80   | —        | 800/2  | FGS800-2  | By80 |

## N Aluminum and Al Alloys - Sheets, plates and strips

| JIS    | AISI/ASTM | DIN/EN     | GB         | BS         | AFNOR      | ГОСТ |
|--------|-----------|------------|------------|------------|------------|------|
| A1060P | 1060      | EN AW-1060 | L2         | —          | —          | —    |
| A1050P | 1050      | A199.50    | 1A50       | —          | —          | —    |
| A1100P | 1100      | EN AW-1100 | L5-1       | —          | —          | —    |
| A1200P | 1200      | EN AW-1200 | L5         | EN AW-1200 | EN AW-1200 | —    |
| A2014P | 2014      | EN AW-2014 | LD10       | EN AW-2014 | EN AW-2014 | —    |
| A2017P | 2017      | EN AW-2017 | 2A11(LY11) | EN AW-2017 | EN AW-2017 | —    |
| A2219P | 2219      | EN AW-2219 | 2A16(LY16) | —          | —          | —    |
| A2024P | 2024      | EN AW-2024 | 2A12(LY12) | EN AW-2024 | EN AW-2024 | —    |
| A2124P | 2124      | EN AW-2124 | 2A12(LY12) | —          | —          | —    |
| A3003P | 3003      | EN AW-3003 | LF21       | EN AW-3003 | EN AW-3003 | —    |
| A3004P | 3004      | EN AW-3004 | 3004       | —          | —          | —    |
| A3005P | 3005      | EN AW-3005 | 3005       | —          | —          | —    |
| A3015P | 3105      | EN AW-3105 | 3105       | —          | —          | —    |
| A5005P | 5005      | EN AW-5005 | 5005       | —          | —          | —    |
| A5050P | 5050      | EN AW-5050 | —          | —          | —          | —    |
| A5052P | 5052      | EN AW-5052 | 5A02       | EN AW-5052 | EN AW-5052 | —    |
| A5154P | 5154      | —          | LF3        | —          | —          | —    |
| A5254P | 5254      | —          | LF3        | —          | —          | —    |
| A5454P | 5454      | EN AW-5454 | 5454       | EN AW-5454 | EN AW-5454 | —    |
| A5456P | 5456      | EN AW-5456 | —          | —          | —          | —    |
| A6101P | 6101      | EN AW-6101 | 6101       | —          | —          | —    |
| A6061P | 6061      | EN AW-6061 | 6061(LD30) | EN AW-6061 | EN AW-6061 | —    |
| A7075P | 7075      | EN AW-7075 | 7A04       | EN AW-7075 | EN AW-7075 | —    |
| A7178P | 7178      | EN AW-7178 | 7A03(LC3)  | —          | —          | —    |

## N Aluminum Alloy Die Castings

|       |        |             |             |             |             |   |
|-------|--------|-------------|-------------|-------------|-------------|---|
| ADC1  | A413.0 | EN AC-44300 | YL102       | —           | —           | — |
| ADC3  | A360.0 | EN AC-43400 | YL104       | EN AC-43400 | EN AC-43400 | — |
| ADC5  | 518.0  | —           | Al-Mg7      | —           | —           | — |
| ADC10 | —      | EN AC-46000 | YL112       | —           | —           | — |
| ADC12 | —      | —           | YL113       | LM20        | —           | — |
| ADC14 | B390.0 | —           | —           | —           | —           | — |
| AC4C  | 357    | G-AlSi7Mg   | ZAlSi7Mg1A  | LM25        | A-S7G-03    | — |
| AC4CH | 356    | G-AlSi7Mg   | ZAlSi7Mg    | LM25        | A-S7G       | — |
| —     | 308    | G-AlSi6Cu4  | ZAlSi6Cu6Mg | LM21        | —           | — |

## H Hardened Steel

|      |      |             |       |   |   |   |
|------|------|-------------|-------|---|---|---|
| C4BS | 440A | X100CrMo13  | 7Cr17 | — | — | — |
| AC4A | 610  | X110CrMoV15 | —     | — | — | — |
| AC4A | 0-2  | X65CrMo14   | —     | — | — | — |

# References

## ■ Hardness Scale Comparison Chart

● Approx. metric value and Brinell hardness of steel

| Brinell Hardness<br>10mm Ball<br>3.000kgf<br>(HB) | Rockwell Hardness                             |                                            |                                                |                                                | Vickers Hardness<br>50kgf<br>(HV) | Shore Hardness<br>(HS) | Traverse Rupture Strength<br>(N/mm <sup>2</sup> ) |
|---------------------------------------------------|-----------------------------------------------|--------------------------------------------|------------------------------------------------|------------------------------------------------|-----------------------------------|------------------------|---------------------------------------------------|
|                                                   | „A“ Scale<br>Diamond,<br>brale 60kgf<br>(HRA) | „B“ Scale<br>100kgf<br>1/10" Ball<br>(HRB) | „C“ Scale<br>Diamond,<br>brale 150kgf<br>(HRC) | „D“ Scale<br>Diamond,<br>brale 100kgf<br>(HRD) |                                   |                        |                                                   |
| —                                                 | 85,6                                          | —                                          | 68,0                                           | 76,9                                           | 940                               | 97                     | —                                                 |
| —                                                 | 85,3                                          | —                                          | 67,5                                           | 76,5                                           | 920                               | 96                     | —                                                 |
| —                                                 | 85,0                                          | —                                          | 67,0                                           | 76,1                                           | 900                               | 95                     | —                                                 |
| 767                                               | 84,7                                          | —                                          | 66,4                                           | 75,7                                           | 880                               | 93                     | —                                                 |
| 757                                               | 84,4                                          | —                                          | 65,9                                           | 75,3                                           | 860                               | 92                     | —                                                 |
| 745                                               | 84,1                                          | —                                          | 65,3                                           | 74,8                                           | 840                               | 91                     | —                                                 |
| 733                                               | 83,8                                          | —                                          | 64,7                                           | 74,3                                           | 820                               | 90                     | —                                                 |
| 722                                               | 83,4                                          | —                                          | 64,0                                           | 73,8                                           | 800                               | 88                     | —                                                 |
| 712                                               | —                                             | —                                          | —                                              | —                                              | —                                 | —                      | —                                                 |
| 710                                               | 83,0                                          | —                                          | 63,3                                           | 73,3                                           | 780                               | 87                     | —                                                 |
| 698                                               | 82,6                                          | —                                          | 62,5                                           | 72,6                                           | 760                               | 86                     | —                                                 |
| 684                                               | 82,2                                          | —                                          | 61,8                                           | 72,1                                           | 740                               | —                      | —                                                 |
| 682                                               | 82,2                                          | —                                          | 61,7                                           | 72,0                                           | 737                               | 84                     | —                                                 |
| 670                                               | 81,8                                          | —                                          | 61,0                                           | 71,5                                           | 720                               | 83                     | —                                                 |
| 656                                               | 81,3                                          | —                                          | 60,1                                           | 70,8                                           | 700                               | —                      | —                                                 |
| 653                                               | 81,2                                          | —                                          | 60,0                                           | 70,7                                           | 697                               | 81                     | —                                                 |
| 647                                               | 81,1                                          | —                                          | 59,7                                           | 70,5                                           | 690                               | —                      | —                                                 |
| 638                                               | 80,8                                          | —                                          | 59,2                                           | 70,1                                           | 680                               | 80                     | —                                                 |
| 630                                               | 80,6                                          | —                                          | 58,8                                           | 69,8                                           | 670                               | —                      | —                                                 |
| 627                                               | 80,5                                          | —                                          | 58,7                                           | 69,8                                           | 667                               | 79                     | —                                                 |
| 601                                               | 79,8                                          | —                                          | 57,3                                           | 68,7                                           | 640                               | 77                     | —                                                 |
| 578                                               | 79,1                                          | —                                          | 56,0                                           | 67,7                                           | 615                               | 75                     | —                                                 |
| 555                                               | 78,4                                          | —                                          | 54,7                                           | 66,7                                           | 591                               | 73                     | 2055                                              |
| 534                                               | 77,8                                          | —                                          | 53,5                                           | 65,8                                           | 569                               | 71                     | 1985                                              |
| 514                                               | 76,9                                          | —                                          | 52,1                                           | 64,7                                           | 547                               | 70                     | 1890                                              |
| 495                                               | 76,3                                          | —                                          | 51,0                                           | 63,8                                           | 528                               | 68                     | 1820                                              |
| 477                                               | 75,6                                          | —                                          | 49,6                                           | 62,7                                           | 508                               | 66                     | 1730                                              |
| 461                                               | 74,9                                          | —                                          | 48,5                                           | 61,7                                           | 491                               | 65                     | 1670                                              |
| 444                                               | 74,2                                          | —                                          | 47,1                                           | 60,8                                           | 472                               | 63                     | 1585                                              |
| 429                                               | 73,4                                          | —                                          | 45,7                                           | 59,7                                           | 455                               | 61                     | 1510                                              |
| 415                                               | 72,8                                          | —                                          | 44,5                                           | 58,8                                           | 440                               | 59                     | 1460                                              |
| 401                                               | 72,0                                          | —                                          | 43,1                                           | 57,8                                           | 425                               | 58                     | 1390                                              |
| 388                                               | 71,4                                          | —                                          | 41,8                                           | 56,8                                           | 410                               | 56                     | 1330                                              |
| 375                                               | 70,6                                          | —                                          | 40,4                                           | 55,7                                           | 396                               | 54                     | 1270                                              |
| 363                                               | 70,0                                          | —                                          | 39,1                                           | 54,6                                           | 383                               | 52                     | 1220                                              |
| 352                                               | 69,3                                          | (110,0)                                    | 37,9                                           | 53,8                                           | 372                               | 51                     | 1180                                              |
| 341                                               | 68,7                                          | (109,0)                                    | 36,6                                           | 52,8                                           | 360                               | 50                     | 1130                                              |
| 331                                               | 68,1                                          | (108,5)                                    | 35,5                                           | 51,9                                           | 350                               | 48                     | 1095                                              |

| Brinell Hardness<br>10mm Ball<br>3.000kgf<br>(HB) | Rockwell Hardness                             |                                            |                                                |                                                | Vickers Hardness<br>50kgf<br>(HV) | Shore Hardness<br>(HS) | Traverse Rupture Strength<br>(N/mm <sup>2</sup> ) |
|---------------------------------------------------|-----------------------------------------------|--------------------------------------------|------------------------------------------------|------------------------------------------------|-----------------------------------|------------------------|---------------------------------------------------|
|                                                   | „A“ Scale<br>Diamond,<br>brale 60kgf<br>(HRA) | „B“ Scale<br>100kgf<br>1/10" Ball<br>(HRB) | „C“ Scale<br>Diamond,<br>brale 150kgf<br>(HRC) | „D“ Scale<br>Diamond,<br>brale 100kgf<br>(HRD) |                                   |                        |                                                   |
| 321                                               | 67,5                                          | (108,0)                                    | 34,3                                           | 50,1                                           | 339                               | 47                     | 1060                                              |
| 311                                               | 66,9                                          | (107,5)                                    | 33,1                                           | 50,0                                           | 328                               | 46                     | 1025                                              |
| 302                                               | 66,3                                          | (107,0)                                    | 32,1                                           | 49,3                                           | 319                               | 45                     | 1005                                              |
| 293                                               | 65,7                                          | (106,0)                                    | 30,9                                           | 48,3                                           | 309                               | 43                     | 970                                               |
| 285                                               | 65,3                                          | (105,5)                                    | 29,9                                           | 47,6                                           | 301                               | —                      | 950                                               |
| 277                                               | 64,6                                          | (104,5)                                    | 28,8                                           | 46,7                                           | 292                               | 41                     | 925                                               |
| 269                                               | 64,1                                          | (104,0)                                    | 27,6                                           | 45,9                                           | 284                               | 40                     | 895                                               |
| 262                                               | 63,6                                          | (103,0)                                    | 26,6                                           | 45,0                                           | 276                               | 39                     | 875                                               |
| 255                                               | 63,0                                          | (102,0)                                    | 25,4                                           | 44,2                                           | 269                               | 38                     | 850                                               |
| 248                                               | 62,6                                          | (101,0)                                    | 24,2                                           | 43,2                                           | 261                               | 37                     | 825                                               |
| 241                                               | 61,8                                          | 100,0                                      | 22,8                                           | 42,0                                           | 253                               | 36                     | 800                                               |
| 235                                               | 61,4                                          | 99,0                                       | 21,7                                           | 41,4                                           | 247                               | 35                     | 785                                               |
| 229                                               | 60,8                                          | 98,2                                       | 20,5                                           | 40,5                                           | 241                               | 34                     | 765                                               |
| 223                                               | —                                             | 97,3                                       | (18,8)                                         | —                                              | 234                               | —                      | —                                                 |
| 217                                               | —                                             | 96,4                                       | (17,5)                                         | —                                              | 228                               | 33                     | 725                                               |
| 212                                               | —                                             | 95,5                                       | (16,0)                                         | —                                              | 222                               | —                      | 705                                               |
| 207                                               | —                                             | 94,6                                       | (15,2)                                         | —                                              | 218                               | 32                     | 690                                               |
| 201                                               | —                                             | 93,8                                       | (13,8)                                         | —                                              | 212                               | 31                     | 675                                               |
| 197                                               | —                                             | 92,8                                       | (12,7)                                         | —                                              | 207                               | 30                     | 655                                               |
| 192                                               | —                                             | 91,9                                       | (11,5)                                         | —                                              | 202                               | 29                     | 640                                               |
| 187                                               | —                                             | 90,7                                       | (10,0)                                         | —                                              | 196                               | —                      | 620                                               |
| 183                                               | —                                             | 90,0                                       | (9,0)                                          | —                                              | 192                               | 28                     | 615                                               |
| 179                                               | —                                             | 89,0                                       | (8,0)                                          | —                                              | 188                               | 27                     | 600                                               |
| 174                                               | —                                             | 87,8                                       | (6,4)                                          | —                                              | 182                               | —                      | 585                                               |
| 170                                               | —                                             | 86,8                                       | (5,4)                                          | —                                              | 178                               | 26                     | 570                                               |
| 167                                               | —                                             | 86,0                                       | (4,4)                                          | —                                              | 175                               | —                      | 560                                               |
| 163                                               | —                                             | 85,0                                       | (3,3)                                          | —                                              | 171                               | 25                     | 545                                               |
| 156                                               | —                                             | 82,9                                       | (0,9)                                          | —                                              | 163                               | —                      | 525                                               |
| 149                                               | —                                             | 80,8                                       | —                                              | —                                              | 156                               | 23                     | 505                                               |
| 143                                               | —                                             | 78,7                                       | —                                              | —                                              | 150                               | 22                     | 490                                               |
| 137                                               | —                                             | 76,4                                       | —                                              | —                                              | 143                               | 21                     | 460                                               |
| 131                                               | —                                             | 74,0                                       | —                                              | —                                              | 137                               | —                      | 450                                               |
| 126                                               | —                                             | 72,0                                       | —                                              | —                                              | 132                               | 20                     | 435                                               |
| 121                                               | —                                             | 69,8                                       | —                                              | —                                              | 127                               | 19                     | 415                                               |
| 116                                               | —                                             | 67,6                                       | —                                              | —                                              | 122                               | 18                     | 400                                               |
| 111                                               | —                                             | 65,7                                       | —                                              | —                                              | 117                               | 15                     | 385                                               |

1) Figures within the ( ) are not commonly used

2) Rockwell A, C and D scales utilises a diamond brale

3) 1 N/mm<sup>2</sup> = 1 MPa



## ■ Finished Surface Roughness

### ● Types of Surface Roughness Measurements

| Types                    | Symbol     | Method of Determination                                                                                                                                                                                                                                                                                             | Descriptive Figure |
|--------------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| Maximum Height           | ※ 1)<br>Ry | This is the value (expressed in $\mu\text{m}$ ) measured from the deepest valley to the highest peak of the reference line, $\ell$ , extracted from the profile.<br><br>(Disregard unusually high peaks and deep valleys as they are considered as flaws.)                                                          |                    |
| Ten-point Mean Roughness | ※ 2)<br>Rz | From the profile, extract a portion to be the reference line, $\ell$ .<br><br>Select the 5 highest peak and 5 deepest valleys. Measure the distance between the two lines and express it in $\mu\text{m}$ .<br>(1 $\mu\text{m}$ = 0,001mm)                                                                          |                    |
| Calculated Roughness     | Ra         | This method is to obtain a center line between the peaks and valleys within the reference line, $\ell$ . Fold along the center line to superimpose the valleys against the peaks. (Shaded portions with dashed outline on the right figure). Take the total shaded area and divided it by $\ell$ in $\mu\text{m}$ . |                    |

Designated values of the above types of surface roughness, standard reference length values and the triangular symbol classifications are shown on the table on the right.

- ※ 1) Ry : According to new JIS B 0601:2001 (Old symbol: Rz)  
 ※ 2) Rz : According to new JIS B 0601:2001 (Old symbol: Rz<sub>JIS</sub>)

| Designated values for ※ 1)<br>Ry           | Designated values for ※ 2)<br>Rz           | Designated values for<br>Ra          | Standard reference length values, $\ell$ (mm) | Triangular Symbols |
|--------------------------------------------|--------------------------------------------|--------------------------------------|-----------------------------------------------|--------------------|
| (0,05S)<br>0,1S<br>0,2S<br>0,4S            | (0,05Z)<br>0,1Z<br>0,2Z<br>0,4Z            | (0,013a)<br>0,025a<br>0,05a<br>0,10a | —                                             | ▽▽▽▽               |
| 0,8S                                       | 0,8Z                                       | 0,20a                                | 0,25                                          |                    |
| 1,6S<br>3,2S<br>6,3S                       | 1,6Z<br>3,2Z<br>6,3Z                       | 0,4a<br>0,8a<br>1,6a                 | 0,8                                           | ▽▽▽                |
| 12,5S<br>(18S)<br>25S                      | 12,5Z<br>(18Z)<br>25Z                      | 3,2a<br>6,3a                         | 2,5                                           | ▽▽                 |
| (35S)<br>50S<br>(70S)<br>100S              | (35Z)<br>50Z<br>(70Z)<br>100Z              | 12,5a<br>25a                         | —                                             | ▽                  |
| (140S)<br>200S<br>(280S)<br>400S<br>(560S) | (140Z)<br>200Z<br>(280Z)<br>400Z<br>(560Z) | (50a)<br>(100a)                      | —                                             | —                  |

Remarks: The designated values in the brackets do not apply unless otherwise stated.



# Spare Parts

P

P1–P8

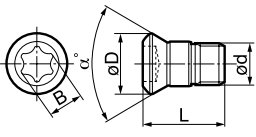


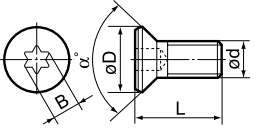
|                               |       |
|-------------------------------|-------|
| Screw .....                   | P2-P4 |
| Lever Pin, Shim, Nut.....     | P4-P6 |
| Shim Pin, Eccentric Pin ..... | P7    |
| Wrench .....                  | P8    |

# SPARE PARTS

## Screw

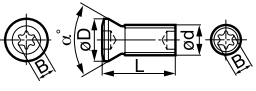
### ■ Screw

| High Precision Screw                                                              | Cat. No.  | Stock | Dimensions (mm) |       |      |      |     |    | $\alpha^\circ$ | $\text{N}\cdot\text{m}$ |
|-----------------------------------------------------------------------------------|-----------|-------|-----------------|-------|------|------|-----|----|----------------|-------------------------|
|                                                                                   |           |       | d               | Pitch | L    | D    | B   |    |                |                         |
|  | BFTG0408F | ●     | M4              | 0,5   | 7,5  | 5,7  | T15 | 61 | 3,4            |                         |
|                                                                                   | BTTG0409F | ●     | M4              | 0,5   | 8,4  | 6,15 | T15 | 61 | 3,4            |                         |
|                                                                                   | BFTG0513F | ●     | M5              | 0,5   | 13   | 6,8  | T20 | 61 | 5,0            |                         |
|                                                                                   | BFTG0617F | ●     | M6              | 0,75  | 16,5 | 8    | T25 | 61 | 7,5            |                         |
|                                                                                   | BFTG0621F | ○     | M6              | 0,75  | 21   | 9,5  | T25 | 61 | 7,5            |                         |
|                                                                                   | BFTG0825F | ●     | M8              | 0,75  | 24,5 | 12   | T25 | 61 | 7,5            |                         |

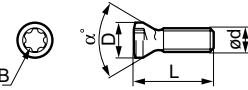
| Torx Flat Head Screw                                                                | Cat. No.   | Stock | Dimensions (mm) |       |      |      |     |    | $\alpha^\circ$ | $\text{N}\cdot\text{m}$ |
|-------------------------------------------------------------------------------------|------------|-------|-----------------|-------|------|------|-----|----|----------------|-------------------------|
|                                                                                     |            |       | d               | Pitch | L    | D    | B   |    |                |                         |
|  | BFTX016033 | ○     | M1,6            | 0,35  | 3,3  | 2,6  | T6  | 60 | 0,2            |                         |
|                                                                                     | BFTX02508  | ●     | M2,5            | 0,45  | 7,5  | 3,45 | T8  | 60 | -              |                         |
|                                                                                     | BFTX0309   | ●     | M3              | 0,5   | 8,8  | 4,2  | T10 | 60 | -              |                         |
|                                                                                     | BFTX03508  | ●     | M3,5            | 0,6   | 8    | 5,1  | T10 | 52 | 2,0            |                         |
|                                                                                     | BFTX03584  | ●     | M3,5            | 0,6   | 7,4  | 5,2  | T15 | 60 | 3,0            |                         |
|                                                                                     | BFTX03588  | ●     | M3,5            | 0,6   | 8,8  | 5,2  | T15 | 60 | 3,4            |                         |
|                                                                                     | BFTX0408   | ●     | M4              | 0,7   | 8    | 5,5  | T15 | 60 | -              |                         |
|                                                                                     | BFTX0414   | ●     | M4              | 0,7   | 14,5 | 5,5  | T15 | 60 | 3,0            |                         |
|                                                                                     | BFTX0515   | ●     | M5              | 0,8   | 15   | 7    | T20 | 60 | -              |                         |
|                                                                                     | BFTX0613   | ●     | M6              | 1,0   | 13   | 9    | T25 | 60 | -              |                         |
|                                                                                     | BFTX0615   | ●     | M6              | 1,0   | 15   | 9    | T25 | 60 | -              |                         |
|                                                                                     | BFTX0617   | ●     | M6              | 1,0   | 17   | 9    | T25 | 60 | -              |                         |

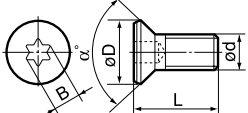
| Cat. No.  | Stock | Dimensions (mm) |       |      |     |     |    | $\alpha^\circ$ | $\text{N}\cdot\text{m}$ |
|-----------|-------|-----------------|-------|------|-----|-----|----|----------------|-------------------------|
|           |       | d               | Pitch | L    | D   | B   |    |                |                         |
| BFTX0203A | ●     | M2              | 0,4   | 3    | 2,7 | T6  | 90 | 0,5            |                         |
| BFTX0204A | ●     | M2              | 0,4   | 4,3  | 2,7 | T6  | 90 | 0,5            |                         |
| BFTX0305A | ●     | M3              | 0,5   | 5,3  | 4,3 | T10 | 90 | -              |                         |
| BFTX0306A | ●     | M3              | 0,5   | 5,8  | 4,3 | T10 | 90 | 2,0            |                         |
| BFTX0307A | ●     | M3              | 0,5   | 6,8  | 4,3 | T10 | 90 | 2,0            |                         |
| BFTX0407A | ●     | M4              | 0,7   | 7,3  | 5,6 | T15 | 90 | 3,4            |                         |
| BFTX0410A | ●     | M4              | 0,7   | 10,3 | 5,6 | T15 | 90 | 3,4            |                         |
| BFTX0509A | ●     | M5              | 0,8   | 9,3  | 6,9 | T20 | 90 | 5,0            |                         |

