

## Tungsten Carbide End Mills UNIMAX Series

超硬エンドミル ユニマックスシリーズ

Vol. 6

HMGCOAT 2枚刃 ボールエンドミル  
HMGCOAT 2 Flutes Ball End Mills

### HGB

全 20 型番  
Total 20 Models

高硬度材加工用  
For Hard Materials

HMGCOAT 2枚刃 ロングネックボールエンドミル  
HMGCOAT 2 Flutes Long Neck Ball End Mills

追加 54  
Add 54

### HGLB

全 155 型番  
Total 155 Models



UNION TOOL CO.

# HGB / HGLB の特長 Features of HGB / HGLB

## 1 新コーティング HMGCOAT を採用

### Adopted new coating "HMGCOAT"

新開発 HMGCOAT (HARDMAX GREAT COAT)。

HARDMAX よりも耐摩耗性に優れる高硬度皮膜。

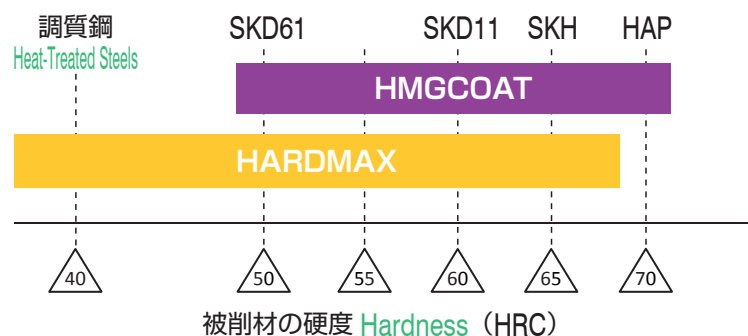
60HRC 以上の高硬度焼入れ鋼を長寿命に加工可能。

Newly developed "HMGCOAT" (HARDMAX GREAT COAT)

High hardness coating offers higher wear resistance compared to HARDMAX.

Long tool life for milling hardened materials over 60 HRC.

### コーティング膜種適用表 Coating Application Chart



## 2 耐摩耗性に優れる新超硬材料を採用

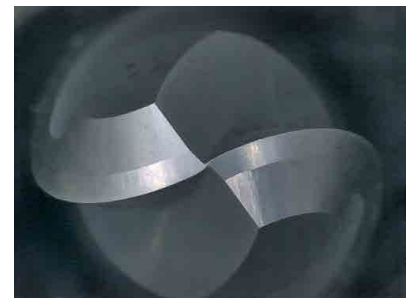
### New Carbide Materials with excellent wear resistance

## 3 耐欠損性を高めた新形状

### New design with improved breakage resistance

すくい角、逃げ角を高硬度材加工用に最適化し、耐欠損性を向上。

The rake and relief angles optimized for milling hard materials improve breakage resistance.



## 4 高精度外径公差・R 精度・シャンク径公差

### High Precision Diameter Tolerance / Radius Accuracy / Shank Diameter Tolerance

#### HSB / HSLB 公差 Tolerance

| ボール半径<br>Radius of Ball Nose | 外径公差<br>Diameter Tolerance | R 精度<br>Ball Radius Accuracy | シャンク径公差<br>Shank Diameter Tolerance |
|------------------------------|----------------------------|------------------------------|-------------------------------------|
| R0.03 ~ R0.075               | 0/-0.01                    | ±0.002                       | 0/-0.005 (h5)                       |
| R0.1 ~ R3                    | 0/-0.015                   | ±0.005                       |                                     |

※ HSB 1001-0020-6 のみ 1 枚刃。R 精度 ±0.005、外径公差 0/-0.015

Only HSB 1001-0020-6 is 1 flute.

Ball Radius Accuracy: ±0.005, Diameter Tolerance: 0/-0.015

#### HGB / HGLB 公差 Tolerance

| ボール半径<br>Radius of<br>Ball Nose | 外径公差<br>Diameter<br>Tolerance | R 精度<br>Ball Radius<br>Accuracy | シャンク径公差<br>Shank Diameter<br>Tolerance |  |
|---------------------------------|-------------------------------|---------------------------------|----------------------------------------|--|
| R0.05 ～ R0.075                  | 0/-0.008                      | ±0.002                          | 0/-0.004<br>(h4)                       |  |
| R0.1 ～ R1.25                    |                               | ±0.003                          |                                        |  |
| R1.5 ～ R2                       | 0/-0.01                       | ±0.005                          |                                        |  |
| R2.5 ～ R3                       |                               |                                 |                                        |  |

h4 公差対応 !  
Shank diameter tolerance h4!



サイズ Size R0.05~R3

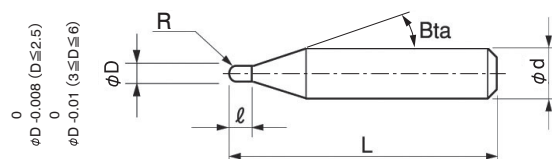
HGB



R0.05~R0.075 R0.1~R2 R2.5~R3

対応被削材表 (☆◎○の順に推奨) Material Applications (☆ Highly Recommended ◎ Recommended ○ Suggested)

| 被 削 材 Work Material                     |                                           |                                                |                         |         |         |                 |                             |                    |             |                |                                        |                             |                                      |                             |                                                    |
|-----------------------------------------|-------------------------------------------|------------------------------------------------|-------------------------|---------|---------|-----------------|-----------------------------|--------------------|-------------|----------------|----------------------------------------|-----------------------------|--------------------------------------|-----------------------------|----------------------------------------------------|
| 炭素鋼<br>CARBON<br>STEELS<br>S45C<br>S55C | 合金鋼<br>ALLOY<br>STEELS<br>SK / SCM<br>SUS | プリハードン鋼<br>PREHARDENED<br>STEELS<br>NAK<br>HPM | 焼入れ鋼<br>HARDENED STEELS |         |         | 鋳鉄<br>CAST IRON | アルミ合金<br>ALUMINUM<br>ALLOYS | グラファイト<br>GRAPHITE | 銅<br>COPPER | 樹脂<br>PLASTICS | ガラス入り樹脂<br>GLASS<br>FILLED<br>PLASTICS | チタン合金<br>TITANIUM<br>ALLOYS | 超耐熱合金<br>HEAT<br>RESISTANT<br>ALLOYS | 超硬合金<br>CEMENTED<br>CARBIDE | 硬脆材<br>HARD BRITTLE<br>(NON-METALLIC<br>MATERIALS) |
|                                         |                                           |                                                | ～ 55HRC                 | ～ 60HRC | ～ 70HRC |                 |                             |                    |             |                |                                        |                             |                                      |                             |                                                    |
|                                         |                                           | ○                                              | ◎                       | ◎       | ◎       |                 |                             |                    |             |                |                                        |                             |                                      |                             |                                                    |



シャックテーパ角は目安です。  
ワークとの干渉が心配な場合は必ず実測して確認してください。  
シャック部とワークの接触にご注意ください。

The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

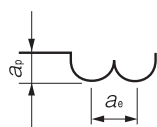
合計 20 型番 Total 20 models

単位 Unit (mm)

| 型番<br>Model<br>Number | ボール半径<br>Radius of<br>Ball Nose<br>R | 刃長<br>Length<br>of Cut<br>ℓ | シャックテーパ角<br>Shank Taper<br>Angle<br>Bta | 全長<br>Overall<br>Length<br>L | シャック径<br>Shank<br>Diameter<br>φd | 定価<br>Price<br>¥ |
|-----------------------|--------------------------------------|-----------------------------|-----------------------------------------|------------------------------|----------------------------------|------------------|
| HGB 2001-0010         | R0.05                                | 0.1                         | 16°                                     | 50                           | 4                                | 12,960           |
| HGB 20015-0015        | R0.075                               | 0.15                        | 16°                                     | 50                           | 4                                | 12,600           |
| HGB 2002-0030         | R0.1                                 | 0.3                         | 16°                                     | 50                           | 4                                | 9,120            |
| HGB 2003-0030         | R0.15                                | 0.3                         | 16°                                     | 50                           | 4                                | 7,440            |
| HGB 2003-0045         |                                      | 0.45                        |                                         | 50                           | 4                                | 7,440            |
| HGB 2004-0040         | R0.2                                 | 0.4                         | 16°                                     | 50                           | 4                                | 5,040            |
| HGB 2004-0060         |                                      | 0.6                         |                                         | 50                           | 4                                | 5,040            |
| HGB 2005-0050         | R0.25                                | 0.5                         | 16°                                     | 50                           | 4                                | 4,680            |
| HGB 2005-0075         |                                      | 0.75                        |                                         | 50                           | 4                                | 4,680            |
| HGB 2006-0060         | R0.3                                 | 0.6                         | 16°                                     | 50                           | 4                                | 4,560            |
| HGB 2006-0090         |                                      | 0.9                         |                                         | 50                           | 4                                | 4,560            |
| HGB 2008-0120         | R0.4                                 | 1.2                         | 16°                                     | 50                           | 4                                | 4,560            |
| HGB 2010-0150         | R0.5                                 | 1.5                         | 16°                                     | 50                           | 4                                | 4,150            |
| HGB 2015-0225         | R0.75                                | 2.25                        | 16°                                     | 50                           | 4                                | 5,040            |
| HGB 2020-0300         | R1                                   | 3                           | 16°                                     | 50                           | 4                                | 3,720            |
| HGB 2025-0375         | R1.25                                | 3.75                        | 16°                                     | 50                           | 4                                | 6,370            |
| HGB 2030-0450         | R1.5                                 | 4.5                         | 16°                                     | 50                           | 6                                | 4,560            |
| HGB 2040-0600         | R2                                   | 6                           | 16°                                     | 50                           | 6                                | 5,160            |
| HGB 2050-0750         | R2.5                                 | 7.5                         | 16°                                     | 50                           | 6                                | 6,240            |
| HGB 2060-0900         | R3                                   | 9                           | —                                       | 50                           | 6                                | 6,480            |

# HGB 切削条件表 Milling Conditions

| 被削材<br>WORK MATERIAL  |                                         |                                | プリハードン鋼 / 焼入れ鋼<br>PREHARDENED STEELS / HARDENED STEELS<br>NAK / STAVAX<br>(~55HRC) |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>SKD11<br>(55~62HRC)   |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>HAP10<br>(62~66HRC)   |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>HAP72<br>(66~70HRC)   |                                  |                                          |                                           |
|-----------------------|-----------------------------------------|--------------------------------|------------------------------------------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|
| 型番<br>Model<br>Number | ボール半径<br>Radius of<br>Ball Nose<br>(mm) | 刃長<br>Length of<br>Cut<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> )                                   | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) |
| 2001-0010             | R0.05                                   | 0.1                            | 48,000                                                                             | 200                              | 0.005                                    | 0.01                                      | 48,000                                           | 200                              | 0.005                                    | 0.01                                      | 48,000                                           | 150                              | 0.003                                    | 0.006                                     | 40,000                                           | 120                              | 0.002                                    | 0.004                                     |
| 20015-0015            | R0.075                                  | 0.15                           | 48,000                                                                             | 230                              | 0.007                                    | 0.014                                     | 48,000                                           | 230                              | 0.007                                    | 0.014                                     | 48,000                                           | 170                              | 0.005                                    | 0.01                                      | 40,000                                           | 135                              | 0.003                                    | 0.006                                     |
| 2002-0030             | R0.1                                    | 0.3                            | 44,000                                                                             | 250                              | 0.01                                     | 0.03                                      | 42,000                                           | 250                              | 0.01                                     | 0.03                                      | 40,000                                           | 200                              | 0.008                                    | 0.024                                     | 36,000                                           | 150                              | 0.006                                    | 0.018                                     |
| 2003-0030             | R0.15                                   | 0.3                            | 44,000                                                                             | 400                              | 0.01                                     | 0.03                                      | 42,000                                           | 350                              | 0.01                                     | 0.03                                      | 40,000                                           | 300                              | 0.01                                     | 0.03                                      | 36,000                                           | 250                              | 0.008                                    | 0.024                                     |
| 2003-0045             |                                         | 0.45                           | 44,000                                                                             | 400                              | 0.01                                     | 0.03                                      | 42,000                                           | 350                              | 0.01                                     | 0.03                                      | 40,000                                           | 300                              | 0.01                                     | 0.03                                      | 36,000                                           | 250                              | 0.008                                    | 0.024                                     |
| 2004-0040             | R0.2                                    | 0.4                            | 44,000                                                                             | 600                              | 0.015                                    | 0.045                                     | 42,000                                           | 550                              | 0.015                                    | 0.045                                     | 40,000                                           | 500                              | 0.013                                    | 0.036                                     | 36,000                                           | 350                              | 0.01                                     | 0.027                                     |
| 2004-0060             |                                         | 0.6                            | 44,000                                                                             | 600                              | 0.015                                    | 0.045                                     | 42,000                                           | 550                              | 0.015                                    | 0.045                                     | 40,000                                           | 500                              | 0.013                                    | 0.036                                     | 36,000                                           | 350                              | 0.01                                     | 0.027                                     |
| 2005-0050             | R0.25                                   | 0.5                            | 44,000                                                                             | 900                              | 0.02                                     | 0.065                                     | 40,000                                           | 800                              | 0.015                                    | 0.05                                      | 36,000                                           | 600                              | 0.015                                    | 0.05                                      | 30,000                                           | 400                              | 0.015                                    | 0.03                                      |
| 2005-0075             |                                         | 0.75                           | 44,000                                                                             | 900                              | 0.02                                     | 0.065                                     | 40,000                                           | 800                              | 0.015                                    | 0.05                                      | 36,000                                           | 600                              | 0.015                                    | 0.05                                      | 30,000                                           | 400                              | 0.015                                    | 0.03                                      |
| 2006-0060             | R0.3                                    | 0.6                            | 40,000                                                                             | 1,400                            | 0.045                                    | 0.15                                      | 36,000                                           | 1,200                            | 0.025                                    | 0.13                                      | 32,000                                           | 1,000                            | 0.02                                     | 0.1                                       | 25,000                                           | 600                              | 0.02                                     | 0.1                                       |
| 2006-0090             |                                         | 0.9                            | 40,000                                                                             | 1,400                            | 0.045                                    | 0.15                                      | 36,000                                           | 1,200                            | 0.025                                    | 0.13                                      | 32,000                                           | 1,000                            | 0.02                                     | 0.1                                       | 25,000                                           | 600                              | 0.02                                     | 0.1                                       |
| 2008-0120             | R0.4                                    | 1.2                            | 35,000                                                                             | 1,600                            | 0.06                                     | 0.21                                      | 30,000                                           | 1,600                            | 0.04                                     | 0.17                                      | 26,000                                           | 1,350                            | 0.04                                     | 0.15                                      | 20,000                                           | 700                              | 0.02                                     | 0.12                                      |
| 2010-0150             | R0.5                                    | 1.5                            | 30,000                                                                             | 1,750                            | 0.2                                      | 0.4                                       | 24,000                                           | 2,000                            | 0.1                                      | 0.3                                       | 21,000                                           | 1,750                            | 0.05                                     | 0.2                                       | 16,000                                           | 875                              | 0.05                                     | 0.2                                       |
| 2015-0225             | R0.75                                   | 2.25                           | 30,000                                                                             | 2,450                            | 0.25                                     | 0.55                                      | 17,000                                           | 2,000                            | 0.12                                     | 0.4                                       | 15,000                                           | 1,750                            | 0.06                                     | 0.29                                      | 11,250                                           | 875                              | 0.06                                     | 0.29                                      |
| 2020-0300             | R1                                      | 3                              | 28,000                                                                             | 2,900                            | 0.3                                      | 0.7                                       | 14,000                                           | 2,100                            | 0.15                                     | 0.5                                       | 14,700                                           | 2,160                            | 0.1                                      | 0.35                                      | 11,040                                           | 1,080                            | 0.08                                     | 0.35                                      |
| 2025-0375             | R1.25                                   | 3.75                           | 24,500                                                                             | 2,950                            | 0.35                                     | 0.85                                      | 12,250                                           | 2,150                            | 0.17                                     | 0.6                                       | 12,840                                           | 2,220                            | 0.12                                     | 0.45                                      | 9,660                                            | 1,110                            | 0.1                                      | 0.45                                      |
| 2030-0450             | R1.5                                    | 4.5                            | 21,000                                                                             | 3,000                            | 0.4                                      | 1                                         | 10,500                                           | 2,200                            | 0.2                                      | 0.7                                       | 11,040                                           | 2,280                            | 0.15                                     | 0.55                                      | 8,280                                            | 1,140                            | 0.12                                     | 0.55                                      |
| 2040-0600             | R2                                      | 6                              | 18,000                                                                             | 3,200                            | 0.5                                      | 1.3                                       | 9,000                                            | 2,300                            | 0.25                                     | 0.95                                      | 9,480                                            | 2,400                            | 0.18                                     | 0.75                                      | 7,080                                            | 1,200                            | 0.15                                     | 0.75                                      |
| 2050-0750             | R2.5                                    | 7.5                            | 15,600                                                                             | 3,500                            | 0.5                                      | 1.5                                       | 7,800                                            | 2,500                            | 0.25                                     | 1.05                                      | 8,160                                            | 2,520                            | 0.2                                      | 0.85                                      | 6,120                                            | 1,260                            | 0.15                                     | 0.85                                      |
| 2060-0900             | R3                                      | 9                              | 13,000                                                                             | 3,500                            | 0.6                                      | 1.8                                       | 6,500                                            | 2,500                            | 0.3                                      | 1.3                                       | 6,840                                            | 2,640                            | 0.25                                     | 1                                         | 5,000                                            | 1,500                            | 0.2                                      | 1                                         |