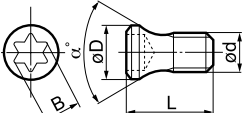
| Cat. No.    | Stock | Dimensions (mm) |       |      |      |      |    | $\alpha^\circ$ | $\text{N}\cdot\text{m}$ |
|-------------|-------|-----------------|-------|------|------|------|----|----------------|-------------------------|
|             |       | d               | Pitch | L    | D    | B    |    |                |                         |
| BFTX01604N  | ●     | M1,6            | 0,35  | 4,2  | 2,4  | T6   | 60 | 0,2            |                         |
| BFTX0203N   | ●     | M2              | 0,4   | 3    | 2,7  | T6   | 60 | 0,5            |                         |
| BFTX0204N   | ●     | M2              | 0,4   | 4,3  | 2,7  | T6   | 60 | 0,5            |                         |
| BFTX02205N  | ●     | M2,5            | 0,45  | 4,5  | 3    | T6   | 60 | 0,5            |                         |
| BFTX2206NT  | ○     | M2,2            | 0,45  | 6    | 3,2  | T1,8 | 60 | 0,7            |                         |
| BFTX02505N  | ●     | M2,5            | 0,45  | 4,5  | 3,45 | T8   | 60 | 1,1            |                         |
| BFTX02506N  | ●     | M2,5            | 0,45  | 5,5  | 3,45 | T8   | 60 | 1,5            |                         |
| BFTX02508NV | ●     | M2,5            | 0,45  | 7,5  | 3,5  | T8   | 60 | 1,5            |                         |
| BFTX0306N   | ○     | M3              | 0,5   | 5,8  | 4,2  | T10  | 60 | 2,0            |                         |
| BFTX0307N   | ○     | M3              | 0,5   | 6,5  | 4,2  | T10  | 60 | 2,0            |                         |
| BFTX03085N  | ○     | M3              | 0,5   | 8,5  | 5,4  | T10  | 60 | -              |                         |
| BFTX0309N   | ●     | M3              | 0,5   | 9    | 4,2  | T10  | 60 | 3,0            |                         |
| BFTX0312N   | ○     | M3              | 0,5   | 12   | 5,4  | T10  | 60 | -              |                         |
| BFTX03509N  | ●     | M3,5            | 0,6   | 8,5  | 4,9  | T10  | 60 | -              |                         |
| BFTX0406N   | ●     | M4              | 0,7   | 6    | 5,6  | T15  | 60 | -              |                         |
| BFTX0407N   | ●     | M4              | 0,7   | 7    | 5,6  | T15  | 60 | 3,0            |                         |
| BFTX0409N   | ●     | M4              | 0,7   | 9    | 5,6  | T15  | 60 | 3,4            |                         |
| BFTX0412N   | ●     | M4              | 0,7   | 12   | 5,5  | T15  | 60 | 3,0            |                         |
| BFTX0509N   | ●     | M5              | 0,8   | 9    | 7    | T20  | 60 | 5,0            |                         |
| BFTX0511N   | ●     | M5              | 0,8   | 11,5 | 7    | T20  | 60 | 5,0            |                         |
| BFTX0513N   | ●     | M5              | 0,8   | 13   | 7    | T20  | 60 | 5,0            |                         |
| BFTX0515N   | ●     | M5              | 0,8   | 15   | 7    | T20  | 60 | -              |                         |
| BFTX0615N   | ●     | M6              | 1,0   | 15   | 9    | T25  | 60 | 5,0            |                         |
| BFTX0619N   | ●     | M6              | 1,0   | 19   | 9    | T25  | 60 | 5,0            |                         |

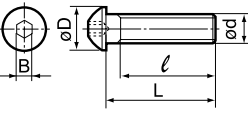
| Torx Flat Head Screw                                                                | Cat. No.    | Stock | Dimensions (mm) |       |     |     |    |    | $\alpha^\circ$ | $\text{N}\cdot\text{m}$ |
|-------------------------------------------------------------------------------------|-------------|-------|-----------------|-------|-----|-----|----|----|----------------|-------------------------|
|                                                                                     |             |       | d               | Pitch | L   | D   | B  |    |                |                         |
|  | BFTX0410T8L | ●     | M4              | 0,7   | 9,6 | 5,6 | T8 | 60 | 1,1            |                         |
|                                                                                     | BFTX0410T8R | ●     | M4              | 0,7   | 9,6 | 5,6 | T8 | 60 | 1,1            |                         |

### ■ Screw

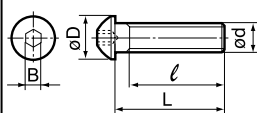
| Torx Plus Flat Head Screw                                                          | Cat. No.      | Stock | Dimensions (mm) |       |      |      |      |    | $\alpha^\circ$ | $\text{N}\cdot\text{m}$ |
|------------------------------------------------------------------------------------|---------------|-------|-----------------|-------|------|------|------|----|----------------|-------------------------|
|                                                                                    |               |       | d               | Pitch | L    | D    | B    |    |                |                         |
|  | BFTX01804IP   | ○     | M1,8            | 0,35  | 3,7  | 2,45 | 6IP  | 60 | 0,5            |                         |
|                                                                                    | BFTX02505IP   | ●     | M2,5            | 0,45  | 4,5  | 3,45 | 8IP  | 60 | -              |                         |
|                                                                                    | BFTX02506IP   | ●     | M2,5            | 0,45  | 5,5  | 3,45 | 8IP  | 60 | -              |                         |
|                                                                                    | BFTX0305IP    | ●     | M3              | 0,5   | 5,3  | 3,8  | 8IP  | 60 | 2,0            |                         |
|                                                                                    | BFTX0306IP    | ●     | M3              | 0,5   | 6    | 3,8  | 8IP  | 60 | 2,0            |                         |
|                                                                                    | BFTX0307IP    | ●     | M3              | 0,5   | 7    | 4,3  | 10IP | 55 | 2,0            |                         |
|                                                                                    | BFTX0308IP    | ●     | M3              | 0,5   | 8    | 3,8  | 8IP  | 60 | -              |                         |
|                                                                                    | BFTX03510IP   | ●     | M3,5            |       |      |      |      |    |                |                         |
|                                                                                    | BFTX03512IP   | ●     | M3,5            | 0,6   | 11,5 | 5,3  | 15IP | 60 | 3,0            |                         |
|                                                                                    | BFTX03584IP   | ●     | M3,5            | 0,6   | 7,4  | 5,1  | 15IP | 60 | -              |                         |
|                                                                                    | BFTX03510IP08 | ●     | M3,5            | 0,6   | 10   | 5,3  | 8IP  | 60 | -              |                         |
|                                                                                    | BFTX03510IP15 | ●     | M3,5            | 0,6   | 10   | 5,3  | 15IP | 60 | -              |                         |
|                                                                                    | BFTX0407IP    | ●     | M4              | 0,7   | 8,0  | 5,6  | 15IP | 60 | 3,0            |                         |
|                                                                                    | BFTX0409IP    | ●     | M4              | 0,7   | 9,0  | 5,6  | 15IP | 60 | 3,0            |                         |
|                                                                                    | BFTX0412IP    | ●     | M4              | 0,7   | 12   | 5,5  | 15IP | 60 | 3,0            |                         |
|                                                                                    | BFTX0418IP    | ●     | M4              | 0,7   | 18   | 5,5  | 15IP | 60 | -              |                         |
|                                                                                    | BFTX04513IP20 | ●     | M4,5            | 0,75  | 13,1 | 6,8  | 20IP | 60 | -              |                         |
|                                                                                    | BFTX0511IP    | ●     | M5              | 0,8   | 11,5 | 7    | 20IP | 60 | -              |                         |
|                                                                                    | BFTX0513IP    | ●     | M5              | 0,8   | 13   | 7    | 20IP | 60 | -              |                         |
|                                                                                    | BFTX0615IP    | ●     | M6              | 1,0   | 15   | 9    | 25IP | 60 | -              |                         |

| Torx Flat Head Screw                                                                | Cat. No.    | Stock | Dimensions (mm) |       |    |     |     |    | $\alpha^\circ$ | $\text{N}\cdot\text{m}$ |
|-------------------------------------------------------------------------------------|-------------|-------|-----------------|-------|----|-----|-----|----|----------------|-------------------------|
|                                                                                     |             |       | d               | Pitch | L  | D   | B   |    |                |                         |
|  | BFTX03510SD | ●     | M3,5            | 0,6   | 10 | 5,3 | T10 | 60 | 2,0            |                         |
|                                                                                     | BFTX03517SD | ●     | M3,5            | 0,6   | 17 | 5,3 | T10 | 60 | 2,0            |                         |
|                                                                                     | BFTX0618SD  | ●     | M5              | 0,8   | 17 | 7,2 | T20 | 60 | 5,0            |                         |
|                                                                                     | BFTX0618SD  | ●     | M6              | 1,0   | 18 |     | T25 | 60 | 7,5            |                         |

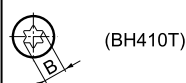
| Torx Flat Head Screw                                                                 | Cat. No.  | Stock | Dimensions (mm) |       |     |      |    |    | $\alpha^\circ$ | $\text{N}\cdot\text{m}$ |
|--------------------------------------------------------------------------------------|-----------|-------|-----------------|-------|-----|------|----|----|----------------|-------------------------|
|                                                                                      |           |       | d               | Pitch | L   | D    | B  |    |                |                         |
|  | BFTY02205 | ●     | M2,2            | 0,45  | 5,0 | 3,05 | T7 | 60 | -              |                         |
|                                                                                      | BFTY02206 | ●     | M2,2            | 0,45  | 5,6 | 3,05 | T7 | 60 | 1,0            |                         |

| Button Head Cap Screw                                                                | Cat. No.            | Stock | Dimensions (mm) |       |    |        |      |     | $\text{N}\cdot\text{m}$ |
|--------------------------------------------------------------------------------------|---------------------|-------|-----------------|-------|----|--------|------|-----|-------------------------|
|                                                                                      |                     |       | d               | Pitch | L  | $\ell$ | D    | B   |                         |
|  | BH0304              | ●     | M3              | 0,5   | 4  | Full   | 5,5  | 2   | -                       |
|                                                                                      | BH0306              | ●     | M3              | 0,5   | 6  | Full   | 5,5  | 2   | -                       |
|                                                                                      | BH0308 (FBUP3-A0-9) | ●     | M3              | 0,5   | 8  | Full   | 5,5  | 2   | 1,0                     |
|                                                                                      | BH0310              | ●     | M3              | 0,5   | 10 | Full   | 5,5  | 2   | -                       |
|                                                                                      | BH0315              | ○     | M3              | 0,5   | 10 | Full   | 5,5  | 2   | -                       |
|                                                                                      | BH03504             | ●     | M3,5            | 0,6   | 4  | Full   | 7    | 2   | -                       |
|                                                                                      | BH0408              | ○     | M4              | 0,7   | 8  | Full   | 6    | 2,5 | -                       |
|                                                                                      | BH0415              | ●     | M4              | 0,7   | 15 | Full   | 7,5  | 2,5 | -                       |
|                                                                                      | BH0510              | ●     | M5              | 0,8   | 10 | Full   | 9,5  | 3   | -                       |
|                                                                                      | BH0516              | ●     | M5              | 0,8   | 16 | 14,4   | 9,5  | 3   | -                       |
|                                                                                      | BH0616              | ●     | M6              | 1,0   | 16 | 14     | 10,5 | 4   | -                       |
|                                                                                      | BH0620              | ●     | M6              | 1,0   | 20 | Full   | 10,5 | 4   | -                       |
|                                                                                      | BH0824R             | ●     | M8              | 1,25  | 24 | 20     | 12   | 4   | -                       |
|                                                                                      | BH0824L             | ●     | M8              | 1,25  | 24 | 20     | 12   | 4   | -                       |
|                                                                                      | BH0825              | ●     | M8              | 1,25  | 25 | 22,5   | 14   | 5   | -                       |
|                                                                                      | BH0830R             | ○     | M8              | 1,25  | 30 | 26     | 12   | 4   | -                       |
|                                                                                      | BH0830L             | ●     | M8              | 1,25  | 30 | 26     | 12   | 4   | -                       |
|                                                                                      | BH0832              | ●     | M8              | 1,25  | 32 | 29,5   | 14   | 5   | -                       |
|                                                                                      | BH1030R             | ○     | M10             | 1,5   | 30 | 26     | 14   | 5   | -                       |
|                                                                                      | BH1030L             | ●     | M10             | 1,5   | 30 | 26     | 14   | 5   | -                       |
|                                                                                      | BH1036R             | ●     | M10             | 1,5   | 36 | 32     | 14   | 5   | -                       |
|                                                                                      | BH1036L             | ●     | M10             | 1,5   | 36 | 32     | 14   | 5   | -                       |

### Hexagonal Hole Type

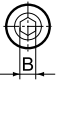


### T Type with Torx Hole



(BH410T)

### ■ Screw

|                                                                                                 |                        |            |       |                 |       |      |      |      |     |      |
|-------------------------------------------------------------------------------------------------|------------------------|------------|-------|-----------------|-------|------|------|------|-----|------|
|                | Phillip Head Cap Screw | Cat. No.   | Stock | Dimensions (mm) |       |      |      |      |     |      |
|                                                                                                 |                        |            |       | d               | Pitch | L    | ℓ    | D    | B   | (Nm) |
|                                                                                                 |                        | BHA0525    | ●     | M5              | 0,8   | 25,5 | 9,5  | 8,5  | 3   | 4,0  |
|                                                                                                 |                        | BHA0625    | ●     | M6              | 1,0   | 30   | 11,3 | 10,5 | 4   | 4,5  |
|                                                                                                 |                        | BHA0834    |       | M8              | 1,25  | 34,2 | 12,7 | 12,0 | 5   | -    |
|                                                                                                 |                        | BHE0407    |       | M4              | 0,7   | 9,5  | 2    | 5,7  | 2,5 | 1,8  |
|                                                                                                 |                        | BHE0510    |       | M5              | 0,8   | 13   | 3    | 7,7  | 3   | 2,7  |
|                | Button Head Screw      | Cat. No.   | Stock | Dimensions (mm) |       |      |      |      |     |      |
|                                                                                                 |                        |            |       | d               | Pitch | L    | D    | B    | α°  | (Nm) |
|                                                                                                 |                        | BHF0203L   |       | M2              | 0,4   | 4    | 3    | 1,5  | 90  |      |
|                                                                                                 |                        | BHF0203B   |       | M2              | 0,4   | 5,5  | 3,5  | 1,5  | 90  |      |
|                                                                                                 |                        | BHF0306R   | ●     | M3              | 0,5   | 6,3  | 4,2  | 2    | 90  | 1,0  |
|                                                                                                 |                        | BHF0308R   | ●     | M3              | 0,5   | 8    | 4,2  | 2    | 90  | 1,0  |
|                                                                                                 |                        | BHF0410    | ●     | M4              | 0,7   | 11,5 | 6    | 3    | 90  | -    |
|                                                                                                 |                        | BHF0623    | ○     | M6              | 1,0   | 23   | 12   | 4    | 90  | 7,0  |
| <br>BT06035T   | Set Screw              | Cat. No.   | Stock | Dimensions (mm) |       |      |      |      |     |      |
|                                                                                                 |                        |            |       | d               | Pitch | L    | D    | B    | α°  | (Nm) |
|                                                                                                 |                        | BT0306     |       | M3              | 0,5   | 6    | -    | 1,5  | -   | -    |
|                                                                                                 |                        | BT0310     |       | M3              | 0,5   | 10   | -    | 1,5  | -   | -    |
|                                                                                                 |                        | BT0404     | ●     | M4              | 0,7   | 4    | -    | 2    | -   | -    |
|                                                                                                 |                        | BT0408     | ○     | M4              | 0,7   | 8    | -    | 2    | -   | -    |
|                                                                                                 |                        | BT0412     | ○     | M4              | 0,7   | 12   | -    | 2    | -   | -    |
|                                                                                                 |                        | BT0506     | ●     | M5              | 0,8   | 6    | -    | 2,5  | -   | -    |
|                                                                                                 |                        | BT0510     |       | M5              | 0,8   | 10   | -    | 2,5  | -   | -    |
|                                                                                                 |                        | BT0610     | ○     | M6              | 1,0   | 10   | -    | 3    | -   | -    |
|                                                                                                 |                        | BT0612     |       | M6              | 1,0   | 12   | -    | 3    | -   | -    |
|                                                                                                 |                        | BT0620     |       | M6              | 1,0   | 20   | -    | 3    | -   | -    |
|                                                                                                 |                        | BT06035T   |       | M6              | 1,0   | 3,5  | -    | T15  | -   | -    |
| <br>BTD0615T | Set Screw              | Cat. No.   | Stock | Dimensions (mm) |       |      |      |      |     |      |
|                                                                                                 |                        |            |       | d               | Pitch | L    | ℓ    | D    | B   | (Nm) |
|                                                                                                 |                        | BTD0408    |       | M4              | 0,7   | 8    | 2    | 2,8  | 2   | -    |
|                                                                                                 |                        | BTD0410    |       | M4              | 0,7   | 10   | 2    | 2,8  | 2   | -    |
|                                                                                                 |                        | BTD0412    |       | M4              | 0,7   | 12   | 2    | 2,8  | 2   | -    |
|                                                                                                 |                        | BTD0508    |       | M5              | 0,8   | 8    | 3    | 3,5  | 2,5 | -    |
|                                                                                                 |                        | BTD05F09   |       | M5              | 0,5   | 9    | 2    | 4    | T15 | -    |
|                                                                                                 |                        | BTD0510    | ○     | M5              | 0,8   | 10   | 3    | 3,5  | 2,5 | 3,0  |
|                                                                                                 |                        | BTD0518    |       | M5              | 0,8   | 18   | 4    | 3,5  | 2,5 | -    |
|                                                                                                 |                        | BTD0609    | ○     | M6              | 1,0   | 9    | 2    | 4    | 3   | -    |
|                                                                                                 |                        | BTD0615    |       | M6              | 1,0   | 15   | 5    | 4    | 3   | -    |
|                                                                                                 |                        | BTD0618    |       | M6              | 1,0   | 18   | 5    | 4    | 3   | -    |
|                                                                                                 |                        | BTD0620    |       | M6              | 1,0   | 20   | 5    | 4    | 3   | -    |
|                                                                                                 |                        | BTD0812    | ○     | M8              | 1,25  | 12   | 2    | 5    | 4   | -    |
|                                                                                                 |                        | BTD0818    |       | M8              | 1,25  | 18   | 6    | 5    | 4   | -    |
|                                                                                                 |                        | BTD0820    |       | M8              | 1,25  | 20   | 6    | 5    | 4   | -    |
|                                                                                                 |                        | BTD0825    |       | M8              | 1,25  | 25   | 8,5  | 5    | 4   | -    |
|                                                                                                 |                        | BTD0615T   |       | M6              | 1,0   | 15   | 5    | 4,3  | T20 | -    |
|              | Set Screw              | Cat. No.   | Stock | Dimensions (mm) |       |      |      |      |     |      |
|                                                                                                 |                        |            |       | d               | Pitch | L    | ℓ    | B    | α°  | (Nm) |
|                                                                                                 |                        | BTT0407    | ●     | M4              | 0,5   | 7    | 2,6  | 2    | 60  | -    |
|                                                                                                 |                        | BTT0411    | ●     | M4              | 0,5   | 11   | 2,6  | 2    | 60  | -    |
|                                                                                                 |                        | BTT0511    |       | M5              | 0,8   | 11   | 5    | 2    | 20  | -    |
|                                                                                                 |                        | BTT0615    |       | M6              | 1,0   | 15   | 6    | 2,5  | 20  | -    |
|              | Special Hollow Screw   | Cat. No.   | Stock | Dimensions (mm) |       |      |      |      |     |      |
|                                                                                                 |                        |            |       | d               | Pitch | L    | ℓ    | D    | B   | (Nm) |
|                                                                                                 |                        | BW0507F    | ●     | M5              | 0,5   | 7    | 1,2  | 6,3  | 3,5 | -    |
|                                                                                                 |                        | BW0609F    | ●     | M6              | 0,75  | 9    | 1,5  | 7,7  | 4   | -    |
|                                                                                                 |                        | BW0508F-SD |       | M5              | 0,5   | 8    | 1,2  | 6,3  | 3,5 | -    |
|                                                                                                 |                        | BW0810F-SD |       | M8              | 0,75  | 10   | 1,8  | 10   | 5   | -    |
|                                                                                                 |                        | BW0912F-SD |       | M9              | 0,75  | 12   |      |      |     | -    |

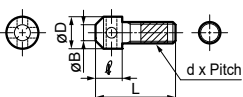
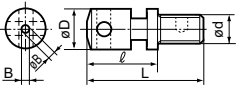
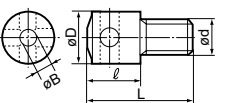
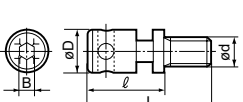
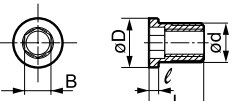
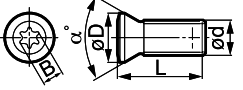
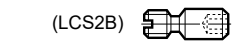
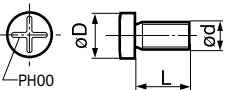
### ■ Screw

|                                                                                              |                         |             |       |                 |       |      |      |     |      |          |
|----------------------------------------------------------------------------------------------|-------------------------|-------------|-------|-----------------|-------|------|------|-----|------|----------|
| <br>BX0520T | Cap Screw               | Cat. No.    | Stock | Dimensions (mm) |       |      |      |     |      |          |
|                                                                                              |                         |             |       | d               | Pitch | L    | ℓ    | D   | B    | (Nm)     |
|                                                                                              |                         | BX0304      | ○     | M3              | 0,5   | 4    | Full | 5,5 | 2,5  | -        |
|                                                                                              |                         | BX0308      | ●     | M3              | 0,5   | 8    | Full | 5,5 | 2,5  | -        |
|                                                                                              |                         | BX0315      | ○     | M3              | 0,5   | 15   | Full | 5,5 | 2,5  | -        |
|                                                                                              |                         | BX0410      |       | M4              | 0,7   | 10   | Full | 7   | 3    | -        |
|                                                                                              |                         | BX0414      | ●     | M4              | 0,7   | 14   | Full | 7   | 3    | -        |
|                                                                                              |                         | BX0425      | ○     | M4              | 0,7   | 25   | 20   | 7   | 3    | -        |
|                                                                                              |                         | BX0508      |       | M5              | 0,8   | 8    | Full | 8,5 | 4    | -        |
|                                                                                              |                         | BX0510      |       | M5              | 0,8   | 10   | Full | 8,5 | 4    | -        |
|                                                                                              |                         | BX0512      | ●     | M5              | 0,8   | 12   | Full | 8,5 | 4    | -        |
|                                                                                              |                         | BX0515      | ●     | M5              | 0,8   | 15   | Full | 8,5 | 4    | -        |
|                                                                                              |                         | BX0520      | ●     | M5              | 0,8   | 20   | Full | 8,5 | 4    | 5,0      |
|                                                                                              |                         | BX0520T     | ●     | M5              | 0,8   | 20   | 16   | 8,5 | T20  | -        |
|                                                                                              |                         | BX0615      | ○     | M6              | 1,0   | 15   | Full | 10  | 5    | -        |
|                                                                                              |                         | BX0620      | ○     | M6              | 1,0   | 20   | Full | 10  | 5    | -        |
|                                                                                              |                         | BX0622      | ●     | M6              | 1,0   | 22   | 18   | 10  | 5    | -        |
|                                                                                              |                         | BX1045      | ○     | M10             |       |      |      |     |      |          |
|                                                                                              |                         | BX1060      | ○     | M10             | 1,5   | 60   |      | 16  | 8    |          |
|                                                                                              |                         | BX1070      | ○     | M10             |       |      |      |     |      |          |
|                                                                                              |                         | BX1240      | ○     | M12             |       |      |      |     |      |          |
|            | Cap Screw (Torx Plus)   | Cat. No.    | Stock | Dimensions (mm) |       |      |      |     |      |          |
|                                                                                              |                         |             |       | d               | Pitch | L    | ℓ    | D   | B    | (Nm)     |
|                                                                                              |                         | BXD02208IP  | ●     | M2,2            | 0,45  | 7,5  | 5,7  | 3,5 | 8IP  | -        |
|                                                                                              |                         | BXD02509IP  | ●     | M2,5            | 0,45  | 9    | 7    | 4,1 | 10IP | -        |
|                                                                                              |                         | BXD03011IP  | ●     | M3              | 0,5   | 10,5 | 8    | 4,9 | 15IP | -        |
|                                                                                              |                         | BXD03512IP  | ●     | M3,5            | 0,6   | 11,5 | 8,8  | 5,5 | 15IP | -        |
|                                                                                              |                         | BXD04014IP  | ●     | M4              | 0,7   | 12,5 | 9,5  | 6   | 20IP | -        |
|                                                                                              |                         | BXD04515IP  | ●     | M4,5            | 0,75  | 14,3 | 10,8 | 6,8 | 25IP | -        |
|           | Cap Screw (Torx Plus)   | Cat. No.    | Stock | Dimensions (mm) |       |      |      |     |      |          |
|                                                                                              |                         |             |       | d               | Pitch | L    | ℓ    | D   | H    | B        |
|                                                                                              |                         | BXA0310IP   | ○     | M3              | 0,5   | 7,5  | Full | 5,3 | 2,4  | 10IP 2,0 |
|                                                                                              |                         |             |       |                 |       |      |      |     |      | -        |
|           | Cap Screw with Oil Hole | Cat. No.    | Stock | Dimensions (mm) |       |      |      |     |      |          |
|                                                                                              |                         |             |       | d               | Pitch | L    | ℓ    | D   | H    | B        |
|                                                                                              |                         | BXH0825-D13 |       | M8              | 1,25  | 25   | Full | 13  | 8    | 6        |
|                                                                                              |                         | BXH1030-D16 |       | M10             | 1,5   | 30   | Full | 16  | 10   | 8        |
|                                                                                              |                         | BXH1235-D18 |       | M12             | 1,75  | 35   | Full | 18  | 12   | 10       |
|           | Cap Screw with Oil Hole | Cat. No.    | Stock | Dimensions (mm) |       |      |      |     |      |          |
|                                                                                              |                         |             |       | d               | Pitch | L    | ℓ    | D   | H1   | H2       |
|                                                                                              |                         | BXH1235-D33 |       | M12             | 1,75  | 35   | Full | 33  | 10   | 2        |
|                                                                                              |                         | BXH1635-D40 |       | M16             | 2,0   | 35   | 30   | 40  | 10   | -        |
|                                                                                              |                         | BXH2036-D50 |       | M20             | 2,5   | 36   | 29   | 50  | 14   | 17       |
|           | Cap Screw               | Cat. No.    | Stock | Dimensions (mm) |       |      |      |     |      |          |
|                                                                                              |                         |             |       | d               | Pitch | L    | ℓ    | D   | B    | (Nm)     |
|                                                                                              |                         | EHBX0512    | ●     | M5              | 0,8   | 12   | 10,5 | 8   | 4    | -        |
|           | Flat Head Screw         | Cat. No.    | Stock | Dimensions (mm) |       |      |      |     |      |          |
|                                                                                              |                         |             |       | d               | Pitch | L    | ℓ    | B   | α°   | (Nm)     |
|                                                                                              |                         | FBUP2-A0-8  | ○     | M3              | 0,5   | 10   | 5,5  | 2   | 82   | 1,0      |
|                                                                                              |                         | FBUP3-A0-9  | ●     |                 |       |      |      |     |      |          |
|                                                                                              |                         | FBUP4-A0-8  |       | M5              | 0,8   | 15   | 9,3  | 3   | 82   | 2,7      |
|           | Button Head Cap Screw   | Cat. No.    | Stock | Dimensions (mm) |       |      |      |     |      |          |
|                                                                                              |                         |             |       | d               | Pitch | L    | ℓ    | D   | B    | (Nm)     |
|                                                                                              |                         | FBUP3-A0-9  | ●     | M3              | 0,5   | 8    | Full | 5,5 | 2    | 1,0      |

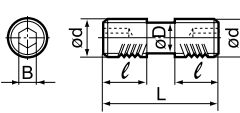
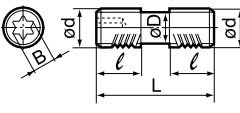
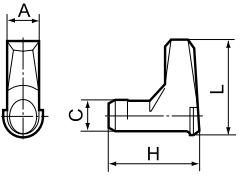
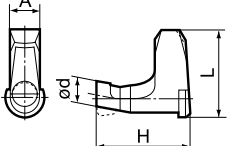
# SPARE PARTS

## Screw, Lever Pin

### ■ Screw

| Axial adjustment Screw                                                              |  | Cat. No.          |  | Stock | Dimensions (mm) |       |      |      |       |     |     |
|-------------------------------------------------------------------------------------|--|-------------------|--|-------|-----------------|-------|------|------|-------|-----|-----|
|                                                                                     |  |                   |  |       | d               | Pitch | L    | ℓ    | D     | B   | ⌀m  |
|    |  | <b>FMJ</b>        |  | ●     | M4              | 0,5   | 15   | 5    | 6     | 3   | -   |
|                                                                                     |  | Cat. No.          |  | Stock | Dimensions (mm) |       |      |      |       |     |     |
|                                                                                     |  |                   |  |       | d               | Pitch | L    | ℓ    | D     | B   | ⌀m  |
|    |  | <b>FMUJ</b>       |  | ○     | M4              | 0,7   | 17   | 10,5 | 6     | 1   | -   |
|                                                                                     |  | Cat. No.          |  | Stock | Dimensions (mm) |       |      |      |       |     |     |
|                                                                                     |  |                   |  |       | d               | Pitch | L    | ℓ    | D     | B   | ⌀m  |
|    |  | <b>RFJ</b>        |  | ○     | M4              | 0,7   | 12   | 6    | 6     | 2   | -   |
|                                                                                     |  | Cat. No.          |  | Stock | Dimensions (mm) |       |      |      |       |     |     |
|                                                                                     |  |                   |  |       | d               | Pitch | L    | ℓ    | D     | B   | ⌀m  |
|    |  | <b>SRFJ</b>       |  |       | M4              | 0,7   | 17   | 10,5 | 6     | 2   | -   |
| Special Hollow Screw                                                                |  | Cat. No.          |  | Stock | Dimensions (mm) |       |      |      |       |     |     |
|                                                                                     |  |                   |  |       | d               | Pitch | L    | ℓ    | D     | B   | ⌀m  |
|  |  | <b>KGBS1111</b>   |  | ●     | M5              | 0,5   | 8    | 1,2  | 6     | 3,5 |     |
|                                                                                     |  | <b>KGBS1221</b>   |  | ●     | M6              | 0,75  | 9    | 1,5  | 7,5   | 4,5 |     |
| Torx Flat Head Screw                                                                |  | Cat. No.          |  | Stock | Dimensions (mm) |       |      |      |       |     |     |
|                                                                                     |  |                   |  |       | d               | Pitch | L    | D    | B     | α°  | ⌀m  |
|  |  | <b>KSS1111</b>    |  | ●     | 3,5             | 0,6   | 11   | 5,2  | T15   | 55  | 3,5 |
|                                                                                     |  | <b>KSS1221</b>    |  | ●     | 4,5             | 0,75  | 12   | 6,6  | T15,3 | 55  | 4,5 |
| Screw for Lever Lock                                                                |  | Cat. No.          |  | Stock | Dimensions (mm) |       |      |      |       |     |     |
|                                                                                     |  |                   |  |       | d               | Pitch | L    | ℓ    | D     | B   | ⌀m  |
|  |  | <b>LCS2B</b>      |  |       | M3              | 0,5   | 10   | 3,05 | 3,6   | 2   | -   |
|                                                                                     |  | <b>LCS3</b>       |  | ●     | M6              | 1,0   | 17   | 10   | 6     | 2,5 | -   |
|                                                                                     |  | <b>LCS3B-SD</b>   |  |       | M5              | 0,8   | 9,5  | 4,2  | 5     | 2   | -   |
|                                                                                     |  | <b>LCS3DB-SD</b>  |  |       | M5              | 0,8   | 12   | 6    | 5     | 2   | -   |
|                                                                                     |  | <b>LCS3S</b>      |  |       | M6              | 1,0   | 15   | 10   | 6     | 2,5 | -   |
|                                                                                     |  | <b>LCS3TB-SD</b>  |  |       | M6              | 1,0   | 16,7 | 9,6  | 6     | 2,5 | -   |
|                                                                                     |  | <b>LCS3TE</b>     |  | ●     | M6              | 1,0   | 15,5 | 8,5  | 6     | 2,5 | -   |
|                                                                                     |  | <b>LCS4</b>       |  | ●     | M8              | 1,0   | 21   | 10   | 8     | 3   | -   |
|                                                                                     |  | <b>LCS4B-SD</b>   |  |       | M6              | 1,0   | 13,4 | 9    | 6     | 2,5 | -   |
|                                                                                     |  | <b>LCS41BS-SD</b> |  |       | M8              | 1,0   | 17   | 9,3  | 8     | 3   | -   |
|                                                                                     |  | <b>LCS42BS-SD</b> |  | ●     | M8              | 1,0   | 20,7 | 9,8  | 8     | 3   | -   |
|                                                                                     |  | <b>LCS4CA</b>     |  | ●     | M8              | 1,0   | 17,5 | 10   | 8     | 3   | -   |
|                                                                                     |  | <b>LCS5</b>       |  | ●     | M8              | 1,0   | 25   | 12   | 8     | 3   | -   |
|                                                                                     |  | <b>LCS5B-SD</b>   |  |       | M8              | 1,0   | 20,5 | 12,3 | 8     | 3   | -   |
|                                                                                     |  | <b>LCS5DB-SD</b>  |  |       | M8              | 1,0   | 21,1 | 11,4 | 8     | 3   | -   |
|                                                                                     |  | <b>LCS6</b>       |  | ○     | M10             | 1,0   | 27,2 | 14,4 | 9,8   | 4   | -   |
|                                                                                     |  | <b>LCS6B-SD</b>   |  | ●     | M10             | 1,0   | 27,2 | 14,4 | 10    | 4   | -   |
|                                                                                     |  | <b>LCS10</b>      |  | ●     | M5              | 0,8   | 14,5 | 8,5  | 5     | 2   | -   |
|                                                                                     |  | <b>LCS12</b>      |  | ●     | M6              | 1,0   | 17   | 9,6  | 6     | 2,5 | -   |
|                                                                                     |  | <b>LCS16</b>      |  | ●     | M6              | 1,0   | 21   | 13,6 | 6     | 2,5 | -   |
|                                                                                     |  | <b>LCS20</b>      |  | ●     | M8              | 1,0   | 23,5 | 13,2 | 8     | 3   | -   |
|                                                                                     |  | <b>LCS25</b>      |  |       | M10             | 1,0   | 30   | 17,4 | 10    | 4   | -   |
|                                                                                     |  | <b>LCS32</b>      |  |       | M12             | 1,0   | 36   | 19,3 | 12    | 5   | -   |
|                                                                                     |  | Cat. No.          |  | Stock | Dimensions (mm) |       |      |      |       |     |     |
|                                                                                     |  |                   |  |       | d               | Pitch | L    | -    | D     | -   | ⌀m  |
|  |  | <b>MIB1.6-2</b>   |  | ●     | M1,6            | 0,35  | 2,0  | -    | 2,4   | -   | 0,2 |
|                                                                                     |  | <b>MIB1.6-2.5</b> |  | ●     | M1,6            | 0,35  | 2,5  | -    | 2,4   | -   | 0,2 |
|                                                                                     |  | <b>MIB1.6-3</b>   |  | ●     | M1,6            | 0,35  | 3,0  | -    | 2,4   | -   | 0,2 |

### ■ Double Screw

| Double Screw                                                                         |  | Cat. No.         |  | Stock | Dimensions (mm) |       |       |      |     |     |    |
|--------------------------------------------------------------------------------------|--|------------------|--|-------|-----------------|-------|-------|------|-----|-----|----|
|                                                                                      |  |                  |  |       | d               | Pitch | L     | ℓ    | D   | B   | ⌀m |
|    |  | <b>WB4-8</b>     |  |       | M4              | 0,7   | 7,5   | 3    | 3,0 | 2   | -  |
|                                                                                      |  | <b>WB5-10</b>    |  | ●     | M5              | 0,8   | 10    | 4    | 3,8 | 2,5 | -  |
|                                                                                      |  | <b>WB5-12</b>    |  | ○     | M5              | 0,8   | 12    | 5    | 3,8 | 2,5 | -  |
|                                                                                      |  | <b>WB5-18</b>    |  | ○     | M5              |       |       |      |     |     |    |
|                                                                                      |  | <b>WB6-13</b>    |  | ○     | M6              | 1,0   | 13    | 5    | 4,5 | 3   | -  |
|                                                                                      |  | <b>WB6-16</b>    |  | ●     | M6              | 1,0   | 16    | 6    | 4,5 | 3   | -  |
|                                                                                      |  | <b>WB6-20</b>    |  | ○     | M6              | 1,0   | 20    | 8,5  | 4,5 | 3   | -  |
|                                                                                      |  | <b>WB6-30</b>    |  | ○     | M6              | 1,0   | 30    | 12   | 4,5 | 3   | -  |
|                                                                                      |  | <b>WB8-20</b>    |  | ●     | M8              | 1,25  | 20    | 8,5  | 6,2 | 4   | -  |
|                                                                                      |  | <b>WB8-24</b>    |  | ●     | M8              | 1,25  | 24    | 8,5  | 6,2 | 4   | -  |
|                                                                                      |  | <b>WB8-30</b>    |  | ●     | M8              | 1,25  | 30    | 11,5 | 6,2 | 4   | -  |
|                                                                                      |  | <b>WB8F-30</b>   |  |       | M8              | 1,0   | 30    | 11,5 | 6,2 | 4   | -  |
| Torx Double Screw                                                                    |  | Cat. No.         |  | Stock | Dimensions (mm) |       |       |      |     |     |    |
|                                                                                      |  |                  |  |       | d               | Pitch | L     | ℓ    | D   | B   | ⌀m |
|    |  | <b>WB6-16T</b>   |  | ●     | M6              | 1,0   | 16    | 6    | 4,5 | T20 | -  |
|                                                                                      |  | <b>WB6-20T</b>   |  | ○     | M6              | 1,0   | 20    | 8,5  | 4,5 | T20 | -  |
|                                                                                      |  | <b>WB6-20TL</b>  |  | ○     | M6              | 1,0   | 20    | 8,5  | 4,5 | T20 | -  |
|                                                                                      |  | <b>WB7-15T</b>   |  | ●     | M7              | 1,0   | 15    | 5,5  | 5   | T25 | -  |
|                                                                                      |  | <b>WB7F-15T</b>  |  |       | M7              | 0,75  | 15    | 8,5  | 5,5 | T25 | -  |
|                                                                                      |  | <b>WB7F-20TL</b> |  |       | M7              | 0,75  | 20    | 8,5  | 5,5 | T25 | -  |
|                                                                                      |  | <b>WB8-22T</b>   |  | ●     | M8              | 1,25  | 22    | 8,5  | 6,2 | T27 | -  |
|                                                                                      |  | <b>WB8-22TL</b>  |  | ○     | M8              | 1,25  | 22    | 8,5  | 6,2 | T27 | -  |
|                                                                                      |  | <b>WB8-30T</b>   |  | ●     | M8              | 1,25  | 30    | 11,5 | 6,2 | T27 | -  |
|                                                                                      |  | <b>WB8-30TL</b>  |  |       | M8              | 1,25  | 30    | 11,5 | 6,2 | T27 | -  |
|                                                                                      |  | <b>WB8R-16T</b>  |  | ○     | M8              | 1,25  | 14    | 5,5  | 6,2 | T27 | -  |
| Lever Pin                                                                            |  | Cat. No.         |  | Stock | Dimensions (mm) |       |       |      |     |     |    |
|                                                                                      |  |                  |  |       | A               | H     | L     | C    |     |     |    |
|  |  | <b>LCL3</b>      |  |       | 3,7             | 12    | 10    | 3,6  |     |     |    |
|                                                                                      |  | <b>LCL3-SD</b>   |  | ●     | 3,7             | 12    | 10    | 3,55 |     |     |    |
|                                                                                      |  | <b>LCL3C-SD</b>  |  |       | 3,1             | 7,8   | 9,9   | 3,1  |     |     |    |
|                                                                                      |  | <b>LCL3D-SD</b>  |  | ●     | 3,7             | 11,5  | 12    | 3,55 |     |     |    |
|                                                                                      |  | <b>LCL3DB-SD</b> |  |       | 3,1             | 9,4   | 11,5  | 3,1  |     |     |    |
|                                                                                      |  | <b>LCL3S</b>     |  | ●     | 3,7             | 10,6  | 10    | 3,6  |     |     |    |
|                                                                                      |  | <b>LCL3T-SD</b>  |  |       | 2,6             | 6,3   | 7,2   | 2,15 |     |     |    |
|                                                                                      |  | <b>LCL4</b>      |  |       | 4,7             | 14    | 14,55 | 4,7  |     |     |    |
|                                                                                      |  | <b>LCL4-SD</b>   |  | ●     | 4,65            | 13,2  | 13,35 | 4,7  |     |     |    |
|                                                                                      |  | <b>LCL4C-SD</b>  |  |       | 4,65            | 10    | 13,35 | 4,7  |     |     |    |
|                                                                                      |  | <b>LCL4D-SD</b>  |  | ●     | 4,65            | 14,8  | 16    | 4,7  |     |     |    |
|                                                                                      |  | <b>LCL4T-SD</b>  |  |       | 4,65            | 13,2  | 13,35 | 4,7  |     |     |    |
|                                                                                      |  | <b>LCL5</b>      |  |       | 6               | 17    | 17,1  | 6    |     |     |    |
|                                                                                      |  | <b>LCL5-SD</b>   |  |       | 6               | 17,3  | 16,65 | 6    |     |     |    |
|                                                                                      |  | <b>LCL5C-SD</b>  |  |       | 7,5             | 18,1  | 20,5  | 7,5  |     |     |    |
|                                                                                      |  | <b>LCL6-SD</b>   |  |       | 7,5             | 21    | 20,5  | 7,5  |     |     |    |
|                                                                                      |  | <b>LCL8</b>      |  |       | 8,6             | 25,4  | 25,4  | 8,6  |     |     |    |
|                                                                                      |  | Cat. No.         |  | Stock | Dimensions (mm) |       |       |      |     |     |    |
|                                                                                      |  |                  |  |       | A               | H     | L     | C    |     |     |    |
|  |  | <b>LCL06</b>     |  | ●     | 2,5             | 6,28  | 7,0   | 2    |     |     |    |
|                                                                                      |  | <b>LCL09</b>     |  | ●     | 3,5             | 9,3   | 10,75 | 3    |     |     |    |
|                                                                                      |  | <b>LCL10</b>     |  | ●     | 3,4             | 11,8  | 10,8  | 3    |     |     |    |
|                                                                                      |  | <b>LCL12</b>     |  | ●     | 3,7             | 13,4  | 12,9  | 3,5  |     |     |    |
|                                                                                      |  | <b>LCL16</b>     |  | ●     | 4,6             | 17,6  | 18,4  | 4,4  |     |     |    |
|                                                                                      |  | <b>LCL20</b>     |  | ○     | 6               | 18,9  | 20,4  | 5,6  |     |     |    |
|                                                                                      |  | <b>LCL32</b>     |  |       | 8,5             | 26,8  | 29,8  | 8    |     |     |    |



# SPARE PARTS

## Shim

### Shim

|  |           |       |                 |      |     |     |   |
|--|-----------|-------|-----------------|------|-----|-----|---|
|  | Cat. No.  | Stock | Dimensions (mm) |      |     |     |   |
|  | CCS09T3   | ●     | 8,525           | 2,38 | 5,4 | 6,4 |   |
|  | Cat. No.  | Stock | Dimensions (mm) |      |     |     |   |
|  | CNS1204   | ●     | 12,57           | 4,76 | 4,4 | 6,0 |   |
|  | CNS1606   | ●     | 15,75           | 4,76 | 5,5 | 7,5 |   |
|  | CNS1906   | ●     | 18,70           | 6,35 | 5,5 | 7,5 |   |
|  | CNS2509   | ○     | 25,27           | 6,35 | 6,6 | 9,5 |   |
|  | CNS1203B  | ●     | 12,57           | 3,18 | 3,4 | 4,5 |   |
|  | CNS1204B  | ●     | 12,57           | 4,76 | 4,4 | 6,0 |   |
|  | Cat. No.  | Stock | Dimensions (mm) |      |     |     |   |
|  | DCS11T3   | ●     | 8,5             | 2,38 | 5,3 | 6,4 |   |
|  | Cat. No.  | Stock | Dimensions (mm) |      |     |     |   |
|  | DGCS13R   | ●     | 13,7            | 3,9  | 6,8 | 8,8 | 5 |
|  | Cat. No.  | Stock | Dimensions (mm) |      |     |     |   |
|  | DNS1504   | ●     | 12,57           | 6,35 | 4,4 | 6,0 |   |
|  | DNS1506   | ●     | 12,57           | 4,76 | 4,4 | 6,0 |   |
|  | DNS1104B  | ○     | 9,45            | 4,73 | 3,4 | 4,5 |   |
|  | DNS1504B  | ○     | 12,57           | 6,35 | 4,4 | 6,0 |   |
|  | DNS1506B  | ○     | 12,57           | 4,76 | 4,4 | 6,0 |   |
|  | Cat. No.  | Stock | Dimensions (mm) |      |     |     |   |
|  | HE060011E | ●     |                 |      |     |     |   |
|  | Cat. No.  | Stock | Dimensions (mm) |      |     |     |   |
|  | LST317SD  | ●     | 9,5             | 2,7  | 5,2 |     |   |
|  | LST42SD   |       | 12,65           | 3,18 | 6,9 |     |   |
|  | Cat. No.  | Stock | Dimensions (mm) |      |     |     |   |
|  | LSS32SD   |       | 9,48            | 3,18 | 5   |     |   |
|  | LSS42SD   | ●     | 12,65           | 3,18 | 6,9 |     |   |
|  | LSS53SD   |       | 15,85           | 4,76 | 7,9 |     |   |
|  | LSS63SD   |       | 19              | 4,76 | 10  |     |   |
|  | Cat. No.  | Stock | Dimensions (mm) |      |     |     |   |
|  | LSC32SD   |       |                 | 3,18 | 5   |     |   |
|  | LSC42SD   | ●     | 12,65           | 3,18 | 6,9 |     |   |
|  | LSC53SD   |       | 15,85           | 4,76 | 7,9 |     |   |
|  | LSC63SD   | ●     | 19              | 4,76 | 10  |     |   |
|  | Cat. No.  | Stock | Dimensions (mm) |      |     |     |   |
|  | LSD32SD   | ●     | 8,5             | 3,18 | 5   |     |   |
|  | LSD42SD   |       | 12,65           | 3,18 | 6,9 |     |   |

### Shim

|  |          |       |                 |      |      |      |    |
|--|----------|-------|-----------------|------|------|------|----|
|  | Cat. No. | Stock | Dimensions (mm) |      |      |      |    |
|  | LSR817   | ○     | 8,4             | 2,7  | 5,2  |      |    |
|  | LSR10    | ●     | 8,4             | 3,18 | 4,7  |      |    |
|  | LSR12    | ●     | 10              | 3,18 | 4,7  |      |    |
|  | LSR16    | ●     | 13,5            | 4,76 | 6,3  |      |    |
|  | LSR20    | ●     | 17,2            | 4,76 | 7,9  |      |    |
|  | LSR25    |       | 22              | 6,35 | 9,5  |      |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |      |      |    |
|  | LSTE31-0 | ●     | 9,5             | 2,7  | 2,7  | 5,2  |    |
|  | LSTE31-1 | ●     | 9,5             | 2,67 | 2,91 | 5,2  |    |
|  | LSTE31-2 | ●     | 9,5             | 2,64 | 3,11 | 5,2  |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |      |      |    |
|  | SCND433  | ○     | 12,65           | 4,76 | 3,4  |      | 80 |
|  | SCN0903  |       | 9,5             | 3,18 | 3,4  |      |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |      |      |    |
|  | SCS1204  |       | 11,5            | 3,18 | 6,4  | 7,9  |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |      |      |    |
|  | SNS1204  | ●     | 12,57           | 4,76 | 4,4  | 6,0  |    |
|  | SNS1506  |       | 15,75           | 4,76 | 5,5  | 7,5  |    |
|  | SNS1906  | ●     | 18,92           | 6,35 | 5,5  | 7,5  |    |
|  | SNS2507  | ○     | 25,27           | 7,93 | 6,6  | 9,5  |    |
|  | SNS2509  | ●     | 25,27           | 6,35 | 6,6  | 9,5  |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |      |      |    |
|  | SVW322   | ○     | 9,5             | 3,18 | 4,7  | 6,5  | 35 |
|  | SFW433   |       | 12,65           | 4,76 | 6,2  | 8,0  | 50 |
|  | SDW323   | ●     | 9,5             | 3,18 | 4,7  | 6,5  | 55 |
|  | SDW423   | ●     | 12,65           | 3,18 | 6,2  | 8,0  | 55 |
|  | SDW433   |       | 12,65           | 3,18 | 6,2  | 8,0  |    |
|  | SCW423   | ●     | 12,65           | 3,18 | 6,2  | 8,0  | 80 |
|  | SCW433   |       |                 |      |      |      |    |
|  | SCW635   | ○     | 19              | 4,76 | 9    | 11,5 | 80 |
|  |          |       |                 |      |      |      |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |      |      |    |
|  | SRND32   | ●     | 9,5             |      |      |      |    |
|  | SRND42   | ○     | 12,7            |      |      |      |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |      |      |    |
|  | SSND423  |       | 12,5            | 3,18 | 3,4  |      |    |
|  | SSND423Z | ○     |                 |      |      |      |    |
|  | SSND433  | ○     | 12,5            | 4,76 | 3,4  |      |    |