a<sub>p</sub> : 軸方向の切込み深さ (mm)  
a<sub>e</sub> : 半径方向の切込み深さ (mm)  
a<sub>p</sub> : Axial Depth (mm)  
a<sub>e</sub> : Radial Depth (mm)

## 備考:

- ・溝加工となる部分では、送り速度を 50%以下に下げてください。
- ・機械の回転速度が足りない場合や、加工中ビビリや工具の赤熱が発生する場合は、回転速度と送り速度を同じ比率で下げてください。
- ・水溶性・油性切削油、オイルミスト、エアブローのいずれにおいても安定した加工が可能です。

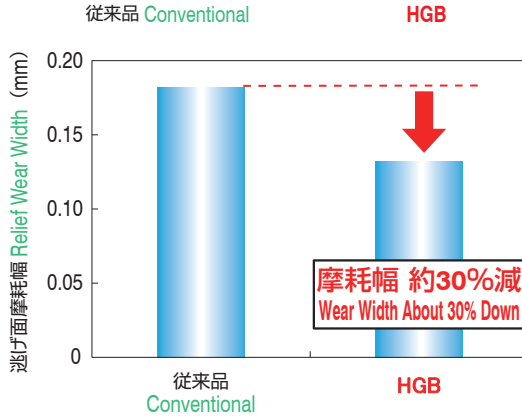
## Note:

- ・ Decrease the feed rate more than 50% from the milling parameters when slot milling.
- ・ Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when chattering and red-hot occur.
- ・ Every coolant offers stable milling.

摩耗比較加工事例 Wear Comparison  
HGB R3 × 刃長 Length of Cut 9

HAP10 (64HRC)

加工後の工具状態 Tools after milling



|                                  |                                                                   |
|----------------------------------|-------------------------------------------------------------------|
| 使用工具 Tool                        | HGB 2060-0900                                                     |
| 回転速度 Spindle Speed               | 6,840 min <sup>-1</sup>                                           |
| 送り速度 Feed Rate                   | 2,640 mm/min                                                      |
| 軸方向の切込み深さ $a_p$<br>Axial Depth   | 0.25 mm                                                           |
| 半径方向の切込み深さ $a_e$<br>Radial Depth | 1 mm                                                              |
| クーラント Coolant                    | エアブロー (スルースピンドル)<br>Air Blow (Through-Spindle)                    |
| 加工形状 Milling Shape               | 四角ポケット Square Pocket<br>(55 x 17.5 x Depth 6.9 mm)<br>× 5 Pockets |
| 加工時間 Cycle Time                  | 75 min                                                            |

平歯車型加工事例 Milling Example of Spur Gear Die  
HGB / HGLB R0.5 · R1 · R1.5

HAP72 (68HRC)



ワークサイズ Work Size : 60 x 60 x 30 mm  
加工サイズ Milling Size :  $\phi$  50.4 x 深さ Depth 11 mm  
クーラント Coolant : エアブロー (スルースピンドル)  
Air Blow (Through-Spindle)



HGB / HGLB  
平歯車型加工事例  
Spur Gear Die  
Milling Video

| No. | 工程名<br>Process         | 使用工具<br>Tool                                                        | 回転速度<br>Spindle Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed Rate<br>(mm/min) | $a_p$<br>Axial Depth<br>(mm)       | $a_e$<br>Radial Depth<br>(mm) | 仕上げ代<br>Allowance<br>(mm) | 加工時間<br>Cycle Time<br>(h:m) |
|-----|------------------------|---------------------------------------------------------------------|-----------------------------------------------|-------------------------------|------------------------------------|-------------------------------|---------------------------|-----------------------------|
| 1   | 荒<br>Roughing          | HGB 2030-0450<br>(R1.5 x 刃長<br>Length of Cut 4.5)                   | 8,280                                         | 1,140                         | 0.12                               | 0.55                          | 0.02                      | 1:41                        |
| 2   | 荒<br>Roughing          | HGLB 2020-060<br>(R1 x 有効長<br>Effective Length 6)                   | 12,250                                        | 1,800                         | 0.06                               | 0.3                           | 0.02                      | 0:06                        |
| 3   | 中仕上げ<br>Semi-finishing |                                                                     | 12,250                                        | 1,800                         | 0.06                               | 0.05                          | 0.01                      | 0:53                        |
| 4   | 仕上げ<br>Finishing       |                                                                     | 12,250                                        | 900                           | 0.00015<br>(カスプハイト<br>Cusp Height) | -                             | 0                         | 0:09                        |
| 5   | 仕上げ<br>Finishing       | HMERS 4030-01-0750<br>( $\phi$ 3 x CR0.1 x 刃長<br>Length of Cut 7.5) | 8,600                                         | 465 / 1,500                   | 0.5                                | 1                             | 0                         | 0:02                        |
| 6   | 仕上げ<br>Finishing       |                                                                     | 8,600                                         | 465 / 1,500                   | 0.0002<br>(カスプハイト<br>Cusp Height)  | 1                             | 0                         | 0:01                        |
| 7   | 仕上げ<br>Finishing       | HGLB 2010-060<br>(R0.5 x 有効長<br>Effective Length 6)                 | 20,000                                        | 800                           | 0.00015<br>(カスプハイト<br>Cusp Height) | -                             | 0                         | 0:55                        |
| 8   | 仕上げ<br>Finishing       |                                                                     | 20,000                                        | 800                           | 0.01                               | 0.04                          | 0                         | 0:51                        |

合計 Total 4:38



サイズ Size R0.05~R3

HGLB

Super  
MG

HMG  
COAT

30°

R  
±0.002

R  
±0.003

R  
±0.005

R  
±0.005

シャंक径  
Shank Dia  
0/-0.004

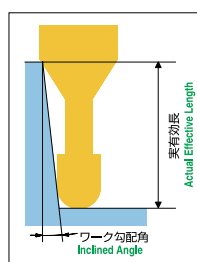
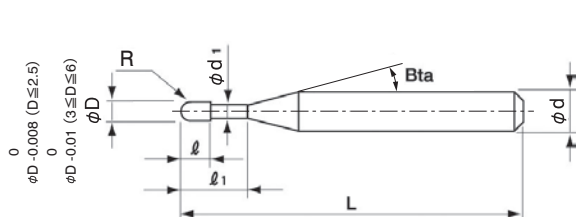
外周  
バックテーパ  
Back Taper  
Geometry

R0.4以下の $\ell_1/D \leq 10$ は  
外周バックテーパ形状ではありません。  
Back taper geometry does not apply to  
R0.4 or below,  $\ell_1/D \leq 10$ .

追加54型番  
Additional 54 Models

対応被削材表 (☆◎○の順に推奨) Material Applications (☆ Highly Recommended ◎ Recommended ○ Suggested)

| 被 削 材 Work Material                     |                                           |                                                |                         |         |         |                 |                             |                    |             |                |                                        |                             |                                      |                             |                                                  |
|-----------------------------------------|-------------------------------------------|------------------------------------------------|-------------------------|---------|---------|-----------------|-----------------------------|--------------------|-------------|----------------|----------------------------------------|-----------------------------|--------------------------------------|-----------------------------|--------------------------------------------------|
| 炭素鋼<br>CARBON<br>STEELS<br>S45C<br>S55C | 合金鋼<br>ALLOY<br>STEELS<br>SK / SCM<br>SUS | プリハードン鋼<br>PREHARDENED<br>STEELS<br>NAK<br>HPM | 焼入れ鋼<br>HARDENED STEELS |         |         | 鋳鉄<br>CAST IRON | アルミ合金<br>ALUMINUM<br>ALLOYS | グラファイト<br>GRAPHITE | 銅<br>COPPER | 樹脂<br>PLASTICS | ガラス入り樹脂<br>GLASS<br>FILLED<br>PLASTICS | チタン合金<br>TITANIUM<br>ALLOYS | 超耐熱合金<br>HEAT<br>RESISTANT<br>ALLOYS | 超硬合金<br>CEMENTED<br>CARBIDE | 硬脆材<br>HARD BRITTLE<br>NON-METALLIC<br>MATERIALS |
|                                         |                                           |                                                | ～ 55HRC                 | ～ 60HRC | ～ 70HRC |                 |                             |                    |             |                |                                        |                             |                                      |                             |                                                  |
|                                         |                                           | ○                                              | ◎                       | ◎       | ◎       |                 |                             |                    |             |                |                                        |                             |                                      |                             |                                                  |



シャंकテーパ角は目安です。  
ワークとの干渉が心配な場合は必ず実測して確認してください。  
シャंक部とワークの接触にご注意ください。

The shank taper angle shown is not an exact value and to avoid contact with the workpiece, we recommend the user controls the precise value of this angle. Shank taper angle should not make contact with the work piece.

合計 155 型番 Total 155 models

単位 Unit (mm)

| 型番<br>Model<br>Number | ボール半径<br>Radius of<br>Ball Nose<br>R | 有効長<br>Effective<br>Length<br>$\ell_1$ | 刃長<br>Length<br>of Cut<br>$\ell$ | 首径<br>Neck<br>Diameter<br>$\phi d_1$ | シャंकテーパ角<br>Shank Taper<br>Angle<br>Bta | 全長<br>Overall<br>Length<br>L | シャंक径<br>Shank<br>Diameter<br>$\phi d$ | 定価<br>Price<br>¥ | ワーク勾配角に対する実有効長<br>Effective Length by Inclined Angles |      |       |      |      |
|-----------------------|--------------------------------------|----------------------------------------|----------------------------------|--------------------------------------|-----------------------------------------|------------------------------|----------------------------------------|------------------|-------------------------------------------------------|------|-------|------|------|
|                       |                                      |                                        |                                  |                                      |                                         |                              |                                        |                  | 30°                                                   | 1°   | 1°30' | 2°   | 3°   |
| HGLB 2001-002         | R0.05                                | 0.2                                    | 0.08                             | 0.095                                | 16°                                     | 45                           | 4                                      | 12,360           | 0.22                                                  | 0.24 | 0.26  | 0.28 | 0.31 |
| HGLB 2001-003         |                                      | 0.3                                    |                                  |                                      |                                         | 45                           | 4                                      | 12,360           | 0.33                                                  | 0.36 | 0.38  | 0.40 | 0.44 |
| HGLB 2001-005         |                                      | 0.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 13,440           | 0.55                                                  | 0.58 | 0.61  | 0.64 | 0.68 |
| HGLB 20015-003        | R0.075                               | 0.3                                    | 0.12                             | 0.14                                 | 16°                                     | 45                           | 4                                      | 14,400           | 0.35                                                  | 0.37 | 0.39  | 0.41 | 0.44 |
| HGLB 20015-005        |                                      | 0.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 15,240           | 0.56                                                  | 0.59 | 0.62  | 0.64 | 0.69 |
| HGLB 20015-0075       |                                      | 0.75                                   |                                  |                                      |                                         | 45                           | 4                                      | 16,020           | 0.83                                                  | 0.86 | 0.90  | 0.93 | 1.00 |
| HGLB 20015-010        |                                      | 1                                      |                                  |                                      |                                         | 45                           | 4                                      | 16,020           | 1.09                                                  | 1.13 | 1.17  | 1.21 | 1.30 |
| HGLB 2002-003         | R0.1                                 | 0.3                                    | 0.16                             | 0.19                                 | 16°                                     | 45                           | 4                                      | 8,640            | 0.42                                                  | 0.44 | 0.46  | 0.48 | 0.52 |
| HGLB 2002-005         |                                      | 0.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 8,640            | 0.63                                                  | 0.66 | 0.68  | 0.71 | 0.76 |
| ※ HGLB 2002-0075      |                                      | 0.75                                   |                                  |                                      |                                         | 45                           | 4                                      | 8,640            | 0.89                                                  | 0.93 | 0.96  | 0.99 | 1.07 |
| HGLB 2002-010         |                                      | 1                                      |                                  |                                      |                                         | 45                           | 4                                      | 8,640            | 1.15                                                  | 1.20 | 1.24  | 1.28 | 1.37 |
| HGLB 2002-015         |                                      | 1.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 9,360            | 1.66                                                  | 1.72 | 1.78  | 1.84 | 1.97 |
| ※ HGLB 2002-020       |                                      | 2                                      |                                  |                                      |                                         | 45                           | 4                                      | 10,440           | 2.18                                                  | 2.25 | 2.33  | 2.41 | 2.58 |