# SPARE PARTS

## Shim, Nut

### Shim

|  |          |       |                 |      |                |                |    |
|--|----------|-------|-----------------|------|----------------|----------------|----|
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | SSW423   |       | A               | T    | d <sub>1</sub> | d <sub>2</sub> |    |
|  | SSW433   | ●     | 12,65           | 3,18 | 6,2            | 8              |    |
|  | SSW635   |       | 19              | 4,76 | 9              | 11,5           |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | STPD322  | ●     | A               | T    | d              |                | θ° |
|  | STPD422  | ○     | 8,4             | 3,18 | 3,4            |                | 6  |
|  |          |       | 11,0            | 3,18 | 3,4            |                | 6  |
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | STW323   | ●     | A               | T    | d <sub>1</sub> | d <sub>2</sub> |    |
|  | STW434   | ●     | 9,5             | 3,18 | 4,7            | 6,5            |    |
|  | STW333   | ○     | 12,65           | 4,76 | 6,2            | 8              |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | SWW433   | ●     | A               | T    | d <sub>1</sub> | d <sub>2</sub> |    |
|  | LSW317   | ●     | 12,65           | 5,15 | 6,2            | 8              |    |
|  |          |       |                 |      |                |                |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | TCS16T3  |       | A               | T    | d <sub>1</sub> | d <sub>2</sub> | θ° |
|  |          |       | 8,8             | 2,38 | 5,3            | 6,3            | 7  |
|  |          |       |                 |      |                |                |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | TNS1604  | ●     | A               | T    | d <sub>1</sub> | d <sub>2</sub> |    |
|  | TNS1603B | ○     | 9,45            | 4,76 | 3,4            | 4,5            |    |
|  | TNS1604B | ○     | 9,45            | 3,18 | 3,4            | 4,5            |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | TRW5505  | ●     | A               | T    | d <sub>1</sub> | d <sub>2</sub> |    |
|  |          |       | 10,5            | 4,76 | 3,4            | 4,5            |    |
|  |          |       |                 |      |                |                |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | VCS1604  | ●     | A               | T    | d <sub>1</sub> | d <sub>2</sub> |    |
|  |          |       | 8,25            | 3,18 | 5,3            | 6,4            |    |
|  |          |       |                 |      |                |                |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | VNS1604  | ●     | A               | T    | d <sub>1</sub> | d <sub>2</sub> |    |
|  |          |       | 9,45            | 4,76 | 3,4            | 4,5            |    |
|  |          |       |                 |      |                |                |    |

### Shim

|  |          |       |                 |      |                |                |    |
|--|----------|-------|-----------------|------|----------------|----------------|----|
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | WFXS4R   | ●     | A               | T    | d <sub>1</sub> | d <sub>2</sub> |    |
|  |          |       | 10,17           | 3,0  | 5,5            | 7,5            |    |
|  |          |       |                 |      |                |                |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | WGCS13R  | ●     | A               | T    | d <sub>1</sub> | d <sub>2</sub> | θ° |
|  |          |       | 10,7            | 3,0  | 5,5            | 7,5            | 5  |
|  |          |       |                 |      |                |                |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | WNS0604  | ●     | A               | T    | d <sub>1</sub> | d <sub>2</sub> |    |
|  | WNS0804  | ●     | 9,52            | 3,18 | 3,5            | 4,5            |    |
|  | WNS0603B | ●     | 12,57           | 4,76 | 4,4            | 6,3            |    |
|  | WNS0803B | ○     | 9,27            | 3,18 | 3,4            | 4,5            |    |
|  | WNS0804B | ○     | 12,57           | 3,18 | 3,4            | 4,5            |    |
|  | Cat. No. | Stock | Dimensions (mm) |      |                |                |    |
|  | YE3      | ●     | A               | T    | d              |                |    |
|  | YI3      | ●     | 9,5             | 3,2  | 4              |                |    |
|  |          |       | 9,5             | 3,2  | 4              |                |    |

### Seat

|  |          |       |                 |    |   |  |  |
|--|----------|-------|-----------------|----|---|--|--|
|  | Cat. No. | Stock | Dimensions (mm) |    |   |  |  |
|  | PWSS4R   | ▲     | d               | L  | H |  |  |
|  |          |       | 4,6             | 15 | 8 |  |  |
|  |          |       |                 |    |   |  |  |

### Ring

|  |          |       |                 |     |     |   |  |
|--|----------|-------|-----------------|-----|-----|---|--|
|  | Cat. No. | Stock | Dimensions (mm) |     |     |   |  |
|  | ER03     |       | A               | B   | T   | d |  |
|  | ER04     | ●     | 7               | 2,6 | 0,6 | 3 |  |
|  | ER05     | ●     | 9               | 3,5 | 0,6 | 4 |  |

### Nut

|  |          |       |                 |       |     |     |     |
|--|----------|-------|-----------------|-------|-----|-----|-----|
|  | Cat. No. | Stock | Dimensions (mm) |       |     |     |     |
|  | BNBW-2   | ●     | L               |       |     |     |     |
|  | BNBW-4   | ○     | 3               |       |     |     |     |
|  | BNBW-7   | ○     | 4               |       |     |     |     |
|  | Cat. No. | Stock | Dimensions (mm) |       |     |     |     |
|  | CPM32N   | ●     | L               | D     | B   |     |     |
|  | CPM43N   | ●     | 7,5             | 7     | 3   |     |     |
|  | CPM43S   | ○     | 8,5             | 7     | 3   |     |     |
|  | Cat. No. | Stock | Dimensions (mm) |       |     |     |     |
|  | CPV33N   | ●     | d               | Pitch | L   | D   | B   |
|  |          |       | M4              | 0,5   | 6,0 | 6,0 | 2,5 |
|  |          |       |                 |       |     |     |     |

### Shim Pin

|  |           |       |                 |      |      |     |      |      |
|--|-----------|-------|-----------------|------|------|-----|------|------|
|  | Cat. No.  | Stock | Dimensions (mm) |      |      |     |      |      |
|  | HE060011P | ●     | M6              | 0,75 | 14,5 | 7,8 | 5,0  | 2,5  |
|  | Cat. No.  | Stock | Dimensions (mm) |      |      |     |      |      |
|  | LP04      | ●     | 0,4             | 1,1  | 4,7  |     |      |      |
|  | LP06      | ●     | 0,4             | 1,1  | 6,0  |     |      |      |
|  | LP07      | ●     | 0,4             | 1,1  | 7,7  |     |      |      |
|  | Cat. No.  | Stock | Dimensions (mm) |      |      |     |      |      |
|  | LSP3      |       | 5               | 3,5  | 5,5  |     |      |      |
|  | LSP3SD    | ●     | 5               | 3,5  | 5,5  |     |      |      |
|  | LSP4      |       | 6,7             | 4    | 7    |     |      |      |
|  | LSP4SD    |       | 6,7             | 4    | 7    |     |      |      |
|  | LSP5SD    |       | 7,7             | 4,5  | 8,5  |     |      |      |
|  | LSP6SD    |       | 9,85            | 5,9  | 11,1 |     |      |      |
|  | LSP8      |       | 13,05           | 10   | 12   |     |      |      |
|  | LSP10     | ●     | 5               | 3,3  | 6,5  |     |      |      |
|  | LSP16     | ●     | 6,6             | 4,5  | 9    |     |      |      |
|  | LSP20     | ●     | 8,2             | 5,5  | 9    |     |      |      |
|  | LSP25     | ○     | 9,8             | 6,5  | 11   |     |      |      |
|  | LSP32     |       | 13              | 10   | 12   |     |      |      |
|  | Cat. No.  | Stock | Dimensions (mm) |      |      |     |      |      |
|  | MP317     |       | M4              | 0,7  | 15,5 | 6   | 4    | 3,7  |
|  | MP320     | ●     | M4              | 0,7  | 19,5 | 6   | 4    | 3,7  |
|  | MP416     | ●     | M5              | 0,8  | 14   | 7,5 | 6    | 5    |
|  | MP420     | ●     | M5              | 0,8  | 20   | 7,5 | 6    | 5    |
|  | MP432     |       | M5              | 0,8  | 32   | 7,5 | 6    | 5    |
|  | MP531     |       |                 |      |      |     |      |      |
|  | MP534     |       |                 |      |      |     |      |      |
|  | Cat. No.  | Stock | Dimensions (mm) |      |      |     |      |      |
|  | SPP308    |       | 3,2             |      | 8    | 4,8 |      | 120  |
|  | Cat. No.  | Stock | Dimensions (mm) |      |      |     |      |      |
|  | SPP3      | ●     |                 |      | 14   | 3,2 |      |      |
|  | Cat. No.  | Stock | Dimensions (mm) |      |      |     |      |      |
|  | VP20      | ●     | M3,5            | M4   | 12,0 | 5,0 | ≥4,5 | ≥4,5 |
|  | VP25      | ●     | M3,5            | M4   | 17,0 | 5,0 | ≥4,5 | ≥4,5 |
|  | VP32      | ●     | M3,5            | M4   | 24,0 | 5,0 | ≥4,5 | ≥4,5 |
|  | Cat. No.  | Stock | Dimensions (mm) |      |      |     |      |      |
|  | VP32B     | ●     | M3,5            | 0,6  | 8,0  | 1,4 | 5,0  | 6,5  |
|  | VP40B     | ●     | M3,5            | 0,6  | 11,5 | 1,4 | 5,0  | 6,5  |

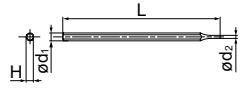
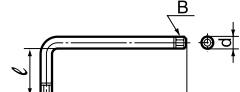
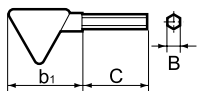
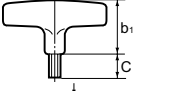
### Eccentric Pin

|  |          |       |                 |       |                |    |     |     |
|--|----------|-------|-----------------|-------|----------------|----|-----|-----|
|  | Cat. No. | Stock | Dimensions (mm) |       |                |    |     |     |
|  | CPB34    | ●     | 3,4             | 4,1   | 5,5            | 14 | 5   | 2,5 |
|  | CPB35    | ○     | 3,4             | 4,1   | 5,5            | 17 | 5   | 2,5 |
|  | CPB42    | ●     | 4,5             | 5,5   | 7              | 14 | 5   | 3   |
|  | CPB43    | ●     | 4,5             | 5,5   | 7              | 19 | 5   | 3   |
|  | CPB43S   | ●     | 4,5             | 5,5   | 7              | 16 | 5   | 3   |
|  | CPB44T   | ○     | 4,5             | 5,5   | 7              | 22 | 5   | 3   |
|  | CPB45T   | ○     | 4,5             | 5,5   | 7              | 27 | 5   | 3   |
|  | CPB64    | ○     | 6,8             | 8,2   | 10,5           | 24 | 6,6 | 4   |
|  | Cat. No. | Stock | Dimensions (mm) |       |                |    |     |     |
|  | CPU304C  | ○     | 3,3             | 5,5   | -              | 10 | 3,5 | 3   |
|  | Cat. No. | Stock | Dimensions (mm) |       |                |    |     |     |
|  | TRXW10IP |       | 10IP            | 2,6   | 40             | 75 | 40  |     |
|  | Cat. No. | Stock | Dimensions (mm) |       |                |    |     |     |
|  | TRB10IP  | ●     | 10IP            | 4     |                |    |     |     |
|  | TRB15IP  | ●     | 15IP            | 4     |                |    |     |     |
|  | TRB20IP  | ●     | 20IP            | 4,55  |                |    |     |     |
|  | TRB25IP  | ●     | 25IP            | 5     |                |    |     |     |
|  | Cat. No. | Stock | Dimensions (mm) |       |                |    |     |     |
|  | HPS1015  | ●     | 32              | 99,4  | For 10IP, 15IP |    |     |     |
|  | HPL2025  |       | 35,5            | 110,3 | For 20IP, 25IP |    |     |     |

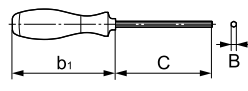
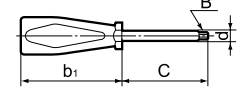
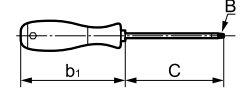
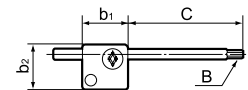
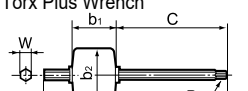
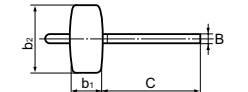
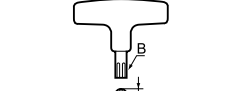
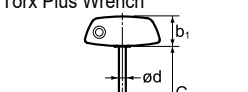
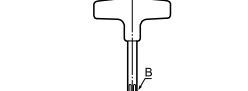
# SPARE PARTS

## Wrench

### Wrench

|                                                                                                                      |                  |       |                 |      |      |      |  |
|----------------------------------------------------------------------------------------------------------------------|------------------|-------|-----------------|------|------|------|--|
| <b>Socket Wrench</b><br>            | Cat. No.         | Stock | Dimensions (mm) |      |      |      |  |
|                                                                                                                      | ANT              |       | d1              | d2   | L    | H    |  |
| <b>Hex Wrench (Hexagonal)</b><br>   | Cat. No.         | Stock | Dimensions (mm) |      |      |      |  |
|                                                                                                                      |                  |       | B               | L    | l    |      |  |
|                                                                                                                      | LH020            | ●     | 2               | 50   | 16   |      |  |
|                                                                                                                      | LH025            | ●     | 2,5             | 56   | 18   |      |  |
|                                                                                                                      | LH030            | ●     | 3               | 63   | 20   |      |  |
|                                                                                                                      | LH035            | ●     | 3,5             | 68   | 22   |      |  |
|                                                                                                                      | LH040            | ●     | 4               | 70   | 25   |      |  |
|                                                                                                                      | LH050            | ○     | 5               | 80   | 28   |      |  |
|                                                                                                                      | LH060            | ○     | 6               | 90   | 32   |      |  |
|                                                                                                                      | Cat. No.         | Stock | Dimensions (mm) |      |      |      |  |
|                                                                                                                      | LH035K<br>LH045K | ●     |                 |      |      |      |  |
| <b>Torx Wrench</b><br>            | Cat. No.         | Stock | Dimensions (mm) |      |      |      |  |
|                                                                                                                      |                  |       | B               | d    | L    | l    |  |
|                                                                                                                      | LT15             | ○     | T15             |      |      |      |  |
|                                                                                                                      | LT20             | ○     | T20             | 3,9  | 57,2 | 19,1 |  |
|                                                                                                                      | LT25             | ○     | T25             | 4,4  | 60,3 | 20,2 |  |
|                                                                                                                      | LT27             | ●     | T27             | 4,96 | 63,5 | 21,5 |  |
|                                                                                                                      | LT1510           | ○     | T15             | 3,26 | 62   | 10   |  |
|                                                                                                                      |                  |       |                 |      |      |      |  |
|                                                                                                                      | Cat. No.         | Stock | Dimensions (mm) |      |      |      |  |
|                                                                                                                      | LT15K            | ●     |                 |      |      |      |  |
| <b>Torx Plus Wrench</b><br>       | Cat. No.         | Stock | Dimensions (mm) |      |      |      |  |
|                                                                                                                      |                  |       | B               | d    | L    | l    |  |
|                                                                                                                      | LT151P           | ○     |                 |      |      |      |  |
|                                                                                                                      | LT201P           |       | T20             | 4,0  | 57   | 18,5 |  |
|                                                                                                                      | LT251P           |       | T25             | 4,5  | 60   | 19,5 |  |
|                                                                                                                      | Cat. No.         | Stock | Dimensions (mm) |      |      |      |  |
|                                                                                                                      | SDBSM            | ●     |                 |      |      |      |  |
| <b>Hex Wrench (Hexagonal)</b><br> | Cat. No.         | Stock | Dimensions (mm) |      |      |      |  |
|                                                                                                                      |                  |       | B               | b1   | C    |      |  |
|                                                                                                                      | TH015            |       | 1,5             | 35   | 30   |      |  |
|                                                                                                                      | TH020            | ●     | 2               | 35   | 39   |      |  |
|                                                                                                                      | TH025            | ●     | 2,5             | 35   | 39   |      |  |
| <b>Hex Wrench (Hexagonal)</b><br> | Cat. No.         | Stock | Dimensions (mm) |      |      |      |  |
|                                                                                                                      |                  |       | B               | b1   | C    |      |  |
|                                                                                                                      | TH030            | ●     | 3               | 48   | 28   |      |  |
|                                                                                                                      | TH040            | ●     | 4               | 48   | 37   |      |  |
|                                                                                                                      | TH050            | ○     | 5               | 48   | 45   |      |  |

### Wrench

|                                                                                                                       |            |       |                 |      |     |      |  |
|-----------------------------------------------------------------------------------------------------------------------|------------|-------|-----------------|------|-----|------|--|
| <b>Hex Wrench (Hexagonal)</b><br>   | Cat. No.   | Stock | Dimensions (mm) |      |     |      |  |
|                                                                                                                       | HD040      | ○     | 4               | 75   | 111 |      |  |
| <b>Torx Wrench</b><br>              | Cat. No.   | Stock | Dimensions (mm) |      |     |      |  |
|                                                                                                                       |            |       | B               | d    | C   | B1   |  |
|                                                                                                                       | TRD07      | ●     | T7              | 2,0  | 45  | 70   |  |
|                                                                                                                       | TRD08      | ●     | T8              | 2,3  | 55  | 70   |  |
|                                                                                                                       | TRD15      | ○     | T15             | 3,3  | 70  | 100  |  |
|                                                                                                                       | TRD20      | ●     | T20             | 3,9  | 100 | 90   |  |
|                                                                                                                       | TRD25      | ●     | T25             | 5,3  | 80  | 110  |  |
| <b>Torx Plus Wrench</b><br>         | Cat. No.   | Stock | Dimensions (mm) |      |     |      |  |
|                                                                                                                       |            |       | B               | C    | b1  |      |  |
|                                                                                                                       | TRDR06IP05 | ●     |                 |      |     |      |  |
|                                                                                                                       | TRDR08IP   | ●     | 8IP             | 60   | 104 |      |  |
|                                                                                                                       | TRDR10IP   | ●     | 10IP            | 80   | 111 |      |  |
|                                                                                                                       | TRDR15IP   | ●     | 15IP            | 80   | 111 |      |  |
|                                                                                                                       | TRDR20IP   | ●     | 20IP            | 100  | 118 |      |  |
|                                                                                                                       | TRDR25IP   | ●     | 25IP            | 100  | 118 |      |  |
| <b>Torx Wrench</b><br>            | Cat. No.   | Stock | Dimensions (mm) |      |     |      |  |
|                                                                                                                       |            |       | B               | C    | b1  | b2   |  |
|                                                                                                                       | TRX06      | ●     | T6              | 35,5 | 15  | 15   |  |
|                                                                                                                       | TRX08      | ●     | T8              | 38,5 | 19  | 19   |  |
|                                                                                                                       | TRX10      | ●     | T10             | 42,1 | 22  | 22   |  |
|                                                                                                                       | TRX15      | ●     | T15             | 46   | 22  | 27   |  |
|                                                                                                                       | TRX20      | ●     | T20             | 49   | 22  | 30   |  |
| <b>Torx Plus Wrench</b><br>       | Cat. No.   | Stock | Dimensions (mm) |      |     |      |  |
|                                                                                                                       |            |       | B               | C    | b1  | b2   |  |
|                                                                                                                       | TRX06IP    | ●     | 6IP             | 34   | 15  | 15   |  |
| <b>Hex Wrench (Hexagonal)</b><br> | Cat. No.   | Stock | Dimensions (mm) |      |     |      |  |
|                                                                                                                       | TSW040     | ●     | 4               | 60   | 20  | 40   |  |
| <b>Torx Wrench</b><br>            | Cat. No.   | Stock | Dimensions (mm) |      |     |      |  |
|                                                                                                                       |            |       | B               | d    |     |      |  |
|                                                                                                                       | TT25       | ●     | T25             | 4,4  |     |      |  |
|                                                                                                                       | TT27       | ●     | T27             | 5,0  |     |      |  |
| <b>Torx Plus Wrench</b><br>       | Cat. No.   | Stock | Dimensions (mm) |      |     |      |  |
|                                                                                                                       |            |       | B               | d    | C   | b1   |  |
|                                                                                                                       | TTR15IP    | ●     | 15IP            | 4,0  | 80  | 25,5 |  |
| <b>Torx Wrench</b><br>            | Cat. No.   | Stock | Dimensions (mm) |      |     |      |  |
|                                                                                                                       |            |       | B               | d    |     |      |  |
|                                                                                                                       | TTX15W     | ●     | T15             | 4,0  |     |      |  |
|                                                                                                                       | TTX20      | ●     | T20             | 3,9  |     |      |  |

P

# Index

## A - B

| A                  |                                                  |                   |
|--------------------|--------------------------------------------------|-------------------|
| 16ER*****CB        | F64                                              | Threading inserts |
| 16IR*****CB        | F65                                              | Threading inserts |
| 1,8x45             | G83, G85, M56, M71, M73                          | Spare parts       |
| AECT*****PEFRA     | G72, G73, H61, H63                               | Indexable insert  |
| AFBSM**            | M50, M51                                         | Spare parts       |
| ANB****R           | G79, G81, H85, H87, M63, M65, M67, M69           | SUMIDIA blades    |
| ANB****R-G         | G79, G81, H85, H87, M63, M65, M67, M69           | SUMIDIA blades    |
| ANB****R-GB        | G79, G81, H85, H87, M63, M65, M67, M69           | SUMIDIA blades    |
| ANB****R-H         | G79, G81, H85, H87, M63, M65, M67, M69           | SUMIDIA blades    |
| ANB****R-L         | G79, G81, H85, H87, M63, M65, M67, M69           | SUMIDIA blades    |
| ANB****R-W         | G79, G81, H85, H87, M63, M65, M67, M69           | SUMIDIA blades    |
| ANB****R-WS        | G79, G81, H85, H87, M63, M65, M67, M69           | SUMIDIA blades    |
| ANB****R-GX        | G79, G81, H85, H87, M63, M65, M67, M69           | SUMIDIA blades    |
| ANT                | P3                                               | Spare parts       |
| ANXA*****R**       | G74, G78, H82, M58, M62                          | Cutter            |
| ANXA*****RS**      | G74, G78, H82, M58, M62                          | Cutter            |
| ANXS*****E**       | G74, H82, H84, M58, M66                          | Cutter            |
| ANXS*****M**       | G74, H82, H86, M58, M68                          | Modular cutter    |
| ANXS*****R**       | G74, G80, H82, M58, M64                          | Cutter            |
| ANXS*****RS**      | G74, G80, H82, M58, M64                          | Cutter            |
| AOET*****PEER-F    | G41, G51, G57, H27, H37, H39, H41, H45, H49, H53 | Indexable insert  |
| AOET*****PEER-P**  | G41, H27, H37, H39, H41, H49,                    | Indexable insert  |
| AOET*****PEFR-S    | G41, G51, G57, H27, H37, H39, H41, H45, H49, H53 | Indexable insert  |
| AOET**T3**PEER-F   | G41, G49, G55, H27, H31, H33, H35, H43, H47, H51 | Indexable insert  |
| AOET**T3**PEER-P** | G41, H27, H31, H33, H35, H43, H47,               | Indexable insert  |
| AOET**T3**PEFR-S   | G41, G49, G55, H27, H31, H33, H35, H43, H47, H51 | Indexable insert  |
| AOMT*****PEER-G    | G41, G51, G57, H27, H37, H39, H41, H45, H49, H53 | Indexable insert  |
| AOMT*****PEER-H    | G41, G51, G57, H27, H37, H39, H41, H45, H49, H53 | Indexable insert  |
| AOMT*****PEER-L    | G41, G51, G57, H27, H37, H39, H41, H45, H49, H53 | Indexable insert  |
| AOMT**T3**PEER-G   | G41, G49, G55, H27, H31, H33, H35, H43, H47, H51 | Indexable insert  |
| AOMT**T3**PEER-H   | G41, G49, G55, H27, H31, H33, H35, H43, H47, H51 | Indexable insert  |
| ASM****            | J36                                              | Solid endmill     |
| ASM****DL          | J30                                              | Solid endmill     |
| ASM****DL-R**      | J30                                              | Solid endmill     |
| AXET*****PEFR-S    | G58, G59, H57, H58, H65, H66                     | Indexable insert  |
| AXMT*****PDER-G    | G58, H56                                         | Indexable insert  |
| AXMT*****PDER-H    | G58, H56                                         | Indexable insert  |
| AXMT*****PDER-L    | G58, H56                                         | Indexable insert  |
| AXMT*****PDFR-S    | G58, H56                                         | Indexable insert  |
| AXMT*****PEER-E    | G58, G59, H57, H58, H65, H66                     | Indexable insert  |
| AXMT*****PEER-EH   | G58, G59, H57, H58, H65, H66                     | Indexable insert  |
| AXMT*****PEER-G    | G58, G59, H57, H58, H65, H66                     | Indexable insert  |
| AXMT*****PEER-H    | G58, G59, H57, H58, H65, H66                     | Indexable insert  |
| AXMT*****PEER-L    | G58, G59, H58, H66                               | Indexable insert  |

| B                     |          |                   |
|-----------------------|----------|-------------------|
| B***-SCLC R/L ****-** | E14      | Boring bar        |
| B***-SDQC R/L ****-** | E17      | Boring bar        |
| B***-SDUC R/L ****-** | E16      | Boring bar        |
| B***-STUP R/L ****-** | E20      | Boring bar        |
| BBT**M*_*             | H5       | Integreted Arbor  |
| BBT**M**_*            | H5       | Integreted Arbor  |
| BCS**                 | F56, F58 | Spare parts       |
| BFTG****F             | P2       | Spare parts       |
| BFTX****              | P2       | Spare parts       |
| BFTX****              | P2       | Spare parts       |
| BFTX****A             | P2       | Spare parts       |
| BFTX****IP            | P2       | Spare parts       |
| BFTX****IPS           | F43      | Spare parts       |
| BFTX****IP**          | P2       | Spare parts       |
| BFTX****IPS           | F43      | Spare parts       |
| BFTX****N             | P2       | Spare parts       |
| BFTX****N             | P2       | Spare parts       |
| BFTX****NV            | P2       | Spare parts       |
| BFTX****SD            | P2       | Spare parts       |
| BFTX****SD            | P2       | Spare parts       |
| BFTX****T8 R/L        | F20, P2  | Spare parts       |
| BFTY****              | P2       | Spare parts       |
| BH****                | P2       | Spare parts       |
| BH****                | P2       | Spare parts       |
| BH**** R/L            | P2       | Spare parts       |
| BHA****               | P3       | Spare parts       |
| BHF****               | P3       | Spare parts       |
| BNB*** R/L            | M53      | Boring bar        |
| BNBB**R               | M52      | Boring bar        |
| BNBC                  | M53      | Spare parts       |
| BNBP 2R*** **** *     | J41, M75 | SUMIBORON endmill |
| BNBW-*                | P6       | Spare parts       |
| BNES****              | J40, M74 | SUMIBORON endmill |
| BNGC R/L              | M56      | Spare parts       |
| BNGG R/L ****-TT      | M56      | Tool holder       |
| BNGS R/L TT           | M56      | Spare parts       |
| BNTT**** R/L          | M56      | SUMIBORON insert  |
| BNZ****R              | M53      | Boring bar        |
| BSME R/L ****D*S6     | M50      | Boring bar        |
| BT****                | P3       | Spare parts       |
| BT****E               | F26, F30 | Spare parts       |
| BT****T               | P3       | Spare parts       |
| BTD****               | P3       | Spare parts       |
| BTR****               | D30      | Indexable insert  |
| BTT****               | P3       | Spare parts       |
| BW****F               | P3       | Spare parts       |
| BW****F-SD            | P3       | Spare parts       |
| BWS**                 | F56, F58 | Spare parts       |
| BX****                | P3       | Spare parts       |
| BX****T               | P3       | Spare parts       |
| BXA****IP             | P3       | Spare parts       |
| BXH****D**            | P3       | Spare parts       |
| BXBR*****R            | E24      | Boring bar        |
| BXBR*****R-NB         | E24      | Boring bar        |
| BXD****IP             | P3       | Spare parts       |



| C                   |               |                  |
|---------------------|---------------|------------------|
| C***-SCLP R/L **    | E15           | Boring bar       |
| C***-SSKP R/L **    | E18           | Boring bar       |
| C***-STUB R/L **    | E20           | Boring bar       |
| C***-STUP R/L **    | E20           | Boring bar       |
| C***-SWUB R/L **    | E23           | Boring bar       |
| CBC*                | D25           | Spare parts      |
| CBC****             | D25           | Spare parts      |
| CBD4 R/L            | D25           | Spare parts      |
| CBS**               | D25           | Spare parts      |
| CCET*****LFY/RFY    | C63           | Indexable insert |
| CCET**T***LFY/RFY   | C63           | Indexable insert |
| CCET**X***LFY/RFY   | C63           | Indexable insert |
| CCET**X***LFY/RFY   | C63           | Indexable insert |
| CCEW**X***LF-NU     | M5            | SUMIBORON insert |
| CCEW**X***LT-NU     | M5            | SUMIBORON insert |
| CCGT*****LAY/RAY    | C65           | Indexable insert |
| CCGT**X***LFY/RFY   | C65           | Indexable insert |
| CCGT*****LFX/RFX    | C64           | Indexable insert |
| CCGT*****LFX/RFX    | C64           | Indexable insert |
| CCGT**T***LFX/RFX   | C64           | Indexable insert |
| CCGT**T***LFX/RFX   | C64           | Indexable insert |
| CCGT**X***LFYS/RFYS | C64           | Indexable insert |
| CCGT**X***LFYS/RFYS | C64           | Indexable insert |
| CCGT*****M NFC      | C64           | Indexable insert |
| CCGT*****M NSC      | C65           | Indexable insert |
| CCGT*****M NSI      | C65           | Indexable insert |
| CCGT*****NAG        | C65           | Indexable insert |
| CCGT*****NFV NC2    | M4            | SUMIBORON insert |
| CCGT*****NFV NU2    | M6            | SUMIBORON insert |
| CCGT*****NLV NC2    | M4            | SUMIBORON insert |
| CCGT*****NLV NU2    | M6            | SUMIBORON insert |
| CCGT*****NSC        | C65           | Indexable insert |
| CCGW**T***          | M5            | SUMIBORON insert |
| CCGW*****HS-NC2     | M4            | SUMIBORON insert |
| CCGW*****HS-NU      | M5            | SUMIBORON insert |
| CCGW*****HS-NU2     | M6            | SUMIBORON insert |
| CCGW*****LE-NC2     | M4            | SUMIBORON insert |
| CCGW*****LS-NC2     | M4            | SUMIBORON insert |
| CCGW*****LT-NU      | M5            | SUMIBORON insert |
| CCGW*****LT-NC2     | M4            | SUMIBORON insert |
| CCGW*****NC-2       | M4            | SUMIBORON insert |
| CCGW*****NC-W2      | M4            | SUMIBORON insert |
| CCGW*****NC-WG2     | M4            | SUMIBORON insert |
| CCGW*****NC-WH2     | M4            | SUMIBORON insert |
| CCGW*****NS         | M5            | SUMIBORON insert |
| CCGW*****NU         | M5            | SUMIBORON insert |
| CCGW*****NU-2       | M6            | SUMIBORON insert |
| CCGW*****NU-WG2     | M6            | SUMIBORON insert |
| CCGW*****NU-WH2     | M6            | SUMIBORON insert |
| CCH**               | G67, H11, H12 | Spare parts      |
| CCLN R/L ****-***   | D25           | Tool holder      |
| CCM 6B L/R          | F50           | Spare parts      |
| CCM 8 LONG          | D25, D26      | Spare parts      |
| CCM 8 UL            | D25, F50      | Spare parts      |
| CCM 8 UR            | F50           | Spare parts      |
| CCMT*****           | M8            | SUMIDIA insert   |
| CCMT*****L/R-DM NU  | M8            | SUMIDIA insert   |
| CCMT*****NF         | M8            | SUMIDIA insert   |
| CCMT*****NFB        | C66           | Indexable insert |
| CCMT*****NFP        | C66           | Indexable insert |
| CCMT*****NGD NF     | M8            | SUMIDIA insert   |
| CCMT*****NGU        | C67           | Indexable insert |
| CCMT*****NLD NF     | M8            | SUMIDIA insert   |
| CCMT*****NLB        | C66           | Indexable insert |
| CCMT*****NLU        | C66           | Indexable insert |
| CCMT*****NLU-W      | C66           | Indexable insert |
| CCMT*****NMU        | C67           | Indexable insert |
| CCMT*****NSC        | C67           | Indexable insert |
| CCMT*****NSK        | C67           | Indexable insert |
| CCMT*****NSU        | C66           | Indexable insert |
| CCMT**T***NUS       | C67           | Indexable insert |
| CCMW*****           | C67           | Indexable insert |
| CCMW*****NF         | M8            | SUMIDIA insert   |
| CCMW*****RH         | M8, M45       | SUMIDIA insert   |
| CCMW**T***          | C67           | Indexable insert |
| CCS**T*             | P5            | Spare parts      |
| CGA R/L **** *      | M55           | SUMIBORON insert |
| CNGA*****           | C26           | Indexable insert |
| CNGA*****ES-NC4     | M9            | SUMIBORON insert |
| CNGA*****HS-NC2     | M10           | SUMIBORON insert |
| CNGA*****HS-NC4     | M10           | SUMIBORON insert |
| CNGA*****HS-NU2     | M12           | SUMIBORON insert |
| CNGA*****HT-NU2     | M11           | SUMIBORON insert |
| CNGA*****LE-NU2     | M11           | SUMIBORON insert |
| CNGA*****LE-NC2     | M9            | SUMIBORON insert |
| CNGA*****LF-NU2     | M11           | SUMIBORON insert |
| CNGA*****LS-NU2     | M11           | SUMIBORON insert |
| CNGA*****LS-NC2     | M9            | SUMIBORON insert |
| CNGA*****LS-NC4     | M9            | SUMIBORON insert |
| CNGA*****LT-NU2     | M11           | SUMIBORON insert |
| CNGA*****LT-NC2     | M9            | SUMIBORON insert |
| CNGA*****NC-2       | M9            | SUMIBORON insert |
| CNGA*****NC-4       | M9            | SUMIBORON insert |
| CNGA*****NC-W4      | M9            | SUMIBORON insert |
| CNGA*****NC-WG4     | M9            | SUMIBORON insert |
| CNGA*****NC-WH4     | M9            | SUMIBORON insert |
| CNGA*****NU         | M12           | SUMIBORON insert |
| CNGA*****NU-2       | M11           | SUMIBORON insert |
| CNGA*****NS-2       | M11           | SUMIBORON insert |
| CNGA*****NU-W2      | M11           | SUMIBORON insert |
| CNGA*****NU-WG2     | M11           | SUMIBORON insert |
| CNGA*****NU-WH2     | M11           | SUMIBORON insert |
| CNGA*****US-NU2     | M12           | SUMIBORON insert |
| CNGG*****LAX/RAX    | C28           | Indexable insert |
| CNGG*****NEF        | C28           | Indexable insert |
| CNGG*****NFV NC4    | M10           | SUMIBORON insert |
| CNGG*****NLV NC4    | M10           | SUMIBORON insert |
| CNGG*****NSV NC4    | M10           | SUMIBORON insert |
| CNGG*****NGH        | C28           | Indexable insert |
| CNGG*****NSU        | C28           | Indexable insert |
| CNGM*****NLV NU2    | M12           | SUMIBORON insert |
| CNGN*****           | M13           | SUMIBORON insert |
| CNGX*****           | M13           | SUMIBORON insert |
| CNMA*****           | C28           | Indexable insert |
| CNMA*****           | M13           | SUMIBORON insert |
| CNMA*****NS         | M13           | SUMIBORON insert |
| CNMA*****NU         | M13           | SUMIBORON insert |
| CNMA*****NU-W       | M13           | SUMIBORON insert |
| CNMG*****NEF        | C20           | Indexable insert |
| CNMG*****NEG        | C22           | Indexable insert |
| CNMG*****NEM        | C23           | Indexable insert |
| CNMG*****NEX        | C22           | Indexable insert |
| CNMG*****NFA        | C20           | Indexable insert |

# Index

## C - D

|                   |     |                  |
|-------------------|-----|------------------|
| CNMG*****NFB      | C20 | Indexable insert |
| CNMG*****NFE      | C20 | Indexable insert |
| CNMG*****NFL      | C20 | Indexable insert |
| CNMG*****NGE      | C22 | Indexable insert |
| CNMG*****NGU      | C21 | Indexable insert |
| CNMG*****NGU-W    | C21 | Indexable insert |
| CNMG*****NGZ      | C25 | Indexable insert |
| CNMG*****NLU      | C20 | Indexable insert |
| CNMG*****NLU-W    | C20 | Indexable insert |
| CNMG*****NME      | C23 | Indexable insert |
| CNMG*****NMU      | C23 | Indexable insert |
| CNMG*****NMX      | C24 | Indexable insert |
| CNMG*****NSE      | C21 | Indexable insert |
| CNMG*****NSE-W    | C21 | Indexable insert |
| CNMG*****NSU      | C21 | Indexable insert |
| CNMG*****NSX      | C21 | Indexable insert |
| CNMG*****NUG      | C22 | Indexable insert |
| CNMG*****NUP      | C23 | Indexable insert |
| CNMG*****NUX      | C24 | Indexable insert |
| CNMG*****NUZ      | C25 | Indexable insert |
| CNMM*****NHF      | C26 | Indexable insert |
| CNMM*****NHG      | C26 | Indexable insert |
| CNMM*****NHP      | C26 | Indexable insert |
| CNMM*****NHU      | C27 | Indexable insert |
| CNMM*****NHW      | C27 | Indexable insert |
| CNMM*****NMH      | C26 | Indexable insert |
| CNMM*****NMP      | C26 | Indexable insert |
| CNM*****NF        | M13 | SUMIDIA insert   |
| CNM*****L/R       | C26 | Indexable insert |
| CNS****           | P5  | Spare parts      |
| CNS****B          | P5  | Spare parts      |
| CPB**             | P7  | Spare parts      |
| CPB**S            | P7  | Spare parts      |
| CPB**T            | P7  | Spare parts      |
| CPGT*****NSD      | C66 | Indexable insert |
| CPGW*****NC2      | M7  | SUMIBORON insert |
| CP-M*_*_*_*       | F20 | Spare parts      |
| CPM**N            | P6  | Spare parts      |
| CPM**S            | P6  | Spare parts      |
| CPMH*****NUS      | C69 | Indexable insert |
| CPMT*****NFB      | C68 | Indexable insert |
| CPMT*****NGU      | C69 | Indexable insert |
| CPMT*****NLB      | C68 | Indexable insert |
| CPMT*****NLU      | C68 | Indexable insert |
| CPMT*****NLU-W    | C68 | Indexable insert |
| CPMT*****NMU      | C69 | Indexable insert |
| CPMT*****NSU      | C69 | Indexable insert |
| CPMT*****NUS      | C69 | Indexable insert |
| CPMW*****NF       | M7  | SUMIDIA insert   |
| CPU***C           | P7  | Spare parts      |
| CPV**N            | P6  | Spare parts      |
| CRDN N****_***    | D26 | Tool holder      |
| CRSN R/L ****_*** | D26 | Tool holder      |
| CSBN R/L ****_*** | D25 | Tool holder      |
| CSKN R/L ****_*** | D25 | Tool holder      |
| CTL*****N/L/R     | F54 | Indexable insert |
| CTR*****N/L/R NB  | F54 | Indexable insert |
| CTR*****N/L/R     | F54 | Indexable insert |

## D

|                       |     |                    |
|-----------------------|-----|--------------------|
| D***-DCLC R/L ****_** | E8  | Boring bar         |
| D***-DDUN R/L ****_** | E9  | Boring bar         |
| D***-DTFN R/L ****_** | E12 | Boring bar         |
| D***-DWLN R/L ****_** | E13 | Boring bar         |
| D***-SCLC R/L ****_** | E14 | Boring bar         |
| D***-SDQC R/L ****_** | E17 | Boring bar         |
| D***-SDUC R/L ****_** | E16 | Boring bar         |
| D***-STUP R/L ****_** | E20 | Boring bar         |
| D***-SVUB R/L ****_** | E21 | Boring bar         |
| D***-SVZB R/L ****_** | E21 | Boring bar         |
| DABB***C-R            | M57 | SUMIDIA-Bohrstange |
| DABB***N-R            | M57 | SUMIDIA-Bohrstange |
| DAL****H              | M78 | SUMIDIA-Bohrer     |
| DC R/L-*              | D25 | Spare parts        |
| DCGT*****LAY/RAY      | C72 | Indexable insert   |
| DCGT*****LFX/RFX      | C70 | Indexable insert   |
| DCGT*****LFX/RFX      | C70 | Indexable insert   |
| DCGT*****LFY/RFY      | C71 | Indexable insert   |
| DCGT*****LFY/RFY      | C71 | Indexable insert   |
| DCGT*****LFYS/RFYS    | C70 | Indexable insert   |
| DCGT*****LFYS/RFYS    | C70 | Indexable insert   |
| DCGT*****LSD/RSD      | C71 | Indexable insert   |
| DCGT*****M NFC        | C70 | Indexable insert   |
| DCGT*****M NSC        | C72 | Indexable insert   |
| DCGT*****M NSI        | C72 | Indexable insert   |
| DCGT*****NAG          | C71 | Indexable insert   |
| DCGT*****N-FV NC2     | M14 | SUMIBORON insert   |
| DCGT*****N-FV NU2     | M15 | SUMIBORON insert   |
| DCGT*****N-LV NC2     | M14 | SUMIBORON insert   |
| DCGT*****N-LV NU2     | M15 | SUMIBORON insert   |
| DCGT*****NSC          | C72 | Indexable insert   |
| DCGW*****             | C72 | Indexable insert   |
| DCGW*****HS-NC2       | M14 | SUMIBORON insert   |
| DCGW*****HS-NU        | M16 | SUMIBORON insert   |
| DCGW*****HS-NU2       | M15 | SUMIBORON insert   |
| DCGW*****LE-NC2       | M14 | SUMIBORON insert   |
| DCGW*****LE-NU2       | M15 | SUMIBORON insert   |
| DCGW*****LF-NU        | M16 | SUMIBORON insert   |
| DCGW*****LF-NU2       | M15 | SUMIBORON insert   |
| DCGW*****LS-NC2       | M14 | SUMIBORON insert   |
| DCGW*****LT-NU        | M16 | SUMIBORON insert   |
| DCGW*****LT-NC2       | M14 | SUMIBORON insert   |
| DCGW*****LU-NC2       | M15 | SUMIBORON insert   |
| DCGW*****NC-2         | M14 | SUMIBORON insert   |
| DCGW*****NC-WG2       | M14 | SUMIBORON insert   |
| DCGW*****NC-WH2       | M14 | SUMIBORON insert   |
| DCGW*****NS           | M16 | SUMIBORON insert   |
| DCGW*****NU           | M16 | SUMIBORON insert   |
| DCGW*****NU-2         | M15 | SUMIBORON insert   |
| DCGW*****NU-WG2       | M15 | SUMIBORON insert   |
| DCGW*****NU-WH2       | M15 | SUMIBORON insert   |
| DCLN R/L ****_***     | D12 | Tool holder        |
| DCMT*****             | M17 | SUMIDIA insert     |
| DCMT*****L/R-DM NU    | M17 | SUMIDIA insert     |
| DCMT*****NF           | M17 | SUMIDIA insert     |
| DCMT*****NFB          | C73 | Indexable insert   |
| DCMT*****NFP          | C73 | Indexable insert   |
| DCMT*****NGD NF       | M17 | SUMIDIA insert     |
| DCMT*****NGU          | C73 | Indexable insert   |
| DCMT*****NLD NF       | M17 | SUMIDIA insert     |
| DCMT*****NLB          | C73 | Indexable insert   |

|                   |          |                   |                     |          |                  |
|-------------------|----------|-------------------|---------------------|----------|------------------|
| DCMT*****NLU      | C73      | Indexable insert  | DNMA*****           | C35      | Indexable insert |
| DCMT*****NMU      | C73      | Indexable insert  | DNMA*****M21        | M21      | SUMIBORON insert |
| DCMT*****NSK      | C73      | Indexable insert  | DNMA*****NF         | M21      | SUMIDIA insert   |
| DCMT*****NSU      | C73      | Indexable insert  | DNMA*****NS         | M21      | SUMIBORON insert |
| DCMW*****         | C73      | Indexable insert  | DNMA*****NU         | M21      | SUMIBORON insert |
| DCMW*****NF       | M17      | SUMIDIA insert    | DNMA*****RH         | M21, M45 | SUMIDIA insert   |
| DCMW*****RH       | M17, M45 | SUMIDIA insert    | DNMG*****LHM/RHM    | C33      | Indexable insert |
| DCMX**T***NLUW    | C73      | Indexable insert  | DNMG*****LUM/RUM    | C32      | Indexable insert |
| DCS**T*           | P5       | Spare parts       | DNMG*****NEF        | C30      | Indexable insert |
| DDHN R/L ****_*** | D13      | Tool holder       | DNMG*****NEG        | C31      | Indexable insert |
| DDJN R/L ****_*** | D13      | Tool holder       | DNMG*****NEM        | C32      | Indexable insert |
| DDL***V           | M78      | SUMIDIA drill     | DNMG*****NEX        | C31      | Indexable insert |
| DDNN N ****_***   | D13      | Tool holder       | DNMG*****NFA        | C29      | Indexable insert |
| DFC*****E         | H16, H17 | Indexable endmill | DNMG*****NFB        | C29      | Indexable insert |
| DFC*****E**       | H17      | Indexable endmill | DNMG*****NFE        | C29      | Indexable insert |
| DFCM*****E        | H16, H17 | Indexable endmill | DNMG*****NFL        | C29      | Indexable insert |
| DFCM*****E**      | H17      | Indexable endmill | DNMG*****NGE        | C31      | Indexable insert |
| DFC*****RS        | G24, H16 | Cutter            | DNMG*****NGU        | C30      | Indexable insert |
| DFCF*****RS       | G24, H16 | Cutter            | DNMG*****NGZ        | C33      | Indexable insert |
| DFCM*****RS       | G24, H16 | Cutter            | DNMG*****NLU        | C29      | Indexable insert |
| DGC*****EW        | H6       | Indexable endmill | DNMG*****NME        | C32      | Indexable insert |
| DGC*****RS        | G8       | Cutter            | DNMG*****NMU        | C32      | Indexable insert |
| DGCF*****RS       | G8       | Cutter            | DNMG*****NMX        | C33      | Indexable insert |
| DGCM*****RS       | G8       | Cutter            | DNMG*****NSE        | C30      | Indexable insert |
| DGCS**R           | P5       | Spare parts       | DNMG*****NSU        | C30      | Indexable insert |
| DML***V           | M79      | SUMIDIA drill     | DNMG*****NSX        | C30      | Indexable insert |
| DMSW*****E        | H8       | Indexable endmill | DNMG*****NUG        | C31      | Indexable insert |
| DMSW*****EL       | H8       | Indexable endmill | DNMG*****NUP        | C32      | Indexable insert |
| DMSW*****M        | H9       | Indexable endmill | DNMG*****NUX        | C33      | Indexable insert |
| DMSW*****R        | G63, G66 | Cutter            | DNMG*****NUZ        | C33      | Indexable insert |
| DMSW*****RS       | G63, G66 | Cutter            | DNMM*****NHG        | C34      | Indexable insert |
| DNGA*****         | C34      | Indexable insert  | DNMM*****NHP        | C34      | Indexable insert |
| DNGA*****ES-NC2   | M19      | SUMIBORON insert  | DNMM*****NMP        | C34      | Indexable insert |
| DNGA*****ES-NC4   | M19      | SUMIBORON insert  | DNMX*****L/R        | C35      | Indexable insert |
| DNGA*****HS-NC2   | M19      | SUMIBORON insert  | DNMX*****NSE-W      | C35      | Indexable insert |
| DNGA*****HS-NC4   | M19      | SUMIBORON insert  | DNS****             | P5       | Spare parts      |
| DNGA*****HS-NU2   | M20      | SUMIBORON insert  | DNS****B            | P5       | Spare parts      |
| DNGA*****LE-NC2   | M18      | SUMIBORON insert  | DNX**** RS          | G14      | Cutter           |
| DNGA*****LF-NU2   | M20      | SUMIBORON insert  | DNXF**** RS         | G14      | Cutter           |
| DNGA*****LS-NC2   | M19      | SUMIBORON insert  | DNXK**R             | G14      | Spare parts      |
| DNGA*****LS-NC4   | M19      | SUMIBORON insert  | DSBN R/L ****_***   | D14      | Tool holder      |
| DNGA*****LT-NC2   | M18      | SUMIBORON insert  | DSDN N ****_***     | D14      | Tool holder      |
| DNGA*****LT-NU2   | M20      | SUMIBORON insert  | DSLX*               | D27      | Spare parts      |
| DNGA*****NC-2     | M18      | SUMIBORON insert  | DSP*                | D25      | Spare parts      |
| DNGA*****NC-4     | M18      | SUMIBORON insert  | DTFN R/L ****_***   | D15      | Tool holder      |
| DNGA*****NC-WG4   | M18      | SUMIBORON insert  | DTGN R/L ****_***   | D15      | Tool holder      |
| DNGA*****NC-WH4   | M18      | SUMIBORON insert  | DTJN R/L ****_***   | D15      | Tool holder      |
| DNGA*****NU       | M20      | SUMIBORON insert  | DTR**C R/L ****_*** | D11      | Tool holder      |
| DNGA*****NU-2     | M20      | SUMIBORON insert  | DTR**Q R/L ****_*** | D11      | Tool holder      |
| DNGA*****NU-WG2   | M20      | SUMIBORON insert  | DVJN R/L ****_***   | D16      | Tool holder      |
| DNGA*****NU-WH2   | M20      | SUMIBORON insert  | DVQN R/L ****_***   | D16      | Tool holder      |
| DNGG*****LAX/RAX  | C36      | Indexable insert  | DVVN N ****_***     | D16      | Tool holder      |
| DNGG*****LUM/RUM  | C36      | Indexable insert  | DWLN R/L ****_***   | D17      | Tool holder      |
| DNGG*****NEF      | C36      | Indexable insert  |                     |          |                  |
| DNGG*****NFV NC4  | M19      | SUMIBORON insert  |                     |          |                  |
| DNGG*****NLV NC4  | M19      | SUMIBORON insert  |                     |          |                  |
| DNGG*****NGH      | C36      | Indexable insert  |                     |          |                  |
| DNGG*****NSU      | C36      | Indexable insert  |                     |          |                  |
| DNGG*****N-SV NC4 | M19      | SUMIBORON insert  |                     |          |                  |
| DNGM*****N-LV NU2 | M20      | SUMIBORON insert  |                     |          |                  |
| DNGA*****         | M21      | SUMIBORON insert  |                     |          |                  |
| DNGN*****         | M21      | SUMIBORON insert  |                     |          |                  |