※追加型番 Additional model

# HMGCOAT 2枚刃 高硬度材加工用ロングネックボールエンドミル 2 Flute Long Neck Ball End Mills for Hard Materials

|   | 型番<br>Model<br>Number | ボール半径<br>Radius of<br>Ball Nose<br>R | 有効長<br>Effective<br>Length<br>$\ell_1$ | 刃長<br>Length<br>of Cut<br>$\ell$ | 首径<br>Neck<br>Diameter<br>$\phi d_1$ | シャンクテーパ角<br>Shank Taper<br>Angle<br>Bta | 全長<br>Overall<br>Length<br>L | シャンク径<br>Shank<br>Diameter<br>$\phi d$ | 定価<br>Price<br>¥ | ワーク勾配角に対する実有効長<br>Effective Length by Inclined Angles |       |       |       |       |
|---|-----------------------|--------------------------------------|----------------------------------------|----------------------------------|--------------------------------------|-----------------------------------------|------------------------------|----------------------------------------|------------------|-------------------------------------------------------|-------|-------|-------|-------|
|   |                       |                                      |                                        |                                  |                                      |                                         |                              |                                        |                  | 30°                                                   | 1°    | 1°30' | 2°    | 3°    |
| ※ | HGLB 2003-005         | R0.15                                | 0.5                                    | 0.24                             | 0.29                                 | 16°                                     | 45                           | 4                                      | 8,520            | 0.63                                                  | 0.65  | 0.68  | 0.70  | 0.75  |
|   | HGLB 2003-0075        |                                      | 0.75                                   |                                  |                                      |                                         | 45                           | 4                                      | 8,520            | 0.89                                                  | 0.92  | 0.96  | 0.99  | 1.05  |
|   | HGLB 2003-010         |                                      | 1                                      |                                  |                                      |                                         | 45                           | 4                                      | 8,520            | 1.15                                                  | 1.19  | 1.23  | 1.27  | 1.36  |
|   | HGLB 2003-015         |                                      | 1.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 9,120            | 1.66                                                  | 1.72  | 1.77  | 1.83  | 1.96  |
|   | HGLB 2003-020         |                                      | 2                                      |                                  |                                      |                                         | 45                           | 4                                      | 9,120            | 2.18                                                  | 2.25  | 2.32  | 2.40  | 2.57  |
|   | HGLB 2003-025         |                                      | 2.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 9,360            | 2.70                                                  | 2.78  | 2.87  | 2.97  | 3.18  |
|   | HGLB 2003-030         |                                      | 3                                      |                                  |                                      |                                         | 45                           | 4                                      | 9,360            | 3.21                                                  | 3.32  | 3.42  | 3.54  | 3.80  |
| ※ | HGLB 2004-005         | R0.2                                 | 0.5                                    | 0.32                             | 0.39                                 | 16°                                     | 45                           | 4                                      | 5,880            | 0.63                                                  | 0.65  | 0.67  | 0.70  | 0.74  |
|   | HGLB 2004-0075        |                                      | 0.75                                   |                                  |                                      |                                         | 45                           | 4                                      | 5,880            | 0.89                                                  | 0.92  | 0.95  | 0.98  | 1.04  |
|   | HGLB 2004-010         |                                      | 1                                      |                                  |                                      |                                         | 45                           | 4                                      | 5,880            | 1.15                                                  | 1.19  | 1.23  | 1.26  | 1.35  |
|   | HGLB 2004-010-6       |                                      | 1                                      |                                  |                                      |                                         | 50                           | 6                                      | 8,640            | 1.15                                                  | 1.19  | 1.23  | 1.26  | 1.35  |
|   | HGLB 2004-0125        |                                      | 1.25                                   |                                  |                                      |                                         | 45                           | 4                                      | 6,000            | 1.40                                                  | 1.45  | 1.49  | 1.54  | 1.64  |
|   | HGLB 2004-015         |                                      | 1.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 6,000            | 1.66                                                  | 1.71  | 1.77  | 1.82  | 1.95  |
|   | HGLB 2004-015-6       |                                      | 1.5                                    |                                  |                                      |                                         | 50                           | 6                                      | 8,740            | 1.66                                                  | 1.71  | 1.77  | 1.82  | 1.95  |
|   | HGLB 2004-020         |                                      | 2                                      |                                  |                                      |                                         | 45                           | 4                                      | 6,120            | 2.18                                                  | 2.25  | 2.32  | 2.39  | 2.56  |
|   | HGLB 2004-020-6       |                                      | 2                                      |                                  |                                      |                                         | 50                           | 6                                      | 9,000            | 2.18                                                  | 2.25  | 2.32  | 2.39  | 2.56  |
|   | HGLB 2004-025         |                                      | 2.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 6,360            | 2.70                                                  | 2.78  | 2.87  | 2.96  | 3.17  |
|   | HGLB 2004-025-6       |                                      | 2.5                                    |                                  |                                      |                                         | 50                           | 6                                      | 9,240            | 2.70                                                  | 2.78  | 2.87  | 2.96  | 3.17  |
|   | HGLB 2004-030         |                                      | 3                                      |                                  |                                      |                                         | 45                           | 4                                      | 6,720            | 3.21                                                  | 3.31  | 3.42  | 3.53  | 3.79  |
|   | HGLB 2004-030-6       |                                      | 3                                      |                                  |                                      |                                         | 50                           | 6                                      | 9,850            | 3.21                                                  | 3.31  | 3.42  | 3.53  | 3.79  |
|   | HGLB 2004-035         |                                      | 3.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 7,320            | 3.73                                                  | 3.84  | 3.97  | 4.10  | 4.40  |
|   | HGLB 2004-040         |                                      | 4                                      |                                  |                                      |                                         | 45                           | 4                                      | 7,320            | 4.24                                                  | 4.38  | 4.52  | 4.67  | 5.01  |
|   | HGLB 2005-010         | R0.25                                | 1                                      | 0.4                              | 0.49                                 | 16°                                     | 45                           | 4                                      | 5,880            | 1.15                                                  | 1.19  | 1.22  | 1.26  | 1.34  |
|   | HGLB 2005-015         |                                      | 1.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 5,880            | 1.65                                                  | 1.71  | 1.76  | 1.82  | 1.94  |
|   | HGLB 2005-020         |                                      | 2                                      |                                  |                                      |                                         | 45                           | 4                                      | 5,880            | 2.18                                                  | 2.24  | 2.31  | 2.39  | 2.55  |
|   | HGLB 2005-025         |                                      | 2.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 5,880            | 2.69                                                  | 2.78  | 2.86  | 2.96  | 3.16  |
|   | HGLB 2005-030         |                                      | 3                                      |                                  |                                      |                                         | 45                           | 4                                      | 5,880            | 3.21                                                  | 3.31  | 3.41  | 3.53  | 3.77  |
|   | HGLB 2005-035         |                                      | 3.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 5,880            | 3.73                                                  | 3.84  | 3.96  | 4.09  | 4.39  |
|   | HGLB 2005-040         |                                      | 4                                      |                                  |                                      |                                         | 45                           | 4                                      | 5,880            | 4.24                                                  | 4.37  | 4.51  | 4.66  | 5.00  |
|   | HGLB 2005-045         |                                      | 4.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 6,000            | 4.76                                                  | 4.91  | 5.06  | 5.23  | 5.61  |
|   | HGLB 2005-050         |                                      | 5                                      |                                  |                                      |                                         | 45                           | 4                                      | 6,000            | 5.27                                                  | 5.44  | 5.61  | 5.80  | 6.22  |
|   | HGLB 2005-060         |                                      | 6                                      |                                  |                                      |                                         | 45                           | 4                                      | 6,120            | 6.30                                                  | 6.50  | 6.71  | 6.94  | 7.45  |
| ※ | HGLB 2006-010         | R0.3                                 | 1                                      | 0.48                             | 0.59                                 | 16°                                     | 45                           | 4                                      | 5,040            | 1.14                                                  | 1.18  | 1.22  | 1.25  | 1.33  |
|   | HGLB 2006-015         |                                      | 1.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 4,560            | 1.65                                                  | 1.71  | 1.76  | 1.81  | 1.93  |
|   | HGLB 2006-015-6       |                                      | 1.5                                    |                                  |                                      |                                         | 50                           | 6                                      | 6,890            | 1.65                                                  | 1.71  | 1.76  | 1.81  | 1.93  |
|   | HGLB 2006-020         |                                      | 2                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,560            | 2.17                                                  | 2.24  | 2.31  | 2.38  | 2.54  |
|   | HGLB 2006-020-6       |                                      | 2                                      |                                  |                                      |                                         | 50                           | 6                                      | 6,960            | 2.17                                                  | 2.24  | 2.31  | 2.38  | 2.54  |
|   | HGLB 2006-025         |                                      | 2.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 2.69                                                  | 2.77  | 2.86  | 2.95  | 3.15  |
|   | HGLB 2006-025-6       |                                      | 2.5                                    |                                  |                                      |                                         | 50                           | 6                                      | 6,890            | 2.69                                                  | 2.77  | 2.86  | 2.95  | 3.15  |
|   | HGLB 2006-030         |                                      | 3                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 3.21                                                  | 3.31  | 3.41  | 3.52  | 3.76  |
|   | HGLB 2006-030-6       |                                      | 3                                      |                                  |                                      |                                         | 50                           | 6                                      | 7,080            | 3.21                                                  | 3.31  | 3.41  | 3.52  | 3.76  |
|   | HGLB 2006-035         |                                      | 3.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 3.72                                                  | 3.84  | 3.96  | 4.09  | 4.38  |
|   | HGLB 2006-040         |                                      | 4                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 4.24                                                  | 4.37  | 4.51  | 4.66  | 4.99  |
|   | HGLB 2006-045         |                                      | 4.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 4.76                                                  | 4.90  | 5.06  | 5.23  | 5.60  |
|   | HGLB 2006-050         |                                      | 5                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 5.27                                                  | 5.44  | 5.61  | 5.80  | 6.21  |
|   | HGLB 2006-055         |                                      | 5.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 5.79                                                  | 5.97  | 6.16  | 6.37  | 6.82  |
|   | HGLB 2006-060         |                                      | 6                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 6.30                                                  | 6.50  | 6.71  | 6.93  | 7.43  |
|   | HGLB 2006-080         |                                      | 8                                      |                                  |                                      |                                         | 45                           | 4                                      | 6,360            | 8.37                                                  | 8.63  | 8.91  | 9.21  | 9.88  |
|   | HGLB 2006-100         |                                      | 10                                     |                                  |                                      |                                         | 45                           | 4                                      | 6,480            | 10.43                                                 | 10.76 | 11.11 | 11.49 | 12.33 |