# Index

## E - H

### E

|                  |     |                  |
|------------------|-----|------------------|
| ECXA***X**LE NU* | M51 | SUMIBORON insert |
| ECXA***X**LF NU* | M51 | SUMIBORON insert |
| E**D*SEXCR/L*-*P | M51 | Boring bar       |
| EHBX****         | P3  | Spare parts      |
| EHHM****ZX       | J31 | Solid endmill    |
| EPMS****U***R**  | J23 | Solid endmill    |
| ER**             | P6  | Spare parts      |
| E***SSHM N*****  | F43 | Tool holder      |

### F

|            |          |             |
|------------|----------|-------------|
| FBUP*-A*-* | P3       | Spare parts |
| FMJ        | P4       | Spare parts |
| FMU****R-S | G85, M73 | Cutter      |
| FMUE       | G85, M73 | Spare parts |
| FMUJ       | P4       | Spare parts |
| FMUU       | G85, M73 | Spare parts |

### G

|                      |                                                     |                  |
|----------------------|-----------------------------------------------------|------------------|
| GCG N**** GA         | F19, F21, F23, F25, F27, F29, F31, Indexable insert |                  |
|                      | F35, F37, F39, F47, F49                             |                  |
| GCM N**** GF         | F19, F21, F23, F25, F27, F29, F31, Indexable insert |                  |
|                      | F35, F37, F39, F47, F49                             |                  |
| GCM N**** GF         | F19, F21, F23, F25, F29, F37                        | Indexable insert |
| GCM N**** GG         | F19, F21, F23, F25, F27, F29, F31, Indexable insert |                  |
|                      | F35, F37, F39, F47, F49                             |                  |
| GCM N**** GL         | F19, F21, F23, F25, F27, F29, F31, Indexable insert |                  |
|                      | F35, F37, F39, F47, F49                             |                  |
| GCM N**** MG         | F19, F21, F23, F25, F27, F29, F31, Indexable insert |                  |
|                      | F35, F37, F39, F47, F49                             |                  |
| GCM N**** ML         | F19, F21, F23, F25, F27, F29, F31, Indexable insert |                  |
|                      | F35, F37, F39, F47, F49                             |                  |
| GCM N**** RG         | F19, F21, F23, F25, F27, F29, F31, Indexable insert |                  |
|                      | F35, F37, F39, F47                                  |                  |
| GCM N**** RN         | F19, F21, F23, F25, F27, F29, F31, Indexable insert |                  |
|                      | F33, F37, F39, F47, F49                             |                  |
| GCM R/L **** CF**    | F19, F21, F23, F25, F27, F29, F31, Indexable insert |                  |
|                      | F47                                                 |                  |
| GCM R/L **** CG**    | F19, F21, F23, F25, F27, F29, F31, Indexable insert |                  |
|                      | F47                                                 |                  |
| GNDCF R/L ***_***    | F48                                                 | Cassette         |
| GNDCM R/L ***        | F46                                                 | Cassette         |
| GNDM R/L ****JX***   | F18                                                 | Tool holder      |
| GNDM R/L ****JX****  | F18                                                 | Tool holder      |
| GNDM R/L ****JX***** | F18                                                 | Tool holder      |
| GNDM R/L ****JX***J  | F20                                                 | Tool holder      |
| GNDM R/L ****JX***J  | F20                                                 | Tool holder      |
| GNDM R/L ****JX***J  | F20                                                 | Tool holder      |
| GNDM R/L ****JX****J | F20                                                 | Tool holder      |
| GNDM R/L ****K***    | F24                                                 | Tool holder      |
| GNDM R/L ****K****   | F24                                                 | Tool holder      |
| GNDM R/L ****K*****  | F24                                                 | Tool holder      |
| GNDM R/L ****M***    | F24                                                 | Tool holder      |
| GNDM R/L ****M****   | F24                                                 | Tool holder      |
| GNDM R/L ****M*****  | F24                                                 | Tool holder      |
| GNDM R/L ****P***    | F24                                                 | Tool holder      |
| GNDM R/L ****X***JE  | F26, F30                                            | Tool holder      |
| GNDMS R/L ****K***   | F24                                                 | Tool holder      |
| GNDMS R/L ****M***   | F24                                                 | Tool holder      |

|                        |                                  |                  |
|------------------------|----------------------------------|------------------|
| GNDL R/L ****JX***     | F18                              | Tool holder      |
| GNDL R/L ****JX****    | F18                              | Tool holder      |
| GNDL R/L ****JX*****   | F18                              | Tool holder      |
| GNDL R/L ****K***      | F28                              | Tool holder      |
| GNDL R/L ****K****     | F28                              | Tool holder      |
| GNDL R/L ****K*****    | F28                              | Tool holder      |
| GNDL R/L ****M***      | F28                              | Tool holder      |
| GNDL R/L ****M****     | F28                              | Tool holder      |
| GNDL R/L ****M*****    | F28                              | Tool holder      |
| GNDL R/L ****P***      | F28                              | Tool holder      |
| GNDLS R/L ****K***     | F28                              | Tool holder      |
| GNDLS R/L ****M***     | F28                              | Tool holder      |
| GNDF R/L ****K***_***  | F34                              | Tool holder      |
| GNDF R/L ****M***_***  | F34                              | Tool holder      |
| GNDFS R/L ****M***_*** | F36                              | Tool holder      |
| GNDFS R/L ****P***_*** | F36                              | Tool holder      |
| GNDI R/L ****T***      | F38                              | Tool holder      |
| GNDIS R/L ****T****    | F40                              | Tool holder      |
| GNDN R/L ****K***_***  | F32                              | Tool holder      |
| GNDN R/L ****M***_***  | F32                              | Tool holder      |
| GNDN R/L ****K***      | F22                              | Tool holder      |
| GNDN R/L ****M***      | F22                              | Tool holder      |
| GSP*                   | M56                              | Spare parts      |
| GSP**                  | D27, M54                         | Spare parts      |
| GSH****SF              | J28                              | Solid endmill    |
| GSRE****SF             | J27                              | Solid endmill    |
| GSX****C-***D          | J7, J12, J15                     | Solid endmill    |
| GSX****C-*D            | J9, J10, J11, J13, J17, J18, J19 | Solid endmill    |
| GSX****S-*D            | J8, J16                          | Solid endmill    |
| GSXB*****              | J34                              | Solid endmill    |
| GSXSLT****C-***D       | J14                              | Solid endmill    |
| GSXVL****_***D         | J20                              | Solid endmill    |
| GSXVL****S-R**_***D    | J21                              | Solid endmill    |
| GSXVL****-R**_***D     | J21                              | Solid endmill    |
| GSXVL****S-***D        | J20                              | Solid endmill    |
| GW B R/L ****_***      | M54                              | Tool holder      |
| GWBCM R/L **           | M55                              | Cassette         |
| GWC R/L ****_**        | F50                              | Tool holder      |
| GWCCM R/L **           | F51                              | Cassette         |
| GWCI R/L ***           | F51                              | Tool holder      |
| GWCS R/L ****_**       | F50                              | Tool holder      |
| GXM N**** S ML         | F41                              | Indexable insert |
| GXM N**** S GF         | F41                              | Indexable insert |
| GXM N***** S GF        | F41                              | Indexable insert |

### H

|          |                                        |             |
|----------|----------------------------------------|-------------|
| HBB***   | M52, M57                               | Tool holder |
| HBB****  | M57                                    | Tool holder |
| HBSM**** | M50, M51                               | Boring bar  |
| HD***    | P8                                     | Spare parts |
| HE*****E | P5                                     | Spare parts |
| HE*****P | P7                                     | Spare parts |
| HE*****W | E13                                    | Spare parts |
| HFJ      | G79, G81, H85, H87, M63, M65, M67, M69 | Spare parts |
| HFVT     | G79, G81, H85, H87, M63, M65, M67, M69 | Spare parts |
| HPL****  | P7                                     | Spare parts |
| HPS****  | P7                                     | Spare parts |



| J                     |               |       |
|-----------------------|---------------|-------|
| J-G1/8-G1/8-**        | F21           | Parts |
| J-G1/8-G1/8-**E       | F21, F26, F30 | Parts |
| J-G1/8-G1/8F-**E      | F21, F26, F30 | Parts |
| J-HOSE-G1/8-G1/8***-E | F21, F26, F30 | Parts |

| K        |    |             |
|----------|----|-------------|
| KGBS**** | P4 | Spare parts |
| KSS****  | P4 | Spare parts |

| L               |                         |                  |
|-----------------|-------------------------|------------------|
| LCL*            | P4                      | Spare parts      |
| LCL**           | P4                      | Spare parts      |
| LCL*C-SD        | P4                      | Spare parts      |
| LCL*D-SD        | P4                      | Spare parts      |
| LCL*DB-SD       | P4                      | Spare parts      |
| LCL*S           | P4                      | Spare parts      |
| LCL*-SD         | P4                      | Spare parts      |
| LCL*T-SD        | P4                      | Spare parts      |
| LCS*            | P4                      | Spare parts      |
| LCS**           | P4                      | Spare parts      |
| LCS**BS-SD      | P4                      | Spare parts      |
| LCS*B-SD        | P4                      | Spare parts      |
| LCS*CA          | P4                      | Spare parts      |
| LCS*DB-SD       | P4                      | Spare parts      |
| LCS*TB-SD       | P4                      | Spare parts      |
| LCS*TE          | P4                      | Spare parts      |
| LH***           | P8                      | Spare parts      |
| LH***K          | P8                      | Spare parts      |
| LHHM****ZX      | J31                     | Solid endmill    |
| LNEX*****PNER-G | G33, G34, G35, H18, H19 | Indexable insert |
| LNEX*****PNER-H | G33, G35, H18, H19      | Indexable insert |
| LNEX*****PNER-L | G33, G34, G35, H18, H19 | Indexable insert |
| LP**            | P7                      | Spare parts      |
| LSC**SD         | P5                      | Spare parts      |
| LSD**SD         | P5                      | Spare parts      |
| LSP*D           | D34                     | Spare parts      |
| LSP*            | P7                      | Spare parts      |
| LSP**           | P7                      | Spare parts      |
| LSP*SD          | P7                      | Spare parts      |
| LSR**           | P5                      | Spare parts      |
| LSR***          | P5                      | Spare parts      |
| LSS**SD         | P5                      | Spare parts      |
| LST**SD         | P5                      | Spare parts      |
| LST***SD        | P5                      | Spare parts      |
| LSTE**.*        | P5                      | Spare parts      |
| LSW***          | P6                      | Spare parts      |
| LT**            | P8                      | Spare parts      |
| LT**.*          | P8                      | Spare parts      |
| LT**IP          | P8                      | Spare parts      |
| LT**K           | P8                      | Spare parts      |

| M                |          |                   |
|------------------|----------|-------------------|
| M*               | H5       | Spare parts       |
| M**              | H5       | Spare parts       |
| MA**M**L***C     | H5       | Tool holder       |
| MA**M**L***S     | H5       | Tool holder       |
| MDF****S2D       | K26      | Multi-drill       |
| MDF****L2D       | K27      | Multi-drill       |
| MDF****H3D       | K29, K30 | Multi-drill       |
| MDF****H5D       | K29, K30 | Multi-drill       |
| MDS****SDC*      | K41      | Multi-drill       |
| MDSS****         | K40      | Multi-drill       |
| MDUS******C      | K40      | Multi-drill       |
| MDW****GS*       | K22, K23 | Multi-drill       |
| MDW****NHGS      | K36, K37 | Multi-drill       |
| MDW****PHT       | K34, K35 | Multi-drill       |
| MDW***XHG-S**HAK | K34      | Multi-drill       |
| MDW***XHT-A**HAK | K35      | Multi-drill       |
| MIB*.*           | P4       | Spare parts       |
| MLDH****L**      | K39      | Multi-drill       |
| MLDH****P        | K39      | Multi-drill       |
| MMW**            | D23      | Spare parts       |
| MP***            | P7       | Spare parts       |
| MSX*****EM       | H11      | Indexable endmill |
| MSX*****ES       | H11      | Indexable endmill |
| MSX*****EW       | H11      | Indexable endmill |
| MSX*****M**Z*    | H12      | Indexable endmill |
| MSX*****RS       | G67      | Cutter            |
| MTIX*****E**     | H69      | Indexable endmill |
| MTIX*****E****   | H69      | Indexable endmill |
| MTIX*****RS**    | G61      | Cutter            |
| MTJN R/L ****.*  | D23      | Tool holder       |
| MTJN R/L V-.*    | D23      | Tool holder       |
| MTXN R/L ****.*  | D23      | Tool holder       |
| MWLN R/L ****.*  | D24      | Tool holder       |
| MWW**            | D24      | Spare parts       |

| N                |          |                 |
|------------------|----------|-----------------|
| NPDB****.*       | J43, M77 | SUMIDIA endmill |
| NPDBS****.*      | J43, M77 | SUMIDIA endmill |
| NPDRS****R****.* | J42, M76 | SUMIDIA endmill |

| O              |        |                  |
|----------------|--------|------------------|
| ONEU****ANER L | G9, H6 | Indexable insert |
| ONEU****ANER G | G9, H6 | Indexable insert |
| ONMU****ANER L | G9, H6 | Indexable insert |
| ONMU****ANER G | G9, H6 | Indexable insert |

| P               |          |             |
|-----------------|----------|-------------|
| P*              | G85, M73 | Spare parts |
| PCBN R/L ****.* | D18      | Tool holder |
| PCLC R/L ****.* | D31      | Tool holder |
| PCLN R/L ****.* | D18      | Tool holder |
| PCT***D*S**     | K67      | Multi-drill |
| PDJC R/L ****.* | D32      | Tool holder |
| PDJN R/L ****.* | D19      | Tool holder |
| PDL***D*S**     | K67      | Multi-drill |

# Index

## P - S

### P

|                        |               |                             |
|------------------------|---------------|-----------------------------|
| PRDC N****_***         | D34           | Tool holder                 |
| PRGC R/L ****_***      | D34           | Tool holder                 |
| PSBN R/L ****_***      | D20           | Tool holder                 |
| PSC**DCLN R/L *****-12 | D41           | Polygon tool holder         |
| PSC**DDJN R/L *****-15 | D41           | Polygon tool holder         |
| PSC**DDHN R/L *****-15 | D41           | Polygon tool holder         |
| PSC**DSBN R/L *****-12 | D41           | Polygon tool holder         |
| PSC**DTJN R/L *****-16 | D42           | Polygon tool holder         |
| PSC**DWLN R/L *****-0* | D42           | Polygon tool holder         |
| PSC**GM** R/L *****    | F46, F48, M55 | Polygon modular tool holder |
| PSC**SCLC R/L *****-09 | D43           | Polygon tool holder         |
| PSC**SDJC R/L *****-11 | D43           | Polygon tool holder         |
| PSC**SDHC R/L *****-11 | D43           | Polygon tool holder         |
| PSC**SSBC R/L *****-12 | D43           | Polygon tool holder         |
| PSC**STJC R/L *****-16 | D44           | Polygon tool holder         |
| PSC**SVJB R/L *****-16 | D44           | Polygon tool holder         |
| PSC**SVVB R/L *****-16 | D44           | Polygon tool holder         |
| PSC**SVHB R/L *****-16 | D44           | Polygon tool holder         |
| PSC**SVJC R/L *****-16 | D45           | Polygon tool holder         |
| PSC**SVVC R/L *****-16 | D45           | Polygon tool holder         |
| PSC**SVHC R/L *****-16 | D45           | Polygon tool holder         |
| PSDN N ****_***        | D20           | Tool holder                 |
| PSKN R/L ****_***      | D21           | Tool holder                 |
| PSSN R/L ****_***      | D21           | Tool holder                 |
| PTFN R/L ****_***      | D22           | Tool holder                 |
| PTGN R/L ****_***      | D22           | Tool holder                 |
| PTTN R/L ****_***      | D22           | Tool holder                 |
| PW*                    | F63           | Spare parts                 |
| PWLN R/L ****_***      | D24           | Tool holder                 |
| PWSS*R                 | P6            | Spare parts                 |

### Q

|                  |               |                  |
|------------------|---------------|------------------|
| QPET*****PPFR-S  | G16, H74, H75 | Indexable insert |
| QPMT*****PPEN    | G16, H74, H75 | Indexable insert |
| QPMT*****PPEN-CP | G16           | Indexable insert |
| QPMT*****PPEN-H  | G16, H74, H75 | Indexable insert |

### R

|                |                    |                  |
|----------------|--------------------|------------------|
| RCMT***M0 NRH  | C74                | Indexable insert |
| RCMT***M0 NRX  | C74                | Indexable insert |
| RCMX***M0 NRP  | C74                | Indexable insert |
| RDET**T*M0EN-G | G21, H76, H77      | Indexable insert |
| RDET**T*M0EN-H | G21, H76, H77      | Indexable insert |
| RDET***M0EN-G  | G21, H76, H77      | Indexable insert |
| RDET***M0EN-H  | G21, H76, H77      | Indexable insert |
| RF-SET         | G82, G85, M70, M73 | Spare parts      |
| RF***RS        | G82, M70           | Cutter           |
| RFB            | G82, M70           | SUMIDIA insert   |
| RFBW           | G82, M70           | SUMIDIA insert   |
| RFC            | G82, M70           | Spare parts      |
| RFD            | G82, M70           | Spare parts      |
| RFF            | G82, M70           | Spare parts      |
| RFJ            | P4                 | Spare parts      |
| RFR            | G82, M70           | Spare parts      |
| RFS            | G82, M70           | Spare parts      |
| RNGN*****      | M22                | SUMIBORON insert |
| RNGN*****B     | M22                | SUMIBORON insert |

|             |          |                   |
|-------------|----------|-------------------|
| RSX*****ES  | G18, H76 | Indexable endmill |
| RSXF*****ES | G18, H76 | Indexable endmill |
| RSX*****M   | G18, H77 | Indexable endmill |
| RSXF*****M  | G18, H77 | Indexable endmill |
| RSX*****RS  | G18, G20 | Cutter            |
| RSXF*****RS | G18, G20 | Cutter            |

### S

|                      |                                                                                                                                                                             |                  |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| S***-DTR**C-R/L-**   | E11                                                                                                                                                                         | Boring bar       |
| S***-MWLN R/L **     | E13                                                                                                                                                                         | Boring bar       |
| S***-PCLN R/L **     | E8                                                                                                                                                                          | Boring bar       |
| S***-PDUN R/L **     | E9                                                                                                                                                                          | Boring bar       |
| S***-PSKN R/L **     | E10                                                                                                                                                                         | Boring bar       |
| S***-PTFN R/L **     | E12                                                                                                                                                                         | Boring bar       |
| S***-SCLC R/L **     | E14                                                                                                                                                                         | Boring bar       |
| S***-SCLP R/L **     | E15                                                                                                                                                                         | Boring bar       |
| S***-SDQC R/L **     | E17                                                                                                                                                                         | Boring bar       |
| S***-SDUC R/L **     | E16                                                                                                                                                                         | Boring bar       |
| S***-SSKP R/L **     | E18                                                                                                                                                                         | Boring bar       |
| S***-STFC R/L **     | E19                                                                                                                                                                         | Boring bar       |
| S***-STUB R/L **_*** | E20                                                                                                                                                                         | Boring bar       |
| S***-STUP R/L **     | E20                                                                                                                                                                         | Boring bar       |
| S***-STUP R/L **_*** | E20                                                                                                                                                                         | Boring bar       |
| S***-SVQB R/L **     | E22                                                                                                                                                                         | Boring bar       |
| S***-SVUB R/L **     | E22                                                                                                                                                                         | Boring bar       |
| S***-SVZB R/L **     | E23                                                                                                                                                                         | Boring bar       |
| S***-SWUB R/L **     | D11, E11                                                                                                                                                                    | Boring bar       |
| SBN**_*              | F56, F58                                                                                                                                                                    | Tool holder      |
| SBU**_*              | F56, F58                                                                                                                                                                    | Tool holder      |
| SCAC R/L ****_***    | D31                                                                                                                                                                         | Tool holder      |
| SCGT**T***LFX/RFX    | C75                                                                                                                                                                         | Indexable insert |
| SCGT*****M NSC       | C75                                                                                                                                                                         | Indexable insert |
| SCGW*****NU          | M19                                                                                                                                                                         | SUMIBORON insert |
| SCLC R/L ****_***    | D31                                                                                                                                                                         | Tool holder      |
| SCMT*****NFB         | C76                                                                                                                                                                         | Indexable insert |
| SCMT*****NFP         | C76                                                                                                                                                                         | Indexable insert |
| SCMT*****NGU         | C76                                                                                                                                                                         | Indexable insert |
| SCMT*****NLB         | C76                                                                                                                                                                         | Indexable insert |
| SCMT*****NLU         | C76                                                                                                                                                                         | Indexable insert |
| SCMT*****NMU         | C76                                                                                                                                                                         | Indexable insert |
| SCMT*****NSK         | C76                                                                                                                                                                         | Indexable insert |
| SCMT*****NSU         | C76                                                                                                                                                                         | Indexable insert |
| SCMW*****            | C76                                                                                                                                                                         | Indexable insert |
| SCN****              | P5                                                                                                                                                                          | Spare parts      |
| SCND***              | P5                                                                                                                                                                          | Spare parts      |
| SCP-*                | D12, D13, D14, D15, D16, D17, D18, D19, D20, D21, D22, D23, D24, D25, D26, D27, D28, D29, D30, D31, D32, D33, D34, D35, D36, D37, D38, D39, D40, D41, D42, E8, E9, E12, E13 | Spare parts      |
| SCP*A                | F51, M55                                                                                                                                                                    | Spare parts      |
| SCS****              | P5                                                                                                                                                                          | Spare parts      |
| SCT R/L ****         | F54                                                                                                                                                                         | Tool holder      |
| SCW***               | P5                                                                                                                                                                          | Spare parts      |
| SDAC R/L ****_***    | D33                                                                                                                                                                         | Tool holder      |
| SDBSM                | M51                                                                                                                                                                         | Spare parts      |
| SDET****ZDFR         | G82, M70                                                                                                                                                                    | Indexable insert |
| SDHC R/L ****_***    | D32                                                                                                                                                                         | Tool holder      |
| SDJC R/L ****_***    | D32                                                                                                                                                                         | Tool holder      |
| SDM****U*HAK         | K17, K18, K19                                                                                                                                                               | Multi-drill      |
| SDNC N ****_***      | D33                                                                                                                                                                         | Tool holder      |
| SDP****U*HAK         | K8, K9, K10, K11                                                                                                                                                            | Multi-drill      |
| SDW***               | P5                                                                                                                                                                          | Spare parts      |

|                   |               |                  |
|-------------------|---------------|------------------|
| SEET****AGFR-L    | G11, H7       | Indexable insert |
| SEET****AGSR-L    | G11, H7       | Indexable insert |
| SEET****AGSR-G    | G11, H7       | Indexable insert |
| SEMT****AGSR-L    | G11, H7       | Indexable insert |
| SEMT****AGSR-G    | G11, H7       | Indexable insert |
| SEMT****AGSR-H    | G11, H7       | Indexable insert |
| SEMT****AGSR-FG   | G11, H7       | Indexable insert |
| SFKN****AZFN      | G13           | Indexable insert |
| SFKN****AZTN      | G13           | Indexable insert |
| SFKR****AZTN      | G13           | Indexable insert |
| SFW***            | P5            | Spare parts      |
| SL-*              | F56, F58, F59 | Spare parts      |
| SMDH****S/M/L/D*  | K44, K48,     | Multi-drill      |
| SMDT****MFS       | K49           | Indexable insert |
| SMDT****MTL       | K51           | Indexable insert |
| SMDT****D MEL     | K46           | Indexable insert |
| SMDT****D MTL     | K45           | Indexable insert |
| SNB****DL         | J35           | Solid endmill    |
| SNEU****ANER-FG   | G9, H6        | Indexable insert |
| SNEU****ANER-FL   | G9, H6        | Indexable insert |
| SNEU****ANER-G    | G9, H6        | Indexable insert |
| SNEU****ANER-L    | G9, H6        | Indexable insert |
| SNEW****ADFR-NF   | G66, M70      | SUMIDIA insert   |
| SNEW****ADFR-W-NF | G66, M70      | SUMIDIA insert   |
| SNEW****ADTR-NF   | G67, M71      | SUMIDIA insert   |
| SNEW****ADTR-R-NF | G67, M71      | SUMIDIA insert   |
| SNEW****ADTR-U-NF | G67, M71      | SUMIDIA insert   |
| SNEW****ADT L/R   | G69, M73      | SUMIBORON insert |
| SNEW****ADT L/R-S | G69, M73      | SUMIBORON insert |
| SNGA*****         | C44           | Indexable insert |
| SNGA*****HS-NC2   | M23           | SUMIBORON insert |
| SNGA*****HS-NU2   | M23           | SUMIBORON insert |
| SNGA*****LT-NU2   | M23           |                  |
| SNGA*****NC2      | M23           | SUMIBORON insert |
| SNGA*****NC4      | M23           | SUMIBORON insert |
| SNGA*****NU2      | M23           | SUMIBORON insert |
| SNGA*****NU4      | M23           | SUMIBORON insert |
| SNGG*****LAX/RAX  | C44           | Indexable insert |
| SNGG*****LST/RST  | C44           | Indexable insert |
| SNGG*****LUM/RUM  | C44           | Indexable insert |
| SNGN*****         | C45           | Indexable insert |
| SNGN*****         | M24           | SUMIBORON insert |
| SNGX*****         | M24           | SUMIBORON insert |
| SNMA*****         | C44           | Indexable insert |
| SNMA*****NS       | M24           | SUMIBORON insert |
| SNMA*****NU       | M24           | SUMIBORON insert |
| SNMA*****NF       | M24           | SUMIDIA insert   |
| SNMA*****RH       | M24, M45      | SUMIDIA insert   |
| SNMG*****LUM/RUM  | C39           | Indexable insert |
| SNMG*****LHM/RHM  | C41           | Indexable insert |
| SNMG*****NEF      | C38           | Indexable insert |
| SNMG*****NEG      | C39           | Indexable insert |
| SNMG*****NEM      | C40           | Indexable insert |
| SNMG*****NEX      | C39           | Indexable insert |
| SNMG*****NFB      | C37           | Indexable insert |
| SNMG*****NFE      | C37           | Indexable insert |
| SNMG*****NFL      | C37           | Indexable insert |
| SNMG*****NGE      | C38           | Indexable insert |
| SNMG*****NGU      | C38           | Indexable insert |
| SNMG*****NGZ      | C41           | Indexable insert |
| SNMG*****NLU      | C37           | Indexable insert |
| SNMG*****NME      | C40           | Indexable insert |