※追加型番 Additional model

# HMGCOAT 2枚刃 高硬度材加工用ロングネックボールエンドミル 2 Flute Long Neck Ball End Mills for Hard Materials

|   | 型番<br>Model<br>Number | ボール半径<br>Radius of<br>Ball Nose<br>R | 有効長<br>Effective<br>Length<br>$\ell_1$ | 刃長<br>Length<br>of Cut<br>$\ell$ | 首径<br>Neck<br>Diameter<br>$\phi d_1$ | シャンクテーパ角<br>Shank Taper<br>Angle<br>Bta | 全長<br>Overall<br>Length<br>L | シャンク径<br>Shank<br>Diameter<br>$\phi d$ | 定価<br>Price<br>¥ | ワーク勾配角に対する実有効長<br>Effective Length by Inclined Angles |       |       |       |       |
|---|-----------------------|--------------------------------------|----------------------------------------|----------------------------------|--------------------------------------|-----------------------------------------|------------------------------|----------------------------------------|------------------|-------------------------------------------------------|-------|-------|-------|-------|
|   |                       |                                      |                                        |                                  |                                      |                                         |                              |                                        |                  | 30°                                                   | 1°    | 1°30' | 2°    | 3°    |
| ※ | HGLB 2008-020         | R0.4                                 | 2                                      | 0.64                             | 0.79                                 | 16°                                     | 45                           | 4                                      | 4,560            | 2.17                                                  | 2.23  | 2.30  | 2.37  | 2.52  |
|   | HGLB 2008-025         |                                      | 2.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 2.69                                                  | 2.77  | 2.85  | 2.94  | 3.13  |
|   | HGLB 2008-030         |                                      | 3                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 3.21                                                  | 3.30  | 3.40  | 3.50  | 3.74  |
|   | HGLB 2008-040         |                                      | 4                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 4.24                                                  | 4.36  | 4.50  | 4.64  | 4.97  |
|   | HGLB 2008-050         |                                      | 5                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 5.27                                                  | 5.43  | 5.60  | 5.78  | 6.19  |
|   | HGLB 2008-060         |                                      | 6                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 6.30                                                  | 6.49  | 6.70  | 6.92  | 7.41  |
|   | HGLB 2008-070         |                                      | 7                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 7.33                                                  | 7.56  | 7.80  | 8.06  | 8.64  |
|   | HGLB 2008-080         |                                      | 8                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,800            | 8.36                                                  | 8.62  | 8.90  | 9.20  | 9.86  |
| ※ | HGLB 2010-020         | R0.5                                 | 2                                      | 0.8                              | 0.98                                 | 16°                                     | 45                           | 4                                      | 3,840            | 2.18                                                  | 2.24  | 2.30  | 2.36  | 2.51  |
|   | HGLB 2010-020-6       |                                      | 2                                      |                                  |                                      |                                         | 50                           | 6                                      | 6,120            | 2.18                                                  | 2.24  | 2.30  | 2.36  | 2.51  |
|   | HGLB 2010-025         |                                      | 2.5                                    |                                  |                                      |                                         | 45                           | 4                                      | 3,840            | 2.70                                                  | 2.77  | 2.85  | 2.93  | 3.12  |
|   | HGLB 2010-030         |                                      | 3                                      |                                  |                                      |                                         | 45                           | 4                                      | 3,840            | 3.21                                                  | 3.30  | 3.40  | 3.50  | 3.73  |
|   | HGLB 2010-030-6       |                                      | 3                                      |                                  |                                      |                                         | 50                           | 6                                      | 6,120            | 3.21                                                  | 3.30  | 3.40  | 3.50  | 3.73  |
|   | HGLB 2010-040         |                                      | 4                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,320            | 4.24                                                  | 4.37  | 4.50  | 4.64  | 4.96  |
|   | HGLB 2010-040-6       |                                      | 4                                      |                                  |                                      |                                         | 50                           | 6                                      | 6,720            | 4.24                                                  | 4.37  | 4.50  | 4.64  | 4.96  |
|   | HGLB 2010-050         |                                      | 5                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,320            | 5.28                                                  | 5.43  | 5.60  | 5.78  | 6.18  |
|   | HGLB 2010-050-6       |                                      | 5                                      |                                  |                                      |                                         | 50                           | 6                                      | 6,720            | 5.28                                                  | 5.43  | 5.60  | 5.78  | 6.18  |
|   | HGLB 2010-060         |                                      | 6                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 6.31                                                  | 6.50  | 6.70  | 6.92  | 7.40  |
|   | HGLB 2010-060-6       |                                      | 6                                      |                                  |                                      |                                         | 50                           | 6                                      | 7,080            | 6.31                                                  | 6.50  | 6.70  | 6.92  | 7.40  |
|   | HGLB 2010-070         |                                      | 7                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 7.34                                                  | 7.56  | 7.80  | 8.06  | 8.63  |
|   | HGLB 2010-070-6       |                                      | 7                                      |                                  |                                      |                                         | 50                           | 6                                      | 7,080            | 7.34                                                  | 7.56  | 7.80  | 8.06  | 8.63  |
|   | HGLB 2010-080         |                                      | 8                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 8.37                                                  | 8.63  | 8.90  | 9.20  | 9.85  |
|   | HGLB 2010-080-6       |                                      | 8                                      |                                  |                                      |                                         | 50                           | 6                                      | 7,080            | 8.37                                                  | 8.63  | 8.90  | 9.20  | 9.85  |
|   | HGLB 2010-100         |                                      | 10                                     |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 10.43                                                 | 10.76 | 11.10 | 11.47 | 12.30 |
|   | HGLB 2010-100-6       |                                      | 10                                     |                                  |                                      |                                         | 50                           | 6                                      | 7,080            | 10.43                                                 | 10.76 | 11.10 | 11.47 | 12.30 |
|   | HGLB 2010-120         |                                      | 12                                     |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 12.50                                                 | 12.89 | 13.30 | 13.75 | 14.75 |
|   | HGLB 2010-140         |                                      | 14                                     |                                  |                                      |                                         | 45                           | 4                                      | 5,400            | 14.56                                                 | 15.02 | 15.51 | 16.03 | 17.19 |
|   | HGLB 2010-160         |                                      | 16                                     |                                  |                                      |                                         | 50                           | 4                                      | 6,360            | 16.62                                                 | 17.15 | 17.71 | 18.31 | 19.64 |
| ※ | HGLB 2015-030         | R0.75                                | 3                                      | 1.2                              | 1.47                                 | 16°                                     | 45                           | 4                                      | 4,440            | 3.10                                                  | 3.18  | 3.26  | 3.35  | 3.55  |
|   | HGLB 2015-030-6       |                                      | 3                                      |                                  |                                      |                                         | 50                           | 6                                      | 7,130            | 3.10                                                  | 3.18  | 3.26  | 3.35  | 3.55  |
|   | HGLB 2015-040         |                                      | 4                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,440            | 4.13                                                  | 4.24  | 4.36  | 4.49  | 4.77  |
|   | HGLB 2015-060         |                                      | 6                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,440            | 6.19                                                  | 6.37  | 6.56  | 6.76  | 7.22  |
|   | HGLB 2015-060-6       |                                      | 6                                      |                                  |                                      |                                         | 50                           | 6                                      | 7,200            | 6.19                                                  | 6.37  | 6.56  | 6.76  | 7.22  |
|   | HGLB 2015-080         |                                      | 8                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 8.25                                                  | 8.50  | 8.76  | 9.04  | 9.67  |
|   | HGLB 2015-080-6       |                                      | 8                                      |                                  |                                      |                                         | 50                           | 6                                      | 7,200            | 8.25                                                  | 8.50  | 8.76  | 9.04  | 9.67  |
|   | HGLB 2015-100         |                                      | 10                                     |                                  |                                      |                                         | 45                           | 4                                      | 5,040            | 10.32                                                 | 10.63 | 10.96 | 11.32 | 12.11 |
|   | HGLB 2015-100-6       |                                      | 10                                     |                                  |                                      |                                         | 50                           | 6                                      | 7,200            | 10.32                                                 | 10.63 | 10.96 | 11.32 | 12.11 |
|   | HGLB 2015-120         |                                      | 12                                     |                                  |                                      |                                         | 45                           | 4                                      | 5,400            | 12.38                                                 | 12.76 | 13.16 | 13.60 | 14.56 |
|   | HGLB 2015-120-6       |                                      | 12                                     |                                  |                                      |                                         | 50                           | 6                                      | 8,130            | 12.38                                                 | 12.76 | 13.16 | 13.60 | 14.56 |
|   | HGLB 2015-140         |                                      | 14                                     |                                  |                                      |                                         | 45                           | 4                                      | 5,400            | 14.44                                                 | 14.89 | 15.36 | 15.87 | 17.01 |
|   | HGLB 2015-160         |                                      | 16                                     |                                  |                                      |                                         | 50                           | 4                                      | 5,400            | 16.50                                                 | 17.02 | 17.57 | 18.15 | 19.46 |
|   | HGLB 2015-200         |                                      | 20                                     |                                  |                                      |                                         | 60                           | 4                                      | 5,400            | 20.63                                                 | 21.28 | 21.97 | 22.71 | 24.35 |

※追加型番 Additional model

## HMGCOAT 2枚刃 高硬度材加工用ロングネックボールエンドミル 2 Flute Long Neck Ball End Mills for Hard Materials

|   | 型番<br>Model<br>Number | ボール半径<br>Radius of<br>Ball Nose<br>R | 有効長<br>Effective<br>Length<br>$\ell_1$ | 刃長<br>Length<br>of Cut<br>$\ell$ | 首径<br>Neck<br>Diameter<br>$\phi d_1$ | シャンクテーパ角<br>Shank Taper<br>Angle<br>Bta | 全長<br>Overall<br>Length<br>L | シャンク径<br>Shank<br>Diameter<br>$\phi d$ | 定価<br>Price<br>¥ | ワーク勾配角に対する実有効長<br>Effective Length by Inclined Angles |       |                         |                         |                         |
|---|-----------------------|--------------------------------------|----------------------------------------|----------------------------------|--------------------------------------|-----------------------------------------|------------------------------|----------------------------------------|------------------|-------------------------------------------------------|-------|-------------------------|-------------------------|-------------------------|
|   |                       |                                      |                                        |                                  |                                      |                                         |                              |                                        |                  | 30°                                                   | 1°    | 1°30'                   | 2°                      | 3°                      |
| ※ | HGLB 2020-030         | R1                                   | 3                                      | 1.6                              | 1.98                                 | 16°                                     | 45                           | 4                                      | 3,840            | 3.07                                                  | 3.14  | 3.21                    | 3.29                    | 3.47                    |
|   | HGLB 2020-030-6       |                                      | 3                                      |                                  |                                      |                                         | 50                           | 6                                      | 6,120            | 3.07                                                  | 3.14  | 3.21                    | 3.29                    | 3.47                    |
|   | HGLB 2020-040         |                                      | 4                                      |                                  |                                      |                                         | 45                           | 4                                      | 3,840            | 4.10                                                  | 4.20  | 4.31                    | 4.43                    | 4.70                    |
|   | HGLB 2020-040-6       |                                      | 4                                      |                                  |                                      |                                         | 50                           | 6                                      | 6,120            | 4.10                                                  | 4.20  | 4.31                    | 4.43                    | 4.70                    |
|   | HGLB 2020-060         |                                      | 6                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,320            | 6.16                                                  | 6.33  | 6.51                    | 6.71                    | 7.14                    |
|   | HGLB 2020-060-6       |                                      | 6                                      |                                  |                                      |                                         | 50                           | 6                                      | 6,600            | 6.16                                                  | 6.33  | 6.51                    | 6.71                    | 7.14                    |
|   | HGLB 2020-080         |                                      | 8                                      |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 8.23                                                  | 8.46  | 8.72                    | 8.99                    | 9.59                    |
|   | HGLB 2020-080-6       |                                      | 8                                      |                                  |                                      |                                         | 50                           | 6                                      | 7,080            | 8.23                                                  | 8.46  | 8.72                    | 8.99                    | 9.59                    |
|   | HGLB 2020-100         |                                      | 10                                     |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 10.29                                                 | 10.59 | 10.92                   | 11.26                   | 12.04                   |
|   | HGLB 2020-100-6       |                                      | 10                                     |                                  |                                      |                                         | 50                           | 6                                      | 7,080            | 10.29                                                 | 10.59 | 10.92                   | 11.26                   | 12.04                   |
|   | HGLB 2020-120         |                                      | 12                                     |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 12.35                                                 | 12.72 | 13.12                   | 13.54                   | 14.48                   |
|   | HGLB 2020-120-6       |                                      | 12                                     |                                  |                                      |                                         | 50                           | 6                                      | 7,080            | 12.35                                                 | 12.72 | 13.12                   | 13.54                   | 14.48                   |
|   | HGLB 2020-140         |                                      | 14                                     |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 14.41                                                 | 14.85 | 15.32                   | 15.82                   | 16.93                   |
|   | HGLB 2020-160         |                                      | 16                                     |                                  |                                      |                                         | 45                           | 4                                      | 4,680            | 16.48                                                 | 16.98 | 17.52                   | 18.10                   | 19.38                   |
|   | HGLB 2020-200         |                                      | 20                                     |                                  |                                      |                                         | 60                           | 4                                      | 4,680            | 20.60                                                 | 21.24 | 21.92                   | 22.65                   | 干渉なし<br>No Interference |
| ※ | HGLB 2020-250         | R1.5                                 | 25                                     | 2.4                              | 2.95                                 | 16°                                     | 60                           | 4                                      | 6,480            | 25.76                                                 | 26.56 | 27.42                   | 28.34                   | 干渉なし<br>No Interference |
|   | HGLB 2020-300         |                                      | 30                                     |                                  |                                      |                                         | 70                           | 4                                      | 7,320            | 30.92                                                 | 31.89 | 32.93                   | 干渉なし<br>No Interference | 干渉なし<br>No Interference |
|   | HGLB 2030-060         |                                      | 6                                      |                                  |                                      |                                         | 60                           | 6                                      | 4,680            | 6.20                                                  | 6.35  | 6.52                    | 6.69                    | 7.09                    |
|   | HGLB 2030-080         |                                      | 8                                      |                                  |                                      |                                         | 60                           | 6                                      | 4,680            | 8.26                                                  | 8.48  | 8.72                    | 8.97                    | 9.54                    |
|   | HGLB 2030-100         |                                      | 10                                     |                                  |                                      |                                         | 60                           | 6                                      | 5,400            | 10.32                                                 | 10.61 | 10.92                   | 11.25                   | 11.99                   |
|   | HGLB 2030-120         |                                      | 12                                     |                                  |                                      |                                         | 60                           | 6                                      | 5,640            | 12.38                                                 | 12.74 | 13.12                   | 13.53                   | 14.43                   |
|   | HGLB 2030-140         |                                      | 14                                     |                                  |                                      |                                         | 60                           | 6                                      | 6,240            | 14.45                                                 | 14.87 | 15.32                   | 15.80                   | 16.88                   |
|   | HGLB 2030-160         |                                      | 16                                     |                                  |                                      |                                         | 60                           | 6                                      | 6,240            | 16.51                                                 | 17.00 | 17.52                   | 18.08                   | 19.33                   |
|   | HGLB 2030-180         |                                      | 18                                     |                                  |                                      |                                         | 60                           | 6                                      | 6,280            | 18.57                                                 | 19.13 | 19.72                   | 20.36                   | 21.78                   |
|   | HGLB 2030-200         |                                      | 20                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,000            | 20.64                                                 | 21.26 | 21.92                   | 22.64                   | 24.22                   |
|   | HGLB 2030-220         |                                      | 22                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,040            | 22.70                                                 | 23.39 | 24.12                   | 24.91                   | 26.67                   |
|   | HGLB 2030-250         |                                      | 25                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,000            | 25.79                                                 | 26.58 | 27.43                   | 28.33                   | 30.34                   |
|   | HGLB 2030-270         |                                      | 27                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,040            | 27.86                                                 | 28.71 | 29.63                   | 30.61                   | 干渉なし<br>No Interference |
|   | HGLB 2030-300         |                                      | 30                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,840            | 30.95                                                 | 31.91 | 32.93                   | 34.02                   | 干渉なし<br>No Interference |
| ※ | HGLB 2040-080         | R2                                   | 8                                      | 3.2                              | 3.95                                 | 16°                                     | 70                           | 6                                      | 4,800            | 8.24                                                  | 8.45  | 8.67                    | 8.90                    | 9.43                    |
|   | HGLB 2040-100         |                                      | 10                                     |                                  |                                      |                                         | 70                           | 6                                      | 4,800            | 10.31                                                 | 10.58 | 10.87                   | 11.18                   | 11.88                   |
|   | HGLB 2040-120         |                                      | 12                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,240            | 12.37                                                 | 12.71 | 13.07                   | 13.46                   | 14.32                   |
|   | HGLB 2040-140         |                                      | 14                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,240            | 14.43                                                 | 14.84 | 15.27                   | 15.74                   | 16.77                   |
|   | HGLB 2040-160         |                                      | 16                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,240            | 16.49                                                 | 16.97 | 17.47                   | 18.01                   | 19.22                   |
|   | HGLB 2040-180         |                                      | 18                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,380            | 18.56                                                 | 19.10 | 19.67                   | 20.29                   | 干渉なし<br>No Interference |
|   | HGLB 2040-200         |                                      | 20                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,240            | 20.62                                                 | 21.23 | 21.87                   | 22.57                   | 干渉なし<br>No Interference |
|   | HGLB 2040-220         |                                      | 22                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,380            | 22.68                                                 | 23.36 | 24.08                   | 24.85                   | 干渉なし<br>No Interference |
|   | HGLB 2040-250         |                                      | 25                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,240            | 25.78                                                 | 26.55 | 27.38                   | 28.26                   | 干渉なし<br>No Interference |
|   | HGLB 2040-270         |                                      | 27                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,380            | 27.84                                                 | 28.68 | 29.58                   | 30.54                   | 干渉なし<br>No Interference |
|   | HGLB 2040-300         |                                      | 30                                     |                                  |                                      |                                         | 70                           | 6                                      | 6,240            | 30.93                                                 | 31.87 | 32.88                   | 干渉なし<br>No Interference | 干渉なし<br>No Interference |
|   | HGLB 2040-350         |                                      | 35                                     |                                  |                                      |                                         | 80                           | 6                                      | 7,200            | 36.09                                                 | 37.20 | 38.38                   | 干渉なし<br>No Interference | 干渉なし<br>No Interference |
|   | HGLB 2040-400         |                                      | 40                                     |                                  |                                      |                                         | 90                           | 6                                      | 8,040            | 41.25                                                 | 42.52 | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference |

※追加型番 Additional model

# HMGCOAT 2枚刃 高硬度材加工用ロングネックボールエンドミル 2 Flute Long Neck Ball End Mills for Hard Materials

| 型番<br>Model<br>Number | ボール半径<br>Radius of<br>Ball Nose<br>R | 有効長<br>Effective<br>Length<br>$\ell_1$ | 刃長<br>Length<br>of Cut<br>$\ell$ | 首径<br>Neck<br>Diameter<br>$\phi d_1$ | シャンクテーパ角<br>Shank Taper<br>Angle<br>Bta | 全長<br>Overall<br>Length<br>L | シャンク径<br>Shank<br>Diameter<br>$\phi d$ | 定価<br>Price<br>¥ | ワーク勾配角に対する実有効長<br>Effective Length by Inclined Angles |                         |                         |                         |                         |
|-----------------------|--------------------------------------|----------------------------------------|----------------------------------|--------------------------------------|-----------------------------------------|------------------------------|----------------------------------------|------------------|-------------------------------------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                       |                                      |                                        |                                  |                                      |                                         |                              |                                        |                  | 30°                                                   | 1°                      | 1°30'                   | 2°                      | 3°                      |
| ※ HGLB 2060-100       | R3                                   | 10                                     | 4.8                              | 5.95                                 | —                                       | 80                           | 6                                      | 7,800            | 干渉なし<br>No Interference                               | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference |
| HGLB 2060-150         |                                      | 15                                     |                                  |                                      |                                         | 80                           | 6                                      | 7,800            | 干渉なし<br>No Interference                               | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference |
| ※ HGLB 2060-180       |                                      | 18                                     |                                  |                                      |                                         | 80                           | 6                                      | 7,890            | 干渉なし<br>No Interference                               | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference |
| HGLB 2060-200         |                                      | 20                                     |                                  |                                      |                                         | 80                           | 6                                      | 7,800            | 干渉なし<br>No Interference                               | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference |
| HGLB 2060-250         |                                      | 25                                     |                                  |                                      |                                         | 80                           | 6                                      | 7,800            | 干渉なし<br>No Interference                               | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference |
| HGLB 2060-300         |                                      | 30                                     |                                  |                                      |                                         | 80                           | 6                                      | 8,040            | 干渉なし<br>No Interference                               | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference |
| ※ HGLB 2060-350       |                                      | 35                                     |                                  |                                      |                                         | 80                           | 6                                      | 8,040            | 干渉なし<br>No Interference                               | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference |
| ※ HGLB 2060-400       |                                      | 40                                     |                                  |                                      |                                         | 90                           | 6                                      | 8,760            | 干渉なし<br>No Interference                               | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference |
| ※ HGLB 2060-500       |                                      | 50                                     |                                  |                                      |                                         | 120                          | 6                                      | 9,480            | 干渉なし<br>No Interference                               | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference | 干渉なし<br>No Interference |

※追加型番 Additional model

# HGLB 切削条件表    Milling Conditions

| 被削材<br>WORK MATERIAL  |                                         |                                    | プリハードン鋼 / 焼入れ鋼<br>PREHARDENED STEELS / HARDENED STEELS<br>NAK / STAVAX<br>(~55HRC) |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>SKD11<br>(55~62HRC)   |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>HAP10<br>(62~66HRC)   |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>HAP72<br>(66~70HRC)   |                                  |                                          |                                           |
|-----------------------|-----------------------------------------|------------------------------------|------------------------------------------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|
| 型番<br>Model<br>Number | ボール半径<br>Radius of<br>Ball Nose<br>(mm) | 有効長<br>Effective<br>Length<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> )                                   | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) |
| 2001-002              | R0.05                                   | 0.2                                | 48,000                                                                             | 200                              | 0.005                                    | 0.01                                      | 48,000                                           | 200                              | 0.005                                    | 0.01                                      | 48,000                                           | 150                              | 0.003                                    | 0.006                                     | 40,000                                           | 120                              | 0.002                                    | 0.004                                     |
| 2001-003              |                                         | 0.3                                | 48,000                                                                             | 200                              | 0.005                                    | 0.01                                      | 48,000                                           | 200                              | 0.005                                    | 0.01                                      | 48,000                                           | 150                              | 0.003                                    | 0.006                                     | 40,000                                           | 120                              | 0.002                                    | 0.004                                     |
| 2001-005              |                                         | 0.5                                | 48,000                                                                             | 200                              | 0.005                                    | 0.01                                      | 48,000                                           | 200                              | 0.005                                    | 0.01                                      | 48,000                                           | 150                              | 0.003                                    | 0.006                                     | 40,000                                           | 120                              | 0.002                                    | 0.004                                     |
| 20015-003             | R0.075                                  | 0.3                                | 48,000                                                                             | 230                              | 0.007                                    | 0.014                                     | 48,000                                           | 230                              | 0.007                                    | 0.014                                     | 48,000                                           | 170                              | 0.005                                    | 0.01                                      | 40,000                                           | 135                              | 0.003                                    | 0.006                                     |
| 20015-005             |                                         | 0.5                                | 48,000                                                                             | 230                              | 0.007                                    | 0.014                                     | 48,000                                           | 230                              | 0.007                                    | 0.014                                     | 48,000                                           | 170                              | 0.005                                    | 0.01                                      | 40,000                                           | 135                              | 0.003                                    | 0.006                                     |
| 20015-0075            |                                         | 0.75                               | 48,000                                                                             | 230                              | 0.007                                    | 0.014                                     | 48,000                                           | 230                              | 0.007                                    | 0.014                                     | 48,000                                           | 170                              | 0.005                                    | 0.01                                      | 40,000                                           | 135                              | 0.003                                    | 0.006                                     |
| 20015-010             |                                         | 1                                  | 38,400                                                                             | 160                              | 0.005                                    | 0.01                                      | 38,400                                           | 160                              | 0.005                                    | 0.01                                      | 38,400                                           | 120                              | 0.003                                    | 0.007                                     | 32,000                                           | 90                               | 0.002                                    | 0.004                                     |
| 2002-003              | R0.1                                    | 0.3                                | 44,000                                                                             | 250                              | 0.01                                     | 0.03                                      | 42,000                                           | 250                              | 0.01                                     | 0.03                                      | 40,000                                           | 200                              | 0.008                                    | 0.024                                     | 36,000                                           | 150                              | 0.006                                    | 0.018                                     |
| 2002-005              |                                         | 0.5                                | 44,000                                                                             | 250                              | 0.01                                     | 0.03                                      | 42,000                                           | 250                              | 0.01                                     | 0.03                                      | 40,000                                           | 200                              | 0.008                                    | 0.024                                     | 36,000                                           | 150                              | 0.006                                    | 0.018                                     |
| 2002-0075             |                                         | 0.75                               | 44,000                                                                             | 250                              | 0.01                                     | 0.03                                      | 42,000                                           | 250                              | 0.01                                     | 0.03                                      | 40,000                                           | 200                              | 0.008                                    | 0.024                                     | 36,000                                           | 150                              | 0.006                                    | 0.018                                     |
| 2002-010              |                                         | 1                                  | 44,000                                                                             | 250                              | 0.01                                     | 0.03                                      | 42,000                                           | 250                              | 0.01                                     | 0.03                                      | 40,000                                           | 200                              | 0.008                                    | 0.024                                     | 36,000                                           | 150                              | 0.006                                    | 0.018                                     |
| 2002-015              |                                         | 1.5                                | 35,200                                                                             | 175                              | 0.008                                    | 0.023                                     | 33,600                                           | 175                              | 0.008                                    | 0.023                                     | 32,000                                           | 140                              | 0.006                                    | 0.018                                     | 28,800                                           | 100                              | 0.004                                    | 0.012                                     |
| 2002-020              |                                         | 2                                  | 35,200                                                                             | 120                              | 0.003                                    | 0.008                                     | 33,600                                           | 100                              | 0.003                                    | 0.008                                     | 32,000                                           | 90                               | 0.003                                    | 0.008                                     | 28,800                                           | 70                               | 0.002                                    | 0.006                                     |
| 2003-005              | R0.15                                   | 0.5                                | 44,000                                                                             | 400                              | 0.01                                     | 0.03                                      | 42,000                                           | 350                              | 0.01                                     | 0.03                                      | 40,000                                           | 300                              | 0.01                                     | 0.03                                      | 36,000                                           | 250                              | 0.008                                    | 0.024                                     |
| 2003-0075             |                                         | 0.75                               | 44,000                                                                             | 400                              | 0.01                                     | 0.03                                      | 42,000                                           | 350                              | 0.01                                     | 0.03                                      | 40,000                                           | 300                              | 0.01                                     | 0.03                                      | 36,000                                           | 250                              | 0.008                                    | 0.024                                     |
| 2003-010              |                                         | 1                                  | 44,000                                                                             | 400                              | 0.01                                     | 0.03                                      | 42,000                                           | 350                              | 0.01                                     | 0.03                                      | 40,000                                           | 300                              | 0.01                                     | 0.03                                      | 36,000                                           | 250                              | 0.008                                    | 0.024                                     |
| 2003-015              |                                         | 1.5                                | 44,000                                                                             | 400                              | 0.01                                     | 0.03                                      | 42,000                                           | 350                              | 0.01                                     | 0.03                                      | 40,000                                           | 300                              | 0.01                                     | 0.03                                      | 36,000                                           | 250                              | 0.008                                    | 0.024                                     |
| 2003-020              |                                         | 2                                  | 35,200                                                                             | 280                              | 0.008                                    | 0.023                                     | 33,600                                           | 245                              | 0.008                                    | 0.023                                     | 32,000                                           | 210                              | 0.008                                    | 0.023                                     | 28,800                                           | 175                              | 0.006                                    | 0.018                                     |
| 2003-025              |                                         | 2.5                                | 35,200                                                                             | 185                              | 0.006                                    | 0.017                                     | 33,600                                           | 165                              | 0.006                                    | 0.017                                     | 32,000                                           | 150                              | 0.006                                    | 0.017                                     | 28,800                                           | 115                              | 0.005                                    | 0.014                                     |
| 2003-030              |                                         | 3                                  | 35,200                                                                             | 140                              | 0.004                                    | 0.01                                      | 33,600                                           | 125                              | 0.004                                    | 0.01                                      | 32,000                                           | 110                              | 0.004                                    | 0.01                                      | 28,800                                           | 85                               | 0.003                                    | 0.009                                     |
| 2004-005              | R0.2                                    | 0.5                                | 44,000                                                                             | 600                              | 0.015                                    | 0.045                                     | 42,000                                           | 550                              | 0.015                                    | 0.045                                     | 40,000                                           | 500                              | 0.013                                    | 0.036                                     | 36,000                                           | 350                              | 0.01                                     | 0.027                                     |
| 2004-0075             |                                         | 0.75                               | 44,000                                                                             | 600                              | 0.015                                    | 0.045                                     | 42,000                                           | 550                              | 0.015                                    | 0.045                                     | 40,000                                           | 500                              | 0.013                                    | 0.036                                     | 36,000                                           | 350                              | 0.01                                     | 0.027                                     |
| 2004-010              |                                         | 1                                  | 44,000                                                                             | 600                              | 0.015                                    | 0.045                                     | 42,000                                           | 550                              | 0.015                                    | 0.045                                     | 40,000                                           | 500                              | 0.013                                    | 0.036                                     | 36,000                                           | 350                              | 0.01                                     | 0.027                                     |
| 2004-0125             |                                         | 1.25                               | 44,000                                                                             | 600                              | 0.015                                    | 0.045                                     | 42,000                                           | 550                              | 0.015                                    | 0.045                                     | 40,000                                           | 500                              | 0.013                                    | 0.036                                     | 36,000                                           | 350                              | 0.01                                     | 0.027                                     |
| 2004-015              |                                         | 1.5                                | 44,000                                                                             | 600                              | 0.015                                    | 0.045                                     | 42,000                                           | 550                              | 0.015                                    | 0.045                                     | 40,000                                           | 500                              | 0.013                                    | 0.036                                     | 36,000                                           | 350                              | 0.01                                     | 0.027                                     |
| 2004-020              |                                         | 2                                  | 44,000                                                                             | 600                              | 0.015                                    | 0.045                                     | 42,000                                           | 550                              | 0.015                                    | 0.045                                     | 40,000                                           | 500                              | 0.013                                    | 0.036                                     | 36,000                                           | 350                              | 0.01                                     | 0.027                                     |
| 2004-025              |                                         | 2.5                                | 35,200                                                                             | 420                              | 0.011                                    | 0.034                                     | 33,600                                           | 385                              | 0.011                                    | 0.034                                     | 32,000                                           | 350                              | 0.01                                     | 0.027                                     | 28,800                                           | 250                              | 0.008                                    | 0.02                                      |
| 2004-030              |                                         | 3                                  | 35,200                                                                             | 330                              | 0.008                                    | 0.024                                     | 33,600                                           | 310                              | 0.008                                    | 0.024                                     | 32,000                                           | 280                              | 0.008                                    | 0.022                                     | 28,000                                           | 200                              | 0.006                                    | 0.016                                     |
| 2004-035              |                                         | 3.5                                | 35,200                                                                             | 300                              | 0.007                                    | 0.022                                     | 31,900                                           | 280                              | 0.007                                    | 0.022                                     | 30,400                                           | 250                              | 0.007                                    | 0.02                                      | 26,600                                           | 175                              | 0.005                                    | 0.014                                     |
| 2004-040              |                                         | 4                                  | 35,200                                                                             | 270                              | 0.006                                    | 0.019                                     | 30,240                                           | 250                              | 0.006                                    | 0.019                                     | 28,800                                           | 220                              | 0.006                                    | 0.018                                     | 25,200                                           | 150                              | 0.004                                    | 0.012                                     |
| 2005-010              | R0.25                                   | 1                                  | 44,000                                                                             | 900                              | 0.02                                     | 0.065                                     | 40,000                                           | 800                              | 0.015                                    | 0.05                                      | 36,000                                           | 600                              | 0.015                                    | 0.05                                      | 30,000                                           | 400                              | 0.015                                    | 0.03                                      |
| 2005-015              |                                         | 1.5                                | 44,000                                                                             | 900                              | 0.02                                     | 0.065                                     | 40,000                                           | 800                              | 0.015                                    | 0.05                                      | 36,000                                           | 600                              | 0.015                                    | 0.05                                      | 30,000                                           | 400                              | 0.015                                    | 0.03                                      |
| 2005-020              |                                         | 2                                  | 44,000                                                                             | 900                              | 0.02                                     | 0.065                                     | 40,000                                           | 800                              | 0.015                                    | 0.05                                      | 36,000                                           | 600                              | 0.015                                    | 0.05                                      | 30,000                                           | 400                              | 0.015                                    | 0.03                                      |
| 2005-025              |                                         | 2.5                                | 44,000                                                                             | 900                              | 0.02                                     | 0.065                                     | 40,000                                           | 800                              | 0.015                                    | 0.05                                      | 36,000                                           | 600                              | 0.015                                    | 0.05                                      | 30,000                                           | 400                              | 0.015                                    | 0.03                                      |
| 2005-030              |                                         | 3                                  | 32,700                                                                             | 450                              | 0.01                                     | 0.04                                      | 31,500                                           | 400                              | 0.01                                     | 0.03                                      | 30,000                                           | 300                              | 0.008                                    | 0.03                                      | 24,000                                           | 200                              | 0.007                                    | 0.015                                     |
| 2005-035              |                                         | 3.5                                | 32,700                                                                             | 450                              | 0.01                                     | 0.04                                      | 31,500                                           | 400                              | 0.01                                     | 0.03                                      | 30,000                                           | 300                              | 0.008                                    | 0.03                                      | 24,000                                           | 200                              | 0.007                                    | 0.015                                     |
| 2005-040              |                                         | 4                                  | 32,700                                                                             | 450                              | 0.01                                     | 0.04                                      | 31,500                                           | 400                              | 0.01                                     | 0.03                                      | 30,000                                           | 300                              | 0.008                                    | 0.03                                      | 24,000                                           | 200                              | 0.007                                    | 0.015                                     |
| 2005-045              |                                         | 4.5                                | 29,430                                                                             | 405                              | 0.008                                    | 0.03                                      | 28,350                                           | 360                              | 0.008                                    | 0.025                                     | 27,000                                           | 270                              | 0.006                                    | 0.025                                     | 21,600                                           | 180                              | 0.005                                    | 0.013                                     |
| 2005-050              |                                         | 5                                  | 26,160                                                                             | 360                              | 0.005                                    | 0.02                                      | 25,200                                           | 320                              | 0.005                                    | 0.02                                      | 24,000                                           | 240                              | 0.004                                    | 0.02                                      | 19,200                                           | 160                              | 0.003                                    | 0.01                                      |
| 2005-060              |                                         | 6                                  | 26,160                                                                             | 360                              | 0.005                                    | 0.02                                      | 25,200                                           | 320                              | 0.005                                    | 0.02                                      | 24,000                                           | 240                              | 0.004                                    | 0.02                                      | 19,200                                           | 160                              | 0.003                                    | 0.01                                      |