|                  |                                   |                  |
|------------------|-----------------------------------|------------------|
| SNMG*****NMU     | C40                               | Indexable insert |
| SNMG*****NMX     | C41                               | Indexable insert |
| SNMG*****NSE     | C37                               | Indexable insert |
| SNMG*****NSJ     | C38                               | Indexable insert |
| SNMG*****NSU     | C37                               | Indexable insert |
| SNMG*****NSX     | C38                               | Indexable insert |
| SNMG*****NUG     | C39                               | Indexable insert |
| SNMG*****NUP     | C39                               | Indexable insert |
| SNMG*****NUX     | C40                               | Indexable insert |
| SNMG*****NUZ     | C41                               | Indexable insert |
| SNMN*****        | C45                               | Indexable insert |
| SNMM*****NHF     | C43                               | Indexable insert |
| SNMM*****NHG     | C42                               | Indexable insert |
| SNMM*****NHGS    | C42                               | Indexable insert |
| SNMM*****NHP     | C42                               | Indexable insert |
| SNMM*****NHU     | C43                               | Indexable insert |
| SNMM*****NHW     | C43                               | Indexable insert |
| SNMM*****NMH     | C42                               | Indexable insert |
| SNMM*****NMP     | C42                               | Indexable insert |
| SNMT****ZNEN-G   | G15                               | Indexable insert |
| SNMT****ZNEN-H   | G15                               | Indexable insert |
| SNMT****ZNEN-L   | G15                               | Indexable insert |
| SNMT****ZNEN-SH  | G15                               | Indexable insert |
| SNMU****ANER FG  | G9, H6                            | Indexable insert |
| SNMU****ANER FL  | G9, H6                            | Indexable insert |
| SNMU****ANER G   | G9, H6                            | Indexable insert |
| SNMU****ANER H   | G9, H6                            | Indexable insert |
| SNMU****ANER L   | G9, H6                            | Indexable insert |
| SNS****          | P5                                | Spare parts      |
| SOET*****PDFR-S  | G26, G29, G71, H15, H19, H79, H80 | Indexable insert |
| SOET*****PZER-G  | G26, G28, G70, H15, H18, H79, H80 | Indexable insert |
| SOET*****PZFR-S  | G26, G28, G70, H15, H18, H79, H80 | Indexable insert |
| SOMT*****PDER-L  | G26, G29, G71, H15, H19, H79, H80 | Indexable insert |
| SOMT*****PDER-G  | G26, G29, G71, H15, H19, H79, H80 | Indexable insert |
| SOMT*****PDER-H  | G26, G29, G71, H15, H19, H79, H80 | Indexable insert |
| SOMT*****PZER-L  | G26, G28, G70, H15, H18, H79, H80 | Indexable insert |
| SOMT*****PZER-G  | G26, G28, G70, H15, H18, H79, H80 | Indexable insert |
| SOMT*****PZER-H  | G26, G28, G70, H15, H18, H79, H80 | Indexable insert |
| SPGN*****        | C79                               | Indexable insert |
| SPGT*****LSD/RSD | C78                               | Indexable insert |
| SPGW*****        | C78                               | Indexable insert |
| SPGW*****T       | C78                               | Indexable insert |
| SPMH*****NUS     | C77                               | Indexable insert |
| SPMN*****        | C79                               | Indexable insert |
| SPMR*****NFK     | C79                               | Indexable insert |
| SPMR*****NSF     | C79                               | Indexable insert |
| SPMR*****NUJ     | C79                               | Indexable insert |
| SPMT*****        | C39, H71                          | Indexable insert |
| SPMT*****NFB     | C77                               | Indexable insert |
| SPMT*****NFK     | C77                               | Indexable insert |
| SPMT*****NLB     | C77                               | Indexable insert |
| SPMT*****NLU     | C77                               | Indexable insert |
| SPMT*****NSF     | C77                               | Indexable insert |



# Index

## S - T

|                   |               |                  |
|-------------------|---------------|------------------|
| SPMT*****NUS      | C77           | Indexable insert |
| SPP*              | P7            | Spare parts      |
| SPP**             | P7            | Spare parts      |
| SRDC N ****_***   | D35           | Tool holder      |
| SRF**R-ST         | G83, M71      | Cutter           |
| SRF**RS           | G83, M71      | Cutter           |
| SRFJ              | P4            | Spare parts      |
| SRND**            | P5            | Spare parts      |
| SRNS***SD         | D35           | Spare parts      |
| SRSC R/L ****_*** | D35           | Tool holder      |
| SSBC R/L ****_*** | D36           | Tool holder      |
| SSEH****R**       | J37           | Solid endmill    |
| SSEH****W-R**     | J26           | Solid endmill    |
| SSEH****WS-R**    | J26           | Solid endmill    |
| SSEHVL ****-R**   | J37           | Solid endmill    |
| SSEHVL ****W-R**  | J25           | Solid endmill    |
| SSEHVL ****WS-R** | J25           | Solid endmill    |
| SSHC R/L ****     | F43           | Indexable insert |
| SSHG R/L ****     | F43, F44      | Indexable insert |
| SSHR R/L ****     | F43, F44      | Indexable insert |
| SSM****           | J38, J39      | Solid endmill    |
| SSND**            | P5            | Spare parts      |
| SSTE R ****       | F63           | Tool holder      |
| SSTI R ****       | F63           | Tool holder      |
| SSUP****ZX        | J33           | Solid endmill    |
| SSUP****ZX-R**    | J33           | Solid endmill    |
| SSW**             | P6            | Spare parts      |
| STAC R/L ****_*** | D37           | Tool holder      |
| STFH**_*          | F56           | Tool holder      |
| STFS R/L ****_*   | F56           | Tool holder      |
| STGC R/L ****_*** | D37           | Tool holder      |
| STPD**            | P6            | Spare parts      |
| STW**             | P6            | Spare parts      |
| SUF*S R/L         | G12           | Spare parts      |
| SVJB R/L ****_*** | D38           | Tool holder      |
| SVLC R/L ****_*** | D39           | Tool holder      |
| SVP**             | D38, E21, E22 | Spare parts      |
| SVPB R/L ****_*** | D38           | Tool holder      |
| SVPC R/L ****_*** | D39           | Tool holder      |
| SVVB N ****_***   | D38           | Tool holder      |
| SVW**             | P5            | Spare parts      |
| SWW               | P6            | Spare parts      |

## T

|                  |     |                  |
|------------------|-----|------------------|
| TBGN*****        | C88 | Indexable insert |
| TBGN*****B       | M25 | SUMIBORON insert |
| TBGN*****NF      | M25 | SUMIDIA insert   |
| TBGR*****LW      | C88 | Indexable insert |
| TBGT*****LAY/RAY | C80 | Indexable insert |
| TBGT*****LFW/RFW | C80 | Indexable insert |
| TBGT*****LFX/RFX | C80 | Indexable insert |
| TBGT*****LFY/RFY | C80 | Indexable insert |
| TBGT*****LW/RW   | C80 | Indexable insert |
| TBGW*****        | C80 | Indexable insert |
| TBGW*****NF      | M25 | SUMIDIA insert   |
| TCGT*****LFX/RFX | C81 | Indexable insert |
| TCGT*****LFY/RFY | C81 | Indexable insert |
| TCGT*****M NSC   | C81 | Indexable insert |
| TCGT*****M NSI   | C81 | Indexable insert |
| TCGT*****NAG     | C81 | Indexable insert |

|                   |     |                  |
|-------------------|-----|------------------|
| TCGW*****NC       | M26 | SUMIBORON insert |
| TCGW*****NC-3     | M26 | SUMIBORON insert |
| TCGW*****NU       | M26 | SUMIBORON insert |
| TCMT*****NF       | M26 | SUMIDIA insert   |
| TCMT*****NFB      | C82 | Indexable insert |
| TCMT*****NFP      | C82 | Indexable insert |
| TCMT*****NLB      | C82 | Indexable insert |
| TCMT*****NLU      | C82 | Indexable insert |
| TCMT*****NSK      | C82 | Indexable insert |
| TCMT*****NSU      | C82 | Indexable insert |
| TCMW*****         | C82 | Indexable insert |
| TCS**T*           | P6  | Spare parts      |
| TEGN*****         | C89 | Indexable insert |
| TGA R/L ****BF    | F51 | Indexable insert |
| TGA R/L ****(E)   | F52 | Indexable insert |
| TGA R/L ****R     | F53 | Indexable insert |
| TGA R/L *T**      | F53 | Indexable insert |
| TF**              | M42 | Spare parts      |
| TH**              | P8  | Spare parts      |
| TNGA*****         | C54 | Indexable insert |
| TNGA*****ES-NC6   | M27 | SUMIBORON insert |
| TNGA*****HS-NC3   | M27 | SUMIBORON insert |
| TNGA*****HS-NC6   | M27 | SUMIBORON insert |
| TNGA*****HS-NU3   | M29 | SUMIBORON insert |
| TNGA*****HT-NU3   | M29 | SUMIBORON insert |
| TNGA*****LE-NC3   | M27 | SUMIBORON insert |
| TNGA*****LE-NU3   | M29 | SUMIBORON insert |
| TNGA*****LS-NC3   | M27 | SUMIBORON insert |
| TNGA*****LS-NU3   | M29 | SUMIBORON insert |
| TNGA*****LT-NC3   | M27 | SUMIBORON insert |
| TNGA*****LF-NU3   | M29 | SUMIBORON insert |
| TNGA*****NC3      | M27 | SUMIBORON insert |
| TNGA*****NC6      | M27 | SUMIBORON insert |
| TNGA*****NU3      | M29 | SUMIBORON insert |
| TNGA*****T NU3    | M29 | SUMIBORON insert |
| TNGA*****US-NU3   | M29 | SUMIBORON insert |
| TNGG*****LAX/RAX  | C54 | Indexable insert |
| TNGG*****LFT/RT   | C53 | Indexable insert |
| TNGG*****LFY/RFY  | C53 | Indexable insert |
| TNGG*****LFX/RFX  | C53 | Indexable insert |
| TNGG*****LST/RST  | C53 | Indexable insert |
| TNGG*****LUM/RUM  | C54 | Indexable insert |
| TNGG*****N-FV NC6 | M28 | SUMIBORON insert |
| TNGG*****N-LV NC6 | M28 | SUMIBORON insert |
| TNGG*****NGH      | C54 | Indexable insert |
| TNGG*****NSU      | C53 | Indexable insert |
| TNGG*****N-SV NC6 | M28 | SUMIBORON insert |
| TNGM*****N-LV NU3 | M29 | SUMIBORON insert |
| TNGN*****         | M29 | SUMIBORON insert |
| TNMA*****         | C52 | Indexable insert |
| TNMA*****         | M30 | SUMIBORON insert |
| TNMA*****NU       | M30 | SUMIBORON insert |
| TNMA*****NS       | M30 | SUMIBORON insert |
| TNMG*****LHM/RHM  | C50 | Indexable insert |
| TNMG*****LUM/RUM  | C48 | Indexable insert |
| TNMG*****NEF      | C46 | Indexable insert |
| TNMG*****NEG      | C48 | Indexable insert |
| TNMG*****NEM      | C49 | Indexable insert |
| TNMG*****NEX      | C48 | Indexable insert |
| TNMG*****NFA      | C46 | Indexable insert |
| TNMG*****NFB      | C46 | Indexable insert |
| TNMG*****NFE      | C46 | Indexable insert |

|                   |     |                  |
|-------------------|-----|------------------|
| TNMG*****NFL      | C46 | Indexable insert |
| TNMG*****NGE      | C47 | Indexable insert |
| TNMG*****NGU      | C47 | Indexable insert |
| TNMG*****NGZ      | C50 | Indexable insert |
| TNMG*****NLU      | C46 | Indexable insert |
| TNMG*****NME      | C49 | Indexable insert |
| TNMG*****NMU      | C49 | Indexable insert |
| TNMG*****NMX      | C49 | Indexable insert |
| TNMG*****NSE      | C47 | Indexable insert |
| TNMG*****NSU      | C46 | Indexable insert |
| TNMG*****NSX      | C47 | Indexable insert |
| TNMG*****NUG      | C48 | Indexable insert |
| TNMG*****NUP      | C48 | Indexable insert |
| TNMG*****NUX      | C49 | Indexable insert |
| TNMG*****NUZ      | C50 | Indexable insert |
| TNMM*****NHG      | C51 | Indexable insert |
| TNMM*****NHP      | C51 | Indexable insert |
| TNMM*****NMP      | C51 | Indexable insert |
| TNMM*****NMP      | C51 | Indexable insert |
| TNMX*****NF       | M30 | SUMIDIA insert   |
| TNS****           | P6  | Spare parts      |
| TNS****B          | P6  | Spare parts      |
| TPGN*****C        | C88 | Indexable insert |
| TPGN*****M        | M31 | SUMIBORON insert |
| TPGN*****HS       | M31 | SUMIBORON insert |
| TPGN*****LT       | M31 | SUMIBORON insert |
| TPGN*****NF       | M31 | SUMIDIA insert   |
| TPGN*****T NF     | M31 | SUMIBORON insert |
| TPGN*****NU       | M31 | SUMIBORON insert |
| TPGR*****LW/RW    | C88 | Indexable insert |
| TPGT*****LAY/RAY  | C84 | Indexable insert |
| TPGT*****LFW/RFW  | C83 | Indexable insert |
| TPGT*****LFX/RFX  | C83 | Indexable insert |
| TPGT*****LFY/RFY  | C84 | Indexable insert |
| TPGT*****LSD/RSD  | C85 | Indexable insert |
| TPGT*****LW/RW    | C85 | Indexable insert |
| TPGT*****M NFC    | C83 | Indexable insert |
| TPGT*****N-FV NC3 | M32 | SUMIBORON insert |
| TPGT*****N-FV NU3 | M33 | SUMIBORON insert |
| TPGW*****C        | C84 | Indexable insert |
| TPGW*****M        | M32 | SUMIBORON insert |
| TPGW*****HS-NC3   | M32 | SUMIBORON insert |
| TPGW*****HS-NU    | M34 | SUMIBORON insert |
| TPGW*****LE-NC3   | M32 | SUMIBORON insert |
| TPGW*****LE-NU3   | M34 | SUMIBORON insert |
| TPGW*****LF-NU    | M33 | SUMIBORON insert |
| TPGW*****LF-NU3   | M34 | SUMIBORON insert |
| TPGW*****LS-NC3   | M32 | SUMIBORON insert |
| TPGW*****LT-NC3   | M32 | SUMIBORON insert |
| TPGW*****LT-NU    | M33 | SUMIBORON insert |
| TPGW*****NC       | M32 | SUMIBORON insert |
| TPGW*****NC3      | M32 | SUMIBORON insert |
| TPGW*****NF       | M34 | SUMIDIA insert   |
| TPGW*****NU       | M33 | SUMIBORON insert |
| TPGW*****NU3      | M34 | SUMIBORON insert |
| TPGX*****L/R-SDW  | C85 | Indexable insert |
| TPMH*****NSF      | C87 | Indexable insert |
| TPMN*****C        | C89 | Indexable insert |
| TPMR*****NFK      | C89 | Indexable insert |
| TPMR*****NSF      | C89 | Indexable insert |
| TPMR*****NUJ      | C89 | Indexable insert |
| TPMT*****L-DM NU  | M35 | SUMIDIA insert   |

|                  |                    |                   |
|------------------|--------------------|-------------------|
| TPMT*****NFB     | C86                | Indexable insert  |
| TPMT*****NFK     | C86                | Indexable insert  |
| TPMT*****N-GD NF | M35                | SUMIDIA insert    |
| TPMT*****NGU     | C87                | Indexable insert  |
| TPMT*****N-LD NF | M35                | SUMIDIA insert    |
| TPMT*****NLB     | C86                | Indexable insert  |
| TPMT*****NLU     | C86                | Indexable insert  |
| TPMT*****NMU     | C87                | Indexable insert  |
| TPMT*****NSF     | C87                | Indexable insert  |
| TPMT*****NSU     | C87                | Indexable insert  |
| TPMW*****RF      | M35                | SUMIDIA insert    |
| TPMW*****RH      | M35, M45           | SUMIDIA insert    |
| TRB**IP          | P7                 | Spare parts       |
| TRCP*            | D11, E11           | Spare parts       |
| TRD**            | P8                 | Spare parts       |
| TRDR**IP         | P8                 | Spare parts       |
| TRM*****-FL      | C52, D11, E11      | Indexable insert  |
| TRM*****-GU      | C52, D11, E11      | Indexable insert  |
| TRM*****-LU      | C52, D11, E11      | Indexable insert  |
| TRM*****-SU      | C52, D11, E11      | Indexable insert  |
| TRW****          | P6                 | Spare parts       |
| TRX**            | P8                 | Spare parts       |
| TRX**IP          | P8                 | Spare parts       |
| TRX**IP**        | D35                | Spare parts       |
| TRXW**IP         | P7                 | Spare parts       |
| TSX*****E        | G30, H20, H22, H23 | Indexable endmill |
| TSXF*****E       | G30, H20, H22, H23 | Indexable endmill |
| TSXM*****E       | G30, H20, H23,     | Indexable endmill |
| TSX*****RS       | G30, G34, G35, H20 | Cutter            |
| TSXF*****RS      | G30, G34, G37, H20 | Cutter            |
| TSXM*****RS      | G30, G36, H20      | Cutter            |
| TSXR*****E       | G30, H20, H24, H25 | Indexable endmill |
| TSXR*****RS      | G30, G38, G39, H20 | Cutter            |
| TSW****          | P8                 | Spare parts       |
| TT**             | P8                 | Spare parts       |
| TTR**IP          | P8                 | Spare parts       |
| TTX**            | P8                 | Spare parts       |

## U

|                |     |                  |
|----------------|-----|------------------|
| UF*K R/L       | G12 | Spare parts      |
| UF*S R/L       | G12 | Spare parts      |
| UFKW R/L       | G12 | Spare parts      |
| UFO**** R/L-S  | G12 | Cutter           |
| UFOF**** R/L-S | G13 | Cutter           |
| UFTW R/L       | G12 | Spare parts      |
| UW*****R       | G13 | Indexable insert |

# Index

## V - W

| V                  |          |                  |
|--------------------|----------|------------------|
| VBGT*****LAY/RAY   | C91      | Indexable insert |
| VBGT*****LFX/RFX   | C91      | Indexable insert |
| VBGT*****LFY/RFY   | C91      | Indexable insert |
| VBGT*****LFYS/RFYS | C91      | Indexable insert |
| VBGT*****M NSI     | C91      | Indexable insert |
| VBGW*****HS-NC2    | M37      | SUMIBORON insert |
| VBGW*****HS-NU     | M36      | SUMIBORON insert |
| VBGW*****LE-NC2    | M37      | SUMIBORON insert |
| VBGW*****LE-NU2    | M37      | SUMIBORON insert |
| VBGW*****LS-NC2    | M37      | SUMIBORON insert |
| VBGW*****LT-NC2    | M37      | SUMIBORON insert |
| VBGW*****LT-NU     | M36      | SUMIBORON insert |
| VBGW*****NC        | M36      | SUMIBORON insert |
| VBGW*****NC2       | M37      | SUMIBORON insert |
| VBGW*****NU        | M36      | SUMIBORON insert |
| VBGW*****NU2       | M37      | SUMIBORON insert |
| VBMT*****NFB       | C90      | Indexable insert |
| VBMT*****NFP       | C90      | Indexable insert |
| VBMT*****NGU       | C90      | Indexable insert |
| VBMT*****NLB       | C90      | Indexable insert |
| VBMT*****NLU       | C90      | Indexable insert |
| VBMT*****NMU       | C90      | Indexable insert |
| VBMT*****NSK       | C90      | Indexable insert |
| VBMT*****NSU       | C90      | Indexable insert |
| VBW*****           | C90      | Indexable insert |
| VCGT*****LFX/RFX   | C92      | Indexable insert |
| VCGT*****LFY/RFY   | C92      | Indexable insert |
| VCGT*****M NFC     | C92      | Indexable insert |
| VCGT*****M NSI     | C92      | Indexable insert |
| VCGT*****NAG       | C92      | Indexable insert |
| VCGW*****HS NC2    | M38      | SUMIBORON insert |
| VCGW*****LS NC2    | M38      | SUMIBORON insert |
| VCGW*****LT NU     | M38      | SUMIBORON insert |
| VCGW*****NC2       | M38      | SUMIBORON insert |
| VCGW*****NU        | M38      | SUMIBORON insert |
| VCMT*****          | M39      | SUMIDIA insert   |
| VCMT*****NF        | M39      | SUMIDIA insert   |
| VCMT*****NFB       | C93      | Indexable insert |
| VCMT*****NGU       | C93      | Indexable insert |
| VCMT*****NLD NF    | M39      | SUMIDIA insert   |
| VCMT*****NGD NF    | M39      | SUMIDIA insert   |
| VCMT*****NLB       | C93      | Indexable insert |
| VCMT*****NLU       | C93      | Indexable insert |
| VCMT*****NSK       | C93      | Indexable insert |
| VCMT*****NSU       | C93      | Indexable insert |
| VCMW*****          | M39      | SUMIBORON insert |
| VCMW*****NF        | M39      | SUMIDIA insert   |
| VCMW*****RH        | M39, M45 | SUMIDIA insert   |
| VCS****            | P6       | Spare parts      |
| VNGA*****ES-NC4    | M41      | SUMIBORON insert |
| VNGA*****HS-NC4    | M41      | SUMIBORON insert |
| VNGA*****HS-NU2    | M40      | SUMIBORON insert |
| VNGA*****LS-NC2    | M41      | SUMIBORON insert |
| VNGA*****LS-NC4    | M41      | SUMIBORON insert |
| VNGA*****LT-NC2    | M41      | SUMIBORON insert |
| VNGA*****LT-NU2    | M40      | SUMIBORON insert |
| VNGA*****NC2       | M41      | SUMIBORON insert |
| VNGA*****NC4       | M41      | SUMIBORON insert |
| VNGA*****NU        | M40      | SUMIBORON insert |
| VNGA*****NU2       | M40      | SUMIBORON insert |
| VNGG*****LAX/RAX   | C57      | Indexable insert |

|                  |          |                  |
|------------------|----------|------------------|
| VNGG*****NEF     | C57      | Indexable insert |
| VNGG*****NFV NC4 | M41      | SUMIBORON insert |
| VNGG*****NLV NC4 | M41      | SUMIBORON insert |
| VNGG*****NSU     | C57      | Indexable insert |
| VNGM*****NLV NU2 | M42      | SUMIBORON insert |
| VNMA*****        | C55      | Indexable insert |
| VNMA*****        | M42      | SUMIBORON insert |
| VNMA*****NU      | M42      | SUMIBORON insert |
| VNMA*****NS      | M42      | SUMIBORON insert |
| VNMA*****NF      | M42      | SUMIDIA insert   |
| VNMA*****RH      | M42, M45 | SUMIDIA insert   |
| VNMG*****NEF     | C55      | Indexable insert |
| VNMG*****NEG     | C56      | Indexable insert |
| VNMG*****NEX     | C56      | Indexable insert |
| VNMG*****NFA     | C55      | Indexable insert |
| VNMG*****NFB     | C55      | Indexable insert |
| VNMG*****NFE     | C55      | Indexable insert |
| VNMG*****NFL     | C55      | Indexable insert |
| VNMG*****NGE     | C56      | Indexable insert |
| VNMG*****NGU     | C56      | Indexable insert |
| VNMG*****NGZ     | C57      | Indexable insert |
| VNMG*****NLU     | C55      | Indexable insert |
| VNMG*****NSE     | C56      | Indexable insert |
| VNMG*****NSU     | C56      | Indexable insert |
| VNMG*****NSX     | C56      | Indexable insert |
| VNMG*****NUG     | C56      | Indexable insert |
| VNMG*****NUP     | C57      | Indexable insert |
| VNMG*****NUX     | C57      | Indexable insert |
| VNMG*****NUZ     | C57      | Indexable insert |
| VNMX*****        | M42      | SUMIDIA insert   |
| VNMX*****NF      | M42      | SUMIDIA insert   |
| VNS****          | P6       | Spare parts      |
| VP**             | P7       | Spare parts      |
| VP**B            | P7       | Spare parts      |