# HGLB 切削条件表    Milling Conditions

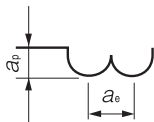
| 被削材<br>WORK MATERIAL  |                                         |                                    | プリハードン鋼 / 焼入れ鋼<br>PREHARDENED STEELS / HARDENED STEELS<br>NAK / STAVAX<br>(~55HRC) |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>SKD11<br>(55~62HRC)   |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>HAP10<br>(62~66HRC)   |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>HAP72<br>(66~70HRC)   |                                  |                                          |                                           |
|-----------------------|-----------------------------------------|------------------------------------|------------------------------------------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|
| 型番<br>Model<br>Number | ボール半径<br>Radius of<br>Ball Nose<br>(mm) | 有効長<br>Effective<br>Length<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> )                                   | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) |
| 2006-010              | R0.3                                    | 1                                  | 40,000                                                                             | 1,400                            | 0.045                                    | 0.15                                      | 36,000                                           | 1,500                            | 0.03                                     | 0.13                                      | 32,000                                           | 1,000                            | 0.02                                     | 0.1                                       | 25,000                                           | 600                              | 0.02                                     | 0.1                                       |
| 2006-015              |                                         | 1.5                                | 40,000                                                                             | 1,400                            | 0.03                                     | 0.13                                      | 36,000                                           | 1,300                            | 0.03                                     | 0.13                                      | 32,000                                           | 1,000                            | 0.02                                     | 0.1                                       | 25,000                                           | 600                              | 0.02                                     | 0.1                                       |
| 2006-020              |                                         | 2                                  | 40,000                                                                             | 1,400                            | 0.03                                     | 0.13                                      | 36,000                                           | 1,300                            | 0.03                                     | 0.13                                      | 32,000                                           | 1,000                            | 0.02                                     | 0.1                                       | 25,000                                           | 600                              | 0.02                                     | 0.1                                       |
| 2006-025              |                                         | 2.5                                | 40,000                                                                             | 1,200                            | 0.025                                    | 0.1                                       | 36,000                                           | 1,100                            | 0.025                                    | 0.1                                       | 32,000                                           | 900                              | 0.02                                     | 0.1                                       | 25,000                                           | 500                              | 0.02                                     | 0.1                                       |
| 2006-030              |                                         | 3                                  | 40,000                                                                             | 1,200                            | 0.025                                    | 0.1                                       | 36,000                                           | 1,100                            | 0.025                                    | 0.1                                       | 32,000                                           | 900                              | 0.02                                     | 0.1                                       | 25,000                                           | 500                              | 0.02                                     | 0.1                                       |
| 2006-035              |                                         | 3.5                                | 40,000                                                                             | 1,100                            | 0.023                                    | 0.09                                      | 34,000                                           | 950                              | 0.023                                    | 0.09                                      | 32,000                                           | 800                              | 0.018                                    | 0.09                                      | 25,000                                           | 450                              | 0.015                                    | 0.09                                      |
| 2006-040              |                                         | 4                                  | 40,000                                                                             | 1,000                            | 0.02                                     | 0.08                                      | 32,000                                           | 800                              | 0.02                                     | 0.08                                      | 32,000                                           | 700                              | 0.015                                    | 0.07                                      | 25,000                                           | 400                              | 0.01                                     | 0.075                                     |
| 2006-045              |                                         | 4.5                                | 32,000                                                                             | 600                              | 0.01                                     | 0.07                                      | 28,000                                           | 600                              | 0.01                                     | 0.05                                      | 25,600                                           | 500                              | 0.01                                     | 0.05                                      | 20,000                                           | 300                              | 0.005                                    | 0.05                                      |
| 2006-050              |                                         | 5                                  | 32,000                                                                             | 600                              | 0.01                                     | 0.07                                      | 28,000                                           | 600                              | 0.01                                     | 0.05                                      | 25,600                                           | 500                              | 0.01                                     | 0.05                                      | 20,000                                           | 300                              | 0.005                                    | 0.05                                      |
| 2006-055              |                                         | 5.5                                | 32,000                                                                             | 600                              | 0.01                                     | 0.07                                      | 28,000                                           | 600                              | 0.01                                     | 0.05                                      | 25,600                                           | 500                              | 0.01                                     | 0.05                                      | 20,000                                           | 300                              | 0.005                                    | 0.05                                      |
| 2006-060              | R0.4                                    | 6                                  | 32,000                                                                             | 600                              | 0.01                                     | 0.07                                      | 28,000                                           | 600                              | 0.01                                     | 0.05                                      | 25,600                                           | 500                              | 0.01                                     | 0.05                                      | 20,000                                           | 300                              | 0.005                                    | 0.05                                      |
| 2006-080              |                                         | 8                                  | 25,600                                                                             | 480                              | 0.008                                    | 0.02                                      | 22,400                                           | 480                              | 0.008                                    | 0.02                                      | 20,480                                           | 350                              | 0.007                                    | 0.02                                      | 16,000                                           | 210                              | 0.004                                    | 0.01                                      |
| 2006-100              |                                         | 10                                 | 20,480                                                                             | 390                              | 0.006                                    | 0.02                                      | 17,920                                           | 390                              | 0.006                                    | 0.02                                      | 16,400                                           | 250                              | 0.005                                    | 0.02                                      | 12,800                                           | 150                              | 0.003                                    | 0.01                                      |
| 2008-020              |                                         | 2                                  | 35,000                                                                             | 1,600                            | 0.06                                     | 0.21                                      | 30,000                                           | 1,600                            | 0.04                                     | 0.17                                      | 26,000                                           | 1,350                            | 0.04                                     | 0.15                                      | 20,000                                           | 700                              | 0.02                                     | 0.12                                      |
| 2008-025              |                                         | 2.5                                | 35,000                                                                             | 1,600                            | 0.06                                     | 0.21                                      | 30,000                                           | 1,600                            | 0.04                                     | 0.17                                      | 26,000                                           | 1,350                            | 0.04                                     | 0.15                                      | 20,000                                           | 700                              | 0.02                                     | 0.12                                      |
| 2008-030              |                                         | 3                                  | 35,000                                                                             | 1,600                            | 0.06                                     | 0.21                                      | 30,000                                           | 1,600                            | 0.04                                     | 0.17                                      | 26,000                                           | 1,350                            | 0.04                                     | 0.15                                      | 20,000                                           | 700                              | 0.02                                     | 0.12                                      |
| 2008-040              |                                         | 4                                  | 35,000                                                                             | 1,600                            | 0.06                                     | 0.21                                      | 30,000                                           | 1,600                            | 0.04                                     | 0.17                                      | 26,000                                           | 1,350                            | 0.04                                     | 0.15                                      | 20,000                                           | 700                              | 0.02                                     | 0.12                                      |
| 2008-050              |                                         | 5                                  | 31,500                                                                             | 1,300                            | 0.04                                     | 0.17                                      | 27,500                                           | 1,300                            | 0.03                                     | 0.15                                      | 23,400                                           | 1,000                            | 0.03                                     | 0.11                                      | 18,000                                           | 530                              | 0.015                                    | 0.09                                      |
| 2008-060              |                                         | 6                                  | 28,000                                                                             | 1,000                            | 0.02                                     | 0.12                                      | 25,000                                           | 1,000                            | 0.02                                     | 0.12                                      | 20,800                                           | 675                              | 0.02                                     | 0.075                                     | 16,000                                           | 350                              | 0.01                                     | 0.06                                      |
| 2008-070              |                                         | 7                                  | 25,200                                                                             | 900                              | 0.02                                     | 0.11                                      | 22,500                                           | 900                              | 0.02                                     | 0.11                                      | 18,700                                           | 600                              | 0.018                                    | 0.068                                     | 14,400                                           | 330                              | 0.009                                    | 0.05                                      |
| 2008-080              | R0.5                                    | 8                                  | 22,400                                                                             | 800                              | 0.02                                     | 0.1                                       | 20,000                                           | 800                              | 0.02                                     | 0.1                                       | 16,640                                           | 540                              | 0.016                                    | 0.06                                      | 12,800                                           | 300                              | 0.008                                    | 0.048                                     |
| 2010-020              |                                         | 2                                  | 30,000                                                                             | 1,750                            | 0.2                                      | 0.4                                       | 24,000                                           | 2,000                            | 0.1                                      | 0.3                                       | 21,000                                           | 1,750                            | 0.05                                     | 0.2                                       | 16,000                                           | 875                              | 0.05                                     | 0.2                                       |
| 2010-025              |                                         | 2.5                                | 30,000                                                                             | 1,750                            | 0.2                                      | 0.4                                       | 24,000                                           | 2,000                            | 0.1                                      | 0.3                                       | 21,000                                           | 1,750                            | 0.05                                     | 0.2                                       | 16,000                                           | 875                              | 0.05                                     | 0.2                                       |
| 2010-030              |                                         | 3                                  | 30,000                                                                             | 1,750                            | 0.1                                      | 0.3                                       | 24,000                                           | 2,000                            | 0.1                                      | 0.2                                       | 21,000                                           | 1,750                            | 0.03                                     | 0.17                                      | 16,000                                           | 875                              | 0.03                                     | 0.17                                      |
| 2010-040              |                                         | 4                                  | 30,000                                                                             | 1,750                            | 0.1                                      | 0.3                                       | 24,000                                           | 2,000                            | 0.1                                      | 0.2                                       | 21,000                                           | 1,750                            | 0.03                                     | 0.17                                      | 16,000                                           | 875                              | 0.03                                     | 0.17                                      |
| 2010-050              |                                         | 5                                  | 30,000                                                                             | 1,750                            | 0.1                                      | 0.3                                       | 24,000                                           | 2,000                            | 0.1                                      | 0.2                                       | 21,000                                           | 1,750                            | 0.03                                     | 0.17                                      | 16,000                                           | 875                              | 0.03                                     | 0.17                                      |
| 2010-060              |                                         | 6                                  | 30,000                                                                             | 1,150                            | 0.06                                     | 0.23                                      | 21,500                                           | 1,250                            | 0.03                                     | 0.17                                      | 19,700                                           | 1,050                            | 0.025                                    | 0.15                                      | 14,500                                           | 525                              | 0.025                                    | 0.15                                      |
| 2010-070              |                                         | 7                                  | 27,000                                                                             | 980                              | 0.04                                     | 0.19                                      | 20,000                                           | 920                              | 0.02                                     | 0.15                                      | 19,000                                           | 770                              | 0.02                                     | 0.14                                      | 14,200                                           | 380                              | 0.02                                     | 0.14                                      |
| 2010-080              |                                         | 8                                  | 24,000                                                                             | 800                              | 0.025                                    | 0.155                                     | 18,500                                           | 580                              | 0.015                                    | 0.12                                      | 18,400                                           | 480                              | 0.015                                    | 0.12                                      | 13,800                                           | 240                              | 0.015                                    | 0.12                                      |
| 2010-100              |                                         | 10                                 | 22,000                                                                             | 600                              | 0.018                                    | 0.13                                      | 14,800                                           | 430                              | 0.01                                     | 0.09                                      | 14,700                                           | 360                              | 0.01                                     | 0.09                                      | 14,700                                           | 360                              | 0.01                                     | 0.09                                      |
| 2010-120              | R0.5                                    | 12                                 | 14,150                                                                             | 320                              | 0.015                                    | 0.12                                      | 13,400                                           | 380                              | 0.008                                    | 0.08                                      | 13,300                                           | 290                              | 0.008                                    | 0.08                                      | 13,300                                           | 290                              | 0.008                                    | 0.08                                      |
| 2010-140              |                                         | 14                                 | 13,500                                                                             | 280                              | 0.012                                    | 0.1                                       | 12,000                                           | 350                              | 0.007                                    | 0.08                                      | 12,000                                           | 220                              | 0.007                                    | 0.08                                      | 12,000                                           | 220                              | 0.007                                    | 0.08                                      |
| 2010-160              |                                         | 16                                 | 12,150                                                                             | 250                              | 0.011                                    | 0.09                                      | 10,800                                           | 320                              | 0.006                                    | 0.07                                      | 10,800                                           | 200                              | 0.006                                    | 0.07                                      | 10,800                                           | 200                              | 0.006                                    | 0.07                                      |

# HGLB 切削条件表    Milling Conditions

| 被削材<br>WORK MATERIAL  |                                         |                                    | プリハードン鋼 / 焼入れ鋼<br>PREHARDENED STEELS / HARDENED STEELS<br>NAK / STAVAX<br>(~55HRC) |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>SKD11<br>(55~62HRC)   |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>HAP10<br>(62~66HRC)   |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>HAP72<br>(66~70HRC)   |                                  |                                          |                                           |
|-----------------------|-----------------------------------------|------------------------------------|------------------------------------------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|
| 型番<br>Model<br>Number | ボール半径<br>Radius of<br>Ball Nose<br>(mm) | 有効長<br>Effective<br>Length<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> )                                   | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) |
| 2015-030              | R0.75                                   | 3                                  | 30,000                                                                             | 2,450                            | 0.25                                     | 0.55                                      | 17,000                                           | 2,000                            | 0.12                                     | 0.4                                       | 15,000                                           | 1,750                            | 0.06                                     | 0.29                                      | 11,250                                           | 875                              | 0.06                                     | 0.29                                      |
| 2015-040              |                                         | 4                                  | 30,000                                                                             | 2,450                            | 0.25                                     | 0.55                                      | 17,000                                           | 2,000                            | 0.12                                     | 0.4                                       | 15,000                                           | 1,750                            | 0.06                                     | 0.29                                      | 11,250                                           | 875                              | 0.06                                     | 0.29                                      |
| 2015-060              |                                         | 6                                  | 30,000                                                                             | 2,450                            | 0.15                                     | 0.45                                      | 17,000                                           | 2,000                            | 0.07                                     | 0.31                                      | 15,000                                           | 1,750                            | 0.04                                     | 0.24                                      | 11,250                                           | 875                              | 0.04                                     | 0.24                                      |
| 2015-080              |                                         | 8                                  | 23,500                                                                             | 1,300                            | 0.1                                      | 0.37                                      | 15,000                                           | 1,250                            | 0.045                                    | 0.25                                      | 14,000                                           | 1,050                            | 0.03                                     | 0.21                                      | 10,500                                           | 525                              | 0.03                                     | 0.21                                      |
| 2015-100              |                                         | 10                                 | 23,500                                                                             | 1,300                            | 0.1                                      | 0.37                                      | 15,000                                           | 1,250                            | 0.045                                    | 0.25                                      | 14,000                                           | 1,050                            | 0.03                                     | 0.21                                      | 10,500                                           | 525                              | 0.03                                     | 0.21                                      |
| 2015-120              |                                         | 12                                 | 13,100                                                                             | 480                              | 0.03                                     | 0.21                                      | 13,000                                           | 580                              | 0.02                                     | 0.17                                      | 13,000                                           | 480                              | 0.02                                     | 0.17                                      | 9,750                                            | 240                              | 0.02                                     | 0.17                                      |
| 2015-140              |                                         | 14                                 | 11,200                                                                             | 400                              | 0.025                                    | 0.19                                      | 10,900                                           | 490                              | 0.015                                    | 0.145                                     | 10,900                                           | 390                              | 0.015                                    | 0.145                                     | 8,200                                            | 190                              | 0.015                                    | 0.145                                     |
| 2015-160              |                                         | 16                                 | 10,000                                                                             | 360                              | 0.023                                    | 0.17                                      | 9,800                                            | 440                              | 0.014                                    | 0.13                                      | 9,800                                            | 350                              | 0.014                                    | 0.13                                      | 7,380                                            | 170                              | 0.014                                    | 0.13                                      |
| 2015-200              |                                         | 20                                 | 8,900                                                                              | 320                              | 0.02                                     | 0.15                                      | 8,700                                            | 390                              | 0.012                                    | 0.12                                      | 8,700                                            | 310                              | 0.012                                    | 0.12                                      | 6,560                                            | 150                              | 0.012                                    | 0.12                                      |
| 2020-030              | R1                                      | 3                                  | 28,000                                                                             | 2,900                            | 0.3                                      | 0.7                                       | 14,000                                           | 2,100                            | 0.15                                     | 0.5                                       | 14,700                                           | 2,100                            | 0.15                                     | 0.35                                      | 12,250                                           | 1,800                            | 0.08                                     | 0.35                                      |
| 2020-040              |                                         | 4                                  | 28,000                                                                             | 2,900                            | 0.3                                      | 0.7                                       | 14,000                                           | 2,100                            | 0.15                                     | 0.5                                       | 14,700                                           | 2,100                            | 0.15                                     | 0.35                                      | 12,250                                           | 1,800                            | 0.08                                     | 0.35                                      |
| 2020-060              |                                         | 6                                  | 28,000                                                                             | 2,900                            | 0.2                                      | 0.6                                       | 14,000                                           | 2,100                            | 0.1                                      | 0.4                                       | 14,700                                           | 2,100                            | 0.15                                     | 0.3                                       | 12,250                                           | 1,800                            | 0.06                                     | 0.3                                       |
| 2020-080              |                                         | 8                                  | 28,000                                                                             | 2,900                            | 0.2                                      | 0.6                                       | 14,000                                           | 2,100                            | 0.1                                      | 0.4                                       | 14,700                                           | 2,100                            | 0.15                                     | 0.3                                       | 12,250                                           | 1,800                            | 0.06                                     | 0.3                                       |
| 2020-100              |                                         | 10                                 | 28,000                                                                             | 2,900                            | 0.2                                      | 0.6                                       | 14,000                                           | 2,100                            | 0.1                                      | 0.4                                       | 14,700                                           | 2,100                            | 0.15                                     | 0.3                                       | 12,250                                           | 1,800                            | 0.06                                     | 0.3                                       |
| 2020-120              |                                         | 12                                 | 19,500                                                                             | 1,350                            | 0.12                                     | 0.45                                      | 12,400                                           | 1,350                            | 0.06                                     | 0.34                                      | 13,800                                           | 1,320                            | 0.09                                     | 0.27                                      | 11,500                                           | 1,100                            | 0.045                                    | 0.27                                      |
| 2020-140              |                                         | 14                                 | 19,500                                                                             | 1,350                            | 0.12                                     | 0.45                                      | 12,400                                           | 1,350                            | 0.06                                     | 0.34                                      | 13,800                                           | 1,320                            | 0.09                                     | 0.27                                      | 11,500                                           | 1,100                            | 0.045                                    | 0.27                                      |
| 2020-160              |                                         | 16                                 | 10,800                                                                             | 500                              | 0.05                                     | 0.3                                       | 10,800                                           | 600                              | 0.03                                     | 0.24                                      | 12,840                                           | 588                              | 0.06                                     | 0.24                                      | 10,700                                           | 490                              | 0.03                                     | 0.24                                      |
| 2020-200              |                                         | 20                                 | 10,800                                                                             | 500                              | 0.035                                    | 0.25                                      | 10,800                                           | 450                              | 0.02                                     | 0.19                                      | 10,270                                           | 440                              | 0.04                                     | 0.19                                      | 8,560                                            | 370                              | 0.02                                     | 0.19                                      |
| 2020-250              |                                         | 25                                 | 9,720                                                                              | 450                              | 0.032                                    | 0.23                                      | 9,720                                            | 410                              | 0.018                                    | 0.17                                      | 9,250                                            | 400                              | 0.036                                    | 0.17                                      | 7,700                                            | 330                              | 0.018                                    | 0.17                                      |
| 2020-300              |                                         | 30                                 | 8,650                                                                              | 400                              | 0.028                                    | 0.2                                       | 8,650                                            | 360                              | 0.016                                    | 0.15                                      | 8,200                                            | 350                              | 0.032                                    | 0.15                                      | 6,850                                            | 300                              | 0.016                                    | 0.15                                      |
| 2030-060              | R1.5                                    | 6                                  | 21,000                                                                             | 3,000                            | 0.4                                      | 1                                         | 13,250                                           | 2,740                            | 0.29                                     | 0.7                                       | 11,040                                           | 2,280                            | 0.24                                     | 0.55                                      | 9,200                                            | 1,900                            | 0.12                                     | 0.55                                      |
| 2030-080              |                                         | 8                                  | 21,000                                                                             | 3,000                            | 0.4                                      | 1                                         | 13,250                                           | 2,740                            | 0.29                                     | 0.7                                       | 11,040                                           | 2,280                            | 0.24                                     | 0.55                                      | 9,200                                            | 1,900                            | 0.12                                     | 0.55                                      |
| 2030-100              |                                         | 10                                 | 21,000                                                                             | 3,000                            | 0.3                                      | 0.9                                       | 13,250                                           | 2,740                            | 0.24                                     | 0.65                                      | 11,040                                           | 2,280                            | 0.2                                      | 0.5                                       | 9,200                                            | 1,900                            | 0.1                                      | 0.5                                       |
| 2030-120              |                                         | 12                                 | 21,000                                                                             | 3,000                            | 0.3                                      | 0.9                                       | 13,250                                           | 2,740                            | 0.24                                     | 0.65                                      | 11,040                                           | 2,280                            | 0.2                                      | 0.5                                       | 9,200                                            | 1,900                            | 0.1                                      | 0.5                                       |
| 2030-140              |                                         | 14                                 | 21,000                                                                             | 3,000                            | 0.3                                      | 0.9                                       | 13,250                                           | 2,740                            | 0.24                                     | 0.65                                      | 11,040                                           | 2,280                            | 0.2                                      | 0.5                                       | 9,200                                            | 1,900                            | 0.1                                      | 0.5                                       |
| 2030-160              |                                         | 16                                 | 21,000                                                                             | 3,000                            | 0.3                                      | 0.9                                       | 13,250                                           | 2,740                            | 0.24                                     | 0.65                                      | 11,040                                           | 2,280                            | 0.2                                      | 0.5                                       | 9,200                                            | 1,900                            | 0.1                                      | 0.5                                       |
| 2030-180              |                                         | 18                                 | 17,750                                                                             | 2,300                            | 0.24                                     | 0.8                                       | 12,800                                           | 2,200                            | 0.21                                     | 0.58                                      | 10,680                                           | 1,830                            | 0.18                                     | 0.48                                      | 8,900                                            | 1,525                            | 0.088                                    | 0.48                                      |
| 2030-200              |                                         | 20                                 | 14,500                                                                             | 1,600                            | 0.18                                     | 0.7                                       | 12,380                                           | 1,660                            | 0.18                                     | 0.5                                       | 10,320                                           | 1,380                            | 0.15                                     | 0.45                                      | 8,600                                            | 1,150                            | 0.075                                    | 0.45                                      |
| 2030-220              |                                         | 22                                 | 13,000                                                                             | 1,440                            | 0.16                                     | 0.63                                      | 11,950                                           | 1,200                            | 0.15                                     | 0.44                                      | 9,960                                            | 1,000                            | 0.13                                     | 0.42                                      | 8,300                                            | 830                              | 0.063                                    | 0.42                                      |
| 2030-250              |                                         | 25                                 | 11,600                                                                             | 1,280                            | 0.14                                     | 0.56                                      | 11,520                                           | 730                              | 0.12                                     | 0.38                                      | 9,600                                            | 610                              | 0.1                                      | 0.38                                      | 8,000                                            | 510                              | 0.05                                     | 0.38                                      |
| 2030-270              |                                         | 27                                 | 10,500                                                                             | 1,150                            | 0.13                                     | 0.51                                      | 9,850                                            | 630                              | 0.1                                      | 0.34                                      | 8,200                                            | 530                              | 0.08                                     | 0.34                                      | 6,850                                            | 440                              | 0.04                                     | 0.34                                      |
| 2030-300              |                                         | 30                                 | 9,280                                                                              | 1,020                            | 0.11                                     | 0.45                                      | 8,200                                            | 530                              | 0.07                                     | 0.29                                      | 6,840                                            | 440                              | 0.06                                     | 0.29                                      | 5,700                                            | 370                              | 0.03                                     | 0.29                                      |