| W                |          |                   |
|------------------|----------|-------------------|
| WAS*****         | K66      | Eccentric sleeve  |
| WAX****E**       | H62, H63 | Indexable endmill |
| WAX****EL **     | H62, H63 | Indexable endmill |
| WAX****RS        | G72, G73 | Cutter            |
| WB*.**           | P4       | Spare parts       |
| WB*.**T          | P4       | Spare parts       |
| WB*F-**T         | P4       | Spare parts       |
| WB*-**TL         | P4       | Spare parts       |
| WB*F-**TL        | P4       | Spare parts       |
| WB*R-**T         | P4       | Spare parts       |
| WBGT*****LFW/RFW | C94      | Indexable insert  |
| WBGT*****LFX/RFX | C94      | Indexable insert  |
| WBGT*****LFY/RFY | C94      | Indexable insert  |
| WBGT*****LW/RW   | C94      | Indexable insert  |
| WBMF****L        | H73      | Indexable endmill |
| WBMF****M        | H73      | Indexable endmill |
| WBMF****MM**N    | H73      | Indexable endmill |
| WBMF****S        | H73      | Indexable endmill |
| WBMR****LL       | H71      | Indexable endmill |
| WBMR****LLW      | H71      | Indexable endmill |
| WBMR****M        | H71      | Indexable endmill |
| WBMR****MW       | H71      | Indexable endmill |
| WBMR****S        | H71      | Indexable endmill |
| WCFH**.*         | F58, F59 | Tool holder       |

|                    |                         |                   |                 |             |                   |
|--------------------|-------------------------|-------------------|-----------------|-------------|-------------------|
| WCFN/R/L*          | F57, F60                | Indexable insert  | WNGA*****LS-NC6 | M43         | SUMIBORON insert  |
| WCFN/R/L*A         | F57, F60                | Indexable insert  | WNGA*****LT-NC3 | M43         | SUMIBORON insert  |
| WCFN/R/L*B         | F57, F60                | Indexable insert  | WNGA*****NC6    | M43         | SUMIBORON insert  |
| WCFN/R/L*T         | F57, F60                | Indexable insert  | WNGA*****NC-WG6 | M43         | SUMIBORON insert  |
| WCFN*GF            | F57, F60                | Indexable insert  | WNGA*****NC-WH6 | M43         | SUMIBORON insert  |
| WCFN*GG            | F57, F60                | Indexable insert  | WNGG*****NSU    | C60         | Indexable insert  |
| WCF R/L*CF         | F57,                    | Indexable insert  | WNMA*****       | C62         | Indexable insert  |
| WCFS R/L **_*      | F59                     | Tool holder       | WNMA*****NU     | M43         | SUMIBORON insert  |
| WDMT****ZDTR       | G67, H11, H12           | Indexable insert  | WNMG*****NEF    | C59         | Indexable insert  |
| WDMT****ZDTR-H     | G67, H11, H12           | Indexable insert  | WNMG*****NEG    | C60         | Indexable insert  |
| WDX***D2S**        | K56                     | Multi-drill       | WNMG*****NEM    | C60         | Indexable insert  |
| WDX***D3S**        | K58                     | Multi-drill       | WNMG*****NEX    | C60         | Indexable insert  |
| WDX***D4S**        | K60                     | Multi-drill       | WNMG*****NFA    | C58         | Indexable insert  |
| WDX***D5S**        | K62                     | Multi-drill       | WNMG*****NFB    | C58         | Indexable insert  |
| WDXT*****-G        | K57, K59, K61, K63, K67 | Indexable insert  | WNMG*****NFE    | C58         | Indexable insert  |
| WDXT*****-H        | K57, K59, K61, K63, K67 | Indexable insert  | WNMG*****NFL    | C58         | Indexable insert  |
| WDXT*****-L        | K57, K59, K61, K63, K67 | Indexable insert  | WNMG*****NGE    | C60         | Indexable insert  |
| WDXT*****-M        | K57, K59, K61, K63      | Indexable insert  | WNMG*****NGU    | C59         | Indexable insert  |
| WEX****E           | H56, H57, H58           | Indexable endmill | WNMG*****NGU-W  | C59         | Indexable insert  |
| WEX****E**         | H58                     | Indexable endmill | WNMG*****NGZ    | C61         | Indexable insert  |
| WEX****EL          | H56, H57, H58           | Indexable endmill | WNMG*****NLU    | C58         | Indexable insert  |
| WEX****EL **       | H56, H57                | Indexable endmill | WNMG*****NLU-W  | C58         | Indexable insert  |
| WEX****EL**Z*      | H57                     | Indexable endmill | WNMG*****NME    | C61         | Indexable insert  |
| WEX****EW          | H57, H58                | Indexable endmill | WNMG*****NMU    | C61         | Indexable insert  |
| WEX****F           | G58                     | Cutter            | WNMG*****NMX    | C61         | Indexable insert  |
| WEX****M**Z*       | H57, H58,               | Indexable endmill | WNMG*****NSE    | C59         | Indexable insert  |
| WEZ****E**         | G40, H26, H30, H36,     | Indexable endmill | WNMG*****NSE-W  | C59         | Indexable insert  |
| WEZ****E****       | G40, H26, H30, H36,     | Indexable endmill | WNMG*****NSU    | C59         | Indexable insert  |
| WEZ****EL **       | G40, H26, H34, H40,     | Indexable endmill | WNMG*****NSX    | C59         | Indexable insert  |
| WEZ****ES****      | G40, H26, H32, H38,     | Indexable endmill | WNMG*****NUG    | C60         | Indexable insert  |
| WEZ****M****Z*     | G40, H26, H46, H48      | Indexable endmill | WNMG*****NUP    | C60         | Indexable insert  |
| WEZ****R**         | G40, G44, G46, H26      | Cutter            | WNMG*****NUX    | C61         | Indexable insert  |
| WEZ****RS**        | G40, G44, G46, H26      | Cutter            | WNMG*****NUZ    | C61         | Indexable insert  |
| WEZR*****E****Z**  | G40, H26, H42, H44      | Indexable endmill | WNMM*****NHG    | C62         | Indexable insert  |
| WEZR*****M****Z*   | G40, H26, H50, H52      | Indexable endmill | WNMM*****NMP    | C62         | Indexable insert  |
| WEZR*****RS****Z** | G40, G54, G56, H26      | Cutter            | WNMU*****ZNER-G | G66, H8, H9 | Indexable insert  |
| WFX*****E          | G26, H18, H19           | Indexable endmill | WNMU*****ZNER-H | G66, H8, H9 | Indexable insert  |
| WFX*****R          | G26                     | Cutter            | WNS****         | P6          | Spare parts       |
| WFX*****E **       | H18                     | Indexable endmill | WNS****B        | P6          | Spare parts       |
| WFXF*****E         | G26, H19                | Indexable endmill | WPMT*****NLB    | C95         | Indexable insert  |
| WFXM*****E         | G26, H18                | Indexable endmill | WRCX*****EL     | H74         | Indexable endmill |
| WFX*****M          | G26                     | Indexable endmill | WRCX*****EM     | H74         | Indexable endmill |
| WFX*****M**Z*      | H18, H58                | Indexable endmill | WRCX*****ES     | H74         | Indexable endmill |
| WFX*****RS         | G26, G28, G29           | Cutter            | WRCX*****M**Z*  | H75         | Indexable endmill |
| WFXC*****E         | G26, H78, H79           | Indexable endmill | WRCX*****RS     | G17         | Cutter            |
| WFXC*****M         | G26, H80                | Indexable endmill | WRCXF*****RS    | G17         | Cutter            |
| WFXF*****R         | G26                     | Cutter            | WRCXX*****RS    | G17         | Cutter            |
| WFX*****RS         | G26, G28, G29           | Cutter            | WRX****RH **E** | H65, H66    | Indexable endmill |
| WFXH*****M         | G26, H14                | Indexable endmill | WRX****RH **F** | G59         | Cutter            |
| WFXH*****M**Z*     | H15                     | Indexable endmill | WRX****RH **W** | H65, H66    | Indexable endmill |
| WFXH*****RS        | G26, G70, G71           | Cutter            |                 |             |                   |
| WFXH*****RSZ6      | G70                     | Cutter            |                 |             |                   |
| WFXM*****R         | G26                     | Cutter            |                 |             |                   |
| WFXM*****RS        | G26, G28                | Cutter            |                 |             |                   |
| WFXS*R             | P6                      | Spare parts       |                 |             |                   |
| WGCS**R            | P6                      | Spare parts       |                 |             |                   |
| WGX*****EW         | H7                      | Indexable endmill |                 |             |                   |
| WGX*****RS         | G10                     | Cutter            |                 |             |                   |
| WGXF*****RS        | G10                     | Cutter            |                 |             |                   |
| WGXM*****RS        | G10                     | Cutter            |                 |             |                   |
| WNGA*****HS-NC6    | M43                     | SUMIBORON insert  |                 |             |                   |
| WNGA*****LS-NC3    | M43                     | SUMIBORON insert  |                 |             |                   |

## X - Z

### X

|                   |                    |                  |
|-------------------|--------------------|------------------|
| XCLN R/L ****-*** | D27                | Tool holder      |
| XEEW****AGER-W    | G13                | Indexable insert |
| XEEW****AGER-WR   | G11, H7            | Indexable insert |
| XEEW****AGFR-W-NF | G13                | Indexable insert |
| XNEU****ANEN-W    | G9, H6             | Indexable insert |
| XNMU****PNER-G    | G25, G27, H14, H15 | Indexable insert |
| XNMU****PNER-GS   | G25, H17           |                  |
| XNMU****PNER-H    | G25, G27, H14, H15 | Indexable insert |
| XNMU****PNER-L    | G25, G27, H14, H15 | Indexable insert |
| XOEW*****PDTR-W   | G31, H17           | Indexable insert |
| XOEW*****PZTR-W   | G30, H14           | Indexable insert |
| XOMT****PEER-E    | G61, H69           | Indexable insert |
| XP**              | F20                | Spare parts      |
| XP**-E            | F26, F30           | Spare parts      |
| XSBN R/L ****-*** | D27                | Tool holder      |

### Y

|     |    |             |
|-----|----|-------------|
| YE* | P6 | Spare parts |
| YI* | P6 | Spare parts |

### Z

|                |     |                  |
|----------------|-----|------------------|
| ZNEX*****LE-NC | M44 | SUMIBORON insert |
| ZNEX*****LT-NC | M44 | SUMIBORON insert |
| ZNEX*****NC    | M44 | SUMIBORON insert |
| ZNEX*****NU    | M44 | SUMIBORON insert |
| ZNMT*****      | H71 | Indexable insert |
| ZNMT*****-C    | H71 | Indexable insert |
| ZNMT*****-N    | H71 | Indexable insert |
| ZNMT*****-S    | H71 | Indexable insert |
| ZPGU*****      | H73 | Indexable insert |



# Sumitomo Electric Cutting Tools Official Apps



**Smart  
Calculation**

Just enter figures



**Easy to  
Find**

Just select conditions

for iOS/Android



Cutting calculation app

**SumiTool Calculator**



Grade and chipbreaker comparison app

**SumiTool Converter**





# SAFETY INSTRUCTIONS

| Target Products                                             | Hazards                                                                                                                                                                                | Measures                                                                                                                                                                                                                                                           |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>General precautions for cutting tools</b>                | The tools have sharp cutting edges. There is a risk of injury if held directly with bare hands.                                                                                        | Always wear protective equipment, such as protective tools when removing the tool from the case or mounting it onto a machine.                                                                                                                                     |
|                                                             | Improper use or incorrect use conditions may cause the tool to break or scatter, and could cause injury.                                                                               | Always use protective equipment such as safety covers and protective eyewear.<br>Always use within the scope of the recommended conditions. Refer to the instruction manual, catalogue and other relevant documents.                                               |
|                                                             | The tool could break and fly off if the cutting force increases suddenly because of impact loads or excessive wear and could cause injury.                                             | Always use protective equipment such as safety covers and protective eyewear.<br>Replace the tool at an early stage.                                                                                                                                               |
|                                                             | Very hot chips could scatter or elongated chips could be discharged, and cause injury or burns.                                                                                        | Always use protective equipment such as safety covers and protective eyewear.<br>When removing the chips, always stop the machine, wear protective gloves, and use tools such as nippers or clippers.                                                              |
|                                                             | The tool and work materials will become very hot during turning. There is a risk of burn if these are touched directly with bare hands immediately after machining.                    | Always wear protective equipment such as protective gloves.                                                                                                                                                                                                        |
|                                                             | There is a risk of igniting or fires from the sparks generated during turning, or the heat generated from broken pieces and chips.                                                     | Do not use in an area where there is a risk of fires or explosions. Always provide fire prevention measures when using water-insoluble turning oil solution.                                                                                                       |
|                                                             | When using at a high rotation speed, if the balance including the machine tool holder is poor, the deflection or vibration could cause tool damage and injury.                         | Always use protective equipment such as safety covers and protective eyewear.<br>Always carry out trial operation, and confirm that there is no deflection, vibration or abnormal noise.                                                                           |
|                                                             | There is a risk of injury if you touch the burrs formed on the workpiece with bare hands.                                                                                              | Do not touch with bare hands.                                                                                                                                                                                                                                      |
| <b>General precautions for cutting edge indexable tools</b> | If insert or parts are not properly clamped, they could come off or fly off during turning and cause injury.                                                                           | Clean the mounting surface and fixing parts free of foreign matter, before mounting the insert.<br>When mounting, use the enclosed spanner and confirm that the insert and parts are securely clamped. Never use parts other than the designated inserts or parts. |
|                                                             | If the parts are tightened excessively with an auxiliary tool such as a pipe, the insert or part could break and come off or fly off.                                                  | Do not use auxiliary tools such as pipes. Use the enclosed spanner.                                                                                                                                                                                                |
|                                                             | Using the tool with high-speed rotation is extremely dangerous as the parts or inserts could fly off with the centrifugal force. Pay special attention to safety when handling.        | Always use within the scope of the recommended conditions. Refer to the instruction manual, catalog and other relevant documents.                                                                                                                                  |
| <b>Various cutters and other tools used with rotation</b>   | The cutters have very sharp cutting edges. Touching these with bare hands could result in injury.                                                                                      | Always wear protective equipment such as protective gloves.                                                                                                                                                                                                        |
|                                                             | Tools could sway or vibrate if the eccentric rotation or balance is poor. There is a risk of injury if they break or fly off.                                                          | Keep the rotation speed within the scope of the recommended conditions.<br>Periodically adjust the accuracy and balance of the rotating sections so that eccentric rotation or deflection do not occur because of bearing wear, etc.                               |
| <b>Drills</b>                                               | When machining a through hole while rotating the workpiece, a disc-shaped uncut section may fly off at the point of penetration. This disc is sharp and very dangerous.                | Always use protective equipment such as safety covers and protective eyewear.<br>Also take measures such as attaching a cover to the chuck section.                                                                                                                |
|                                                             | The very small drill has a pointed end, and is very sharp. It could stab or break when directly touched with a finger, and be difficult to remove. The end could fly off if it breaks. | Take special care to safety when handling.<br>Always wear protective gloves and protective eyewear, etc.                                                                                                                                                           |
| <b>Brazing tool</b>                                         | There is a risk of injury if the insert comes off or breaks, etc.                                                                                                                      | Confirm that the insert is properly brazed before using.<br>Do not use in conditions that could become very hot.                                                                                                                                                   |
| <b>Others</b>                                               | Repeated brazing is dangerous as the insert could break during use.                                                                                                                    | Do not use an insert that has been repeatedly brazed as the strength will have dropped.                                                                                                                                                                            |
|                                                             | Using this product for a purpose other than the designated application can break the machine or tool and is very dangerous.                                                            | Observe the designated usage.                                                                                                                                                                                                                                      |

Finally, this brochure describes the basic safety information. For further information, refer to the instruction manual, catalog and other relevant documents for each tool, or contact Sumitomo Electric Hardmetal. Sumitomo Electric Hardmetal will not be held liable for any damage and injuries resulting from changes to the specifications, including alterations and modifications, made without consent from Sumitomo Electric Hardmetal.

# Tool Engineering Services

In order to provide a higher level of support and satisfaction for our customers, Sumitomo Electric Industries has created the Tool Engineering Service system.

We have created several Tool Engineering Centers around the world as bases for this support. The Tool Engineering Centers provide a wide range of support to assist user manufacturing activities, with services including training (at the Center), test cuts, technical consulting, line diagnostics (at the user's site) and tooling proposals.



### Tool Engineering Center Locations

#### Japan

- ▶ Itami Tool Engineering Center (I-TEC)
- ▶ Yokohama Tool Engineering Center (Y-TEC)
- ▶ Hokkaido Igetalloy Tool Engineering Center (H-TEC)
- ▶ Tokai Tool Engineering Center (T-TEC)
- ▶ Kyushu Tool Engineering Center (K-TEC)

#### Overseas

- ▶ Germany / European Design & Engineering Center (E-DEC)
- ▶ Thailand / Thailand Tool Engineering Center (Ti-TEC)
- ▶ Shanghai / Shanghai Tool Engineering Center (S-TEC)
- ▶ U.S.A. / Americas Tool Engineering Center (A-TEC)
- ▶ Indonesia / Indonesia Tool Engineering Center (In-TEC)
- ▶ India Tool Engineering Center

## 1 Training

To make it easy for anyone to take part, the Centers offer training courses designed for a variety of different training objectives and participants.

\*Contact your nearest SEI sales office for detailed training curricula.

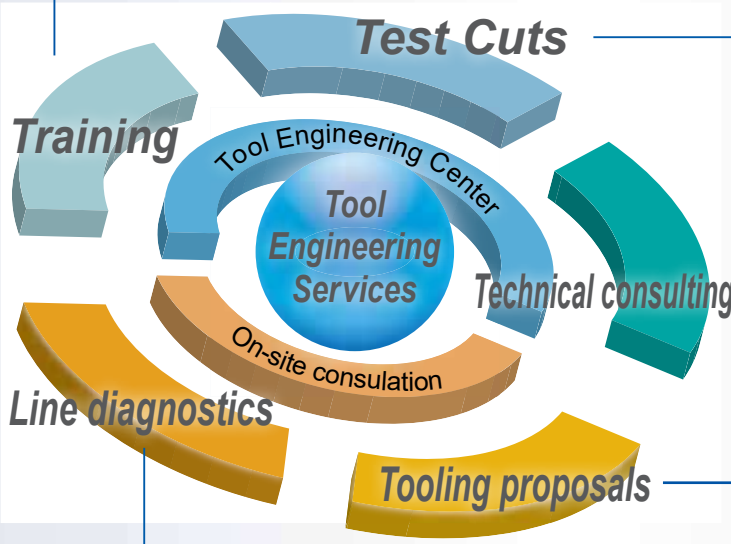
## 2 Performance evaluation technology

To attain improvements in machining on sites, manufacturers must rely on more than just the subjective guidance provided by experience and instinct. Today's advanced measuring instruments can make machining phenomena observable, and clarify problems.

## 3 Test cuts and technical consulting

The Tool Engineering Centers can make test cuts on user workpieces, and work with users to create more detailed technical proposals. The Centers can also provide solutions to various machining problems, general line diagnostics for machining lines, and tooling support for new lines.

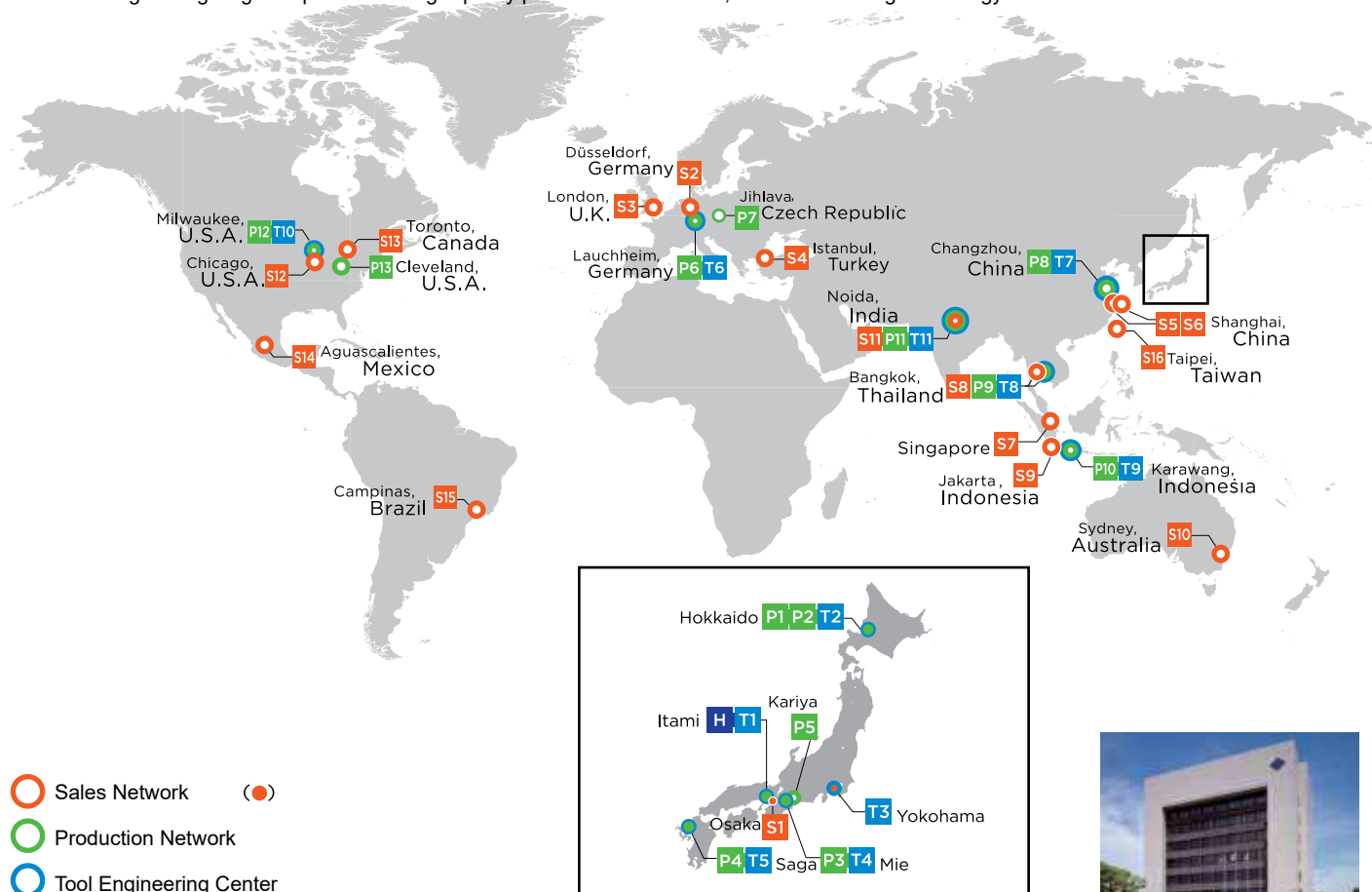
\*Contact your nearest SEI sales office for more information.



## CUTTING TOOLS

# WORLDWIDE LOCATIONS

We are strengthening its global position for high-quality products and services, while contributing technology to market needs around the world.



- Sales Network      (●)
- Production Network
- Tool Engineering Center



**H** Sumitomo Electric Industries Ltd. Hardmetal Div.  
Sumitomo Electric Hardmetal Corp.

## Production Network



**P1** Hokkaido Sumiden Precision Co., Ltd.



**P2** Hokkaido Precision Tool Co., Ltd.



**P3** Tokai Sumiden Precision Tool Co., Ltd.



**P4** Kyushu Sumiden Seimitsu Ltd.



**P5** Asdex Corporation



**P6** Sumitomo Electric Hartmetallfabrik GmbH



**P7** Sumitomo Electric Hartmetallfabrik GmbH, organizační složka.



**P8** Sumitomo Electric Hardmetal Manufacturing (Changzhou) Co., Ltd.



**P9** Sumitomo Electric Hardmetal Manufacturing (Thailand), Ltd.



**P10** PT. Sumiden Hardmetal Manufacturing Indonesia



**P11** Motherson Techno Tools Ltd.



**P12** Sumitomo Electric Carbide Manufacturing, Inc. (WI)



**P13** Sumitomo Electric Carbide Manufacturing, Inc. (OH)