# HGLB 切削条件表 Milling Conditions

| 被削材<br>WORK MATERIAL  |                                         |                                    | プリハードン鋼 / 焼入れ鋼<br>PREHARDENED STEELS / HARDENED STEELS<br>NAK / STAVAX<br>(~55HRC) |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>SKD11<br>(55~62HRC)   |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>HAP10<br>(62~66HRC)   |                                  |                                          |                                           | 焼入れ鋼<br>HARDENED STEELS<br>HAP72<br>(66~70HRC)   |                                  |                                          |                                           |
|-----------------------|-----------------------------------------|------------------------------------|------------------------------------------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|--------------------------------------------------|----------------------------------|------------------------------------------|-------------------------------------------|
| 型番<br>Model<br>Number | ボール半径<br>Radius of<br>Ball Nose<br>(mm) | 有効長<br>Effective<br>Length<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> )                                   | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) | 回転速度<br>Spindle<br>Speed<br>(min <sup>-1</sup> ) | 送り速度<br>Feed<br>Rate<br>(mm/min) | a <sub>p</sub><br>Axial<br>Depth<br>(mm) | a <sub>e</sub><br>Radial<br>Depth<br>(mm) |
| 2040-080              | R2                                      | 8                                  | 18,000                                                                             | 3,200                            | 0.5                                      | 1.3                                       | 11,380                                           | 2,880                            | 0.36                                     | 0.95                                      | 9,480                                            | 2,400                            | 0.3                                      | 0.75                                      | 7,900                                            | 2,000                            | 0.15                                     | 0.75                                      |
| 2040-100              |                                         | 10                                 | 18,000                                                                             | 3,200                            | 0.5                                      | 1.3                                       | 11,380                                           | 2,880                            | 0.36                                     | 0.95                                      | 9,480                                            | 2,400                            | 0.3                                      | 0.75                                      | 7,900                                            | 2,000                            | 0.15                                     | 0.75                                      |
| 2040-120              |                                         | 12                                 | 18,000                                                                             | 3,200                            | 0.4                                      | 1.2                                       | 11,380                                           | 2,880                            | 0.31                                     | 0.85                                      | 9,480                                            | 2,400                            | 0.26                                     | 0.7                                       | 7,900                                            | 2,000                            | 0.13                                     | 0.7                                       |
| 2040-140              |                                         | 14                                 | 18,000                                                                             | 3,200                            | 0.4                                      | 1.2                                       | 11,380                                           | 2,880                            | 0.31                                     | 0.85                                      | 9,480                                            | 2,400                            | 0.26                                     | 0.7                                       | 7,900                                            | 2,000                            | 0.13                                     | 0.7                                       |
| 2040-160              |                                         | 16                                 | 18,000                                                                             | 3,200                            | 0.4                                      | 1.2                                       | 11,380                                           | 2,880                            | 0.31                                     | 0.85                                      | 9,480                                            | 2,400                            | 0.26                                     | 0.7                                       | 7,900                                            | 2,000                            | 0.13                                     | 0.7                                       |
| 2040-180              |                                         | 18                                 | 18,000                                                                             | 3,200                            | 0.4                                      | 1.2                                       | 11,380                                           | 2,880                            | 0.31                                     | 0.85                                      | 9,480                                            | 2,400                            | 0.26                                     | 0.7                                       | 7,900                                            | 2,000                            | 0.13                                     | 0.7                                       |
| 2040-200              |                                         | 20                                 | 18,000                                                                             | 3,200                            | 0.4                                      | 1.2                                       | 10,730                                           | 1,800                            | 0.21                                     | 0.7                                       | 8,940                                            | 1,500                            | 0.18                                     | 0.55                                      | 7,450                                            | 1,250                            | 0.09                                     | 0.55                                      |
| 2040-220              |                                         | 22                                 | 15,250                                                                             | 2,250                            | 0.33                                     | 1.1                                       | 10,730                                           | 1,800                            | 0.21                                     | 0.7                                       | 8,940                                            | 1,500                            | 0.18                                     | 0.55                                      | 7,450                                            | 1,250                            | 0.09                                     | 0.55                                      |
| 2040-250              |                                         | 25                                 | 12,500                                                                             | 1,250                            | 0.25                                     | 0.95                                      | 10,730                                           | 1,800                            | 0.21                                     | 0.7                                       | 8,940                                            | 1,500                            | 0.18                                     | 0.55                                      | 7,450                                            | 1,250                            | 0.09                                     | 0.55                                      |
| 2040-270              |                                         | 27                                 | 11,500                                                                             | 1,150                            | 0.23                                     | 0.9                                       | 10,400                                           | 1,250                            | 0.18                                     | 0.58                                      | 8,670                                            | 1,050                            | 0.15                                     | 0.5                                       | 7,250                                            | 890                              | 0.075                                    | 0.5                                       |
| 2040-300              |                                         | 30                                 | 10,630                                                                             | 1,000                            | 0.2                                      | 0.76                                      | 10,080                                           | 780                              | 0.15                                     | 0.45                                      | 8,400                                            | 650                              | 0.12                                     | 0.45                                      | 7,000                                            | 540                              | 0.06                                     | 0.45                                      |
| 2040-350              |                                         | 35                                 | 9,030                                                                              | 800                              | 0.16                                     | 0.61                                      | 8,640                                            | 730                              | 0.13                                     | 0.43                                      | 7,200                                            | 610                              | 0.11                                     | 0.43                                      | 6,000                                            | 510                              | 0.055                                    | 0.43                                      |
| 2040-400              |                                         | 40                                 | 8,300                                                                              | 700                              | 0.14                                     | 0.54                                      | 8,000                                            | 700                              | 0.12                                     | 0.42                                      | 6,650                                            | 590                              | 0.11                                     | 0.42                                      | 5,500                                            | 500                              | 0.05                                     | 0.42                                      |
| 2060-100              | R3                                      | 10                                 | 14,400                                                                             | 3,200                            | 0.5                                      | 1.5                                       | 9,140                                            | 2,880                            | 0.38                                     | 1.05                                      | 7,620                                            | 2,400                            | 0.32                                     | 0.88                                      | 6,350                                            | 2,000                            | 0.16                                     | 0.88                                      |
| 2060-150              |                                         | 15                                 | 14,400                                                                             | 3,200                            | 0.5                                      | 1.5                                       | 9,140                                            | 2,880                            | 0.38                                     | 1.05                                      | 7,620                                            | 2,400                            | 0.32                                     | 0.88                                      | 6,350                                            | 2,000                            | 0.16                                     | 0.88                                      |
| 2060-180              |                                         | 18                                 | 14,400                                                                             | 3,200                            | 0.5                                      | 1.5                                       | 9,140                                            | 2,880                            | 0.38                                     | 1.05                                      | 7,620                                            | 2,400                            | 0.32                                     | 0.88                                      | 6,350                                            | 2,000                            | 0.16                                     | 0.88                                      |
| 2060-200              |                                         | 20                                 | 14,400                                                                             | 3,200                            | 0.5                                      | 1.5                                       | 9,000                                            | 2,300                            | 0.32                                     | 0.95                                      | 7,620                                            | 2,400                            | 0.32                                     | 0.88                                      | 6,350                                            | 2,000                            | 0.16                                     | 0.88                                      |
| 2060-250              |                                         | 25                                 | 14,400                                                                             | 3,200                            | 0.5                                      | 1.5                                       | 8,100                                            | 2,000                            | 0.3                                      | 0.95                                      | 7,500                                            | 1,920                            | 0.27                                     | 0.805                                     | 6,250                                            | 1,600                            | 0.135                                    | 0.805                                     |
| 2060-300              |                                         | 30                                 | 14,400                                                                             | 3,200                            | 0.5                                      | 1.5                                       | 7,700                                            | 1,800                            | 0.26                                     | 0.88                                      | 7,440                                            | 1,500                            | 0.22                                     | 0.73                                      | 6,200                                            | 1,250                            | 0.11                                     | 0.73                                      |
| 2060-350              |                                         | 35                                 | 9,200                                                                              | 2,050                            | 0.32                                     | 1                                         | 6,200                                            | 1,450                            | 0.21                                     | 0.71                                      | 6,000                                            | 1,200                            | 0.18                                     | 0.59                                      | 5,000                                            | 1,000                            | 0.09                                     | 0.59                                      |
| 2060-400              |                                         | 40                                 | 7,000                                                                              | 1,050                            | 0.2                                      | 0.8                                       | 5,600                                            | 1,000                            | 0.19                                     | 0.64                                      | 4,800                                            | 950                              | 0.14                                     | 0.47                                      | 4,000                                            | 810                              | 0.07                                     | 0.47                                      |
| 2060-500              |                                         | 50                                 | 5,600                                                                              | 850                              | 0.16                                     | 0.6                                       | 4,500                                            | 810                              | 0.15                                     | 0.52                                      | 3,900                                            | 780                              | 0.12                                     | 0.38                                      | 3,200                                            | 650                              | 0.06                                     | 0.38                                      |



a<sub>p</sub> : 軸方向の切込み深さ (mm)  
a<sub>e</sub> : 半径方向の切込み深さ (mm)  
a<sub>p</sub> : Axial Depth (mm)  
a<sub>e</sub> : Radial Depth (mm)

備考 :

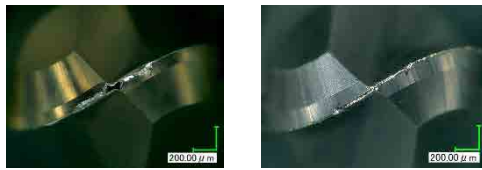
- ・ 溝加工となる部分では、送り速度を 50%以下に下げてください。
- ・ 機械の回転速度が足りない場合や、加工中ビビリや工具の赤熱が発生する場合は、回転速度と送り速度を同じ比率で下げてください。
- ・ 水溶性・油性切削油、オイルミスト、エアブローのいずれにおいても安定した加工が可能です。

Note:

- ・ Decrease the feed rate more than 50% from the milling parameters when slot milling.
- ・ Decrease both spindle speed and feed rate proportionally when the milling parameters exceed the machine's maximum spindle speed, or when chattering and red-hot occur.
- ・ Every coolant offers stable milling.

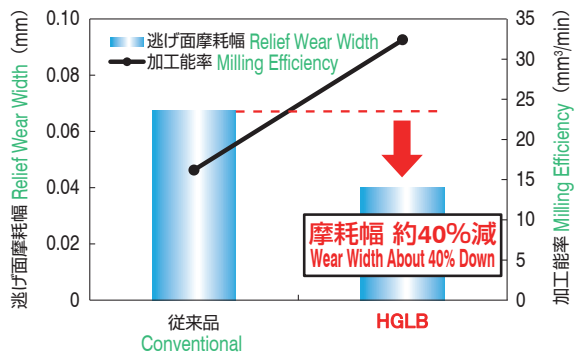
HGLB は従来品の2倍の加工能率で加工！  
HGLB mills twice as efficient as the conventional tool.

加工後の工具状態 Tools after milling



従来品 Conventional

HGLB



|                               |                                                         |                          |
|-------------------------------|---------------------------------------------------------|--------------------------|
| 使用工具 Tool                     | 従来品 Conventional                                        | HGLB 2020-060            |
| 回転速度 Spindle Speed            | 9,200 min <sup>-1</sup>                                 | 12,250 min <sup>-1</sup> |
| 送り速度 Feed Rate                | 900 mm/min                                              | 1,800 mm/min             |
| 軸方向の切込み深さ $a_p$ Axial Depth   | 0.06 mm                                                 |                          |
| 半径方向の切込み深さ $a_e$ Radial Depth | 0.3 mm                                                  |                          |
| クーラント Coolant                 | エアブロー (スルースピンドル) Air Blow (Through-Spindle)             |                          |
| 加工形状 Milling Shape            | 四角ポケット Square Pocket (20 x 15 x Depth 2 mm) × 2 Pockets |                          |
| 加工時間 Cycle Time               | 76 min                                                  | 50 min                   |

加工能率 Milling Efficiency (mm<sup>3</sup>/min) = 送り速度 Feed Rate ×  $a_p$  ×  $a_e$



## ユニマックス超硬エンドミル取扱上の注意

エンドミルをご使用いただく際には、切削条件の不適合、切りくずの巻き付きや堆積、工具の摩耗などにより発熱や発火、加工物の損傷など重大な事故を招くことがありますので、十分ご注意ください。超硬エンドミルは鋭利な刃物ですから、取扱に際しては十分ご注意ください。

- 切削に直接触れると怪我をすることがありますので、ケースから抜き取る際は十分ご注意ください。
- エンドミルを落とした場合、飛散した刃先で怪我をすることがありますので、取扱にご注意ください。
- 工具への衝撃的負荷や工具損傷により切削抵抗が急増し、工具が飛散することがありますので、安全カバーや保護めがね等の保護具をご使用ください。
- 切削条件表は切削条件の目安を示すものです。実際の加工では被削材の材種、加工形状、機械剛性、主軸などの加工環境により、加工条件の最適化が必要となる場合があります。
- 振れの小さい剛性の高い機械をご使用ください。小径工具（φ1以下）においては振れ 管理値：5μm以下を推奨致します。
- 発火性の高い切削油の使用は避けてください。

### ユニマックス超硬エンドミル再研磨時の注意

- 超硬合金の研磨塵が目に入らないよう必ず保護めがねを着用してください。研磨塵を吸い込まないよう必ずマスクをかけてください。



## Advisory for Safe Use of UNIMAX Tungsten Carbide End Mills

Correct application and operation is strongly advised to avoid clogging, abrasion, etc, that could cause serious accidents or injuries. Ignition or sparks generated during milling could lead to fire or extreme damage to the work piece. End Mills are made with very sharp cutting edges and must be handled with extra care.

- Never touch the cutting edge with your bare hands, as this could cause serious injury. Special caution is required when opening the package.
- Dropping the tool could cause breakage or flying debris, leading to serious injury.
- During milling, unexpected impact or shock on the tool could cause breakage or flying debris. Ensure to use protective items such as safety glasses and a face guard.
- For best results, fine parameter adjustment may be required, depending on the materials; milling shape and strategy; machine rigidity and spindle capability.
- Use a machine that has high rigidity and generates a low level of vibration.
- Do not use flammable cutting oils.

### Advisory for regrinding UNIMAX Tungsten Carbide End Mills

- Never regrind the tool without wearing safety glasses and a face guard.



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エンドミルの技術的なお問い合わせは下記まで



**0120-60-2620**

受付時間: 9:30~12:00, 13:00~16:30 (土曜、日曜、祝日、弊社休日を除く)

**<https://www.uniontool.co.jp>**

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Price & Specifications are subject to change without notice.