INDEXABLE INSERT ENDMILL CUTTER

# FULLCUT MILL *FCR Type*

Cutter diameter: ø16 - ø32

## Evolved rigidity realizes both heavy and stable ramping.

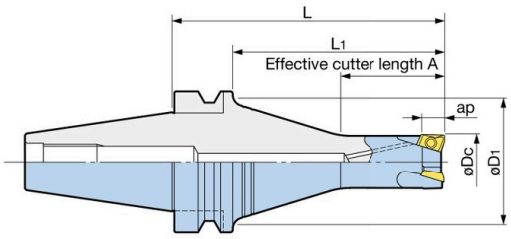
- Integral design with a taper shank and dual face contact of BIG-PLUS and HSK provide the highest rigidity.

## BBT Integrated Type

Slotting | Shoulder milling | Ramping | Helical milling | Peck-drilling

**[Standard Type]**

DUAL CONTACT BIG-PLUS®




● Model Description

BBT30 - FCR 16 08 2 - 65

- BBT30 – BIG-PLUS BT No.
- FCR – FCR Type
- 16 – Cutter diameter øDc
- 08 – Effective cutting edge length ap
- 2 – Number of inserts
- 65 – L dimension

BIG-PLUS (BBT Shank) tools can be used on both BIG-PLUS spindles and conventional **BT spindles**.

| Cutter diameter øDc | Model | Effective cutting edge length ap | øD1 | L | L1 | A | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | **BBT30-FCR16082- 65** | 8 | 40 | 65 | 43 | 28 | 2 | BRG1608□□ | 0.47 |
| 20 | **-FCR20083- 65** | | | 65 | 43 | 28 | 3 | BRG2008□□ | 0.49 |
| 25 | **-FCR25083- 65** | | | 65 | 43 | 33 | | BRG2508□□ | 0.52 |
| | **-105** NEW | | 42 | 105 | 83 | 35 | | | 0.73 |
| 32 | **-FCR32103- 65** | 10 | 40 | 65 | 43 | 40 | | BRG3210□□ | 0.56 |
| | **-105** NEW | | 42 | 105 | 83 | 45 | | | 0.83 |
| 16 | **BBT40-FCR16082- 85** | 8 | 60 | 85 | 58 | 25 | 2 | BRG1608□□ | 1.2 |
| | **-120** | | | 120 | 93 | 30 | | | 1.5 |
| | **-135** | | | 135 | 108 | 25 | | | 1.6 |
| 20 | **-FCR20083- 85** | 8 | 60 | 85 | 58 | 35 | 3 | BRG2008□□ | 1.2 |
| | **-120** | | | 120 | 93 | 30 | | | 1.5 |
| | **-135** | | | 135 | 108 | 30 | | | 1.6 |
| 25 | **-FCR25083- 85** | 8 | 60 | 85 | 58 | 40 | 3 | BRG2508□□ | 1.2 |
| | **-120** | | | 120 | 93 | 45 | | | 1.5 |
| | **-135** | | | 135 | 108 | 35 | | | 1.7 |
| 32 | **-FCR32103- 85** | 10 | 60 | 85 | 58 | 45 | 3 | BRG3210□□ | 1.3 |
| | **-120** | | | 120 | 93 | 50 | | | 1.6 |
| | **-135** | | | 135 | 108 | 40 | | | 1.8 |

1. Wrench included. Inserts must be ordered separately.

Inserts J6
Cutting conditions J7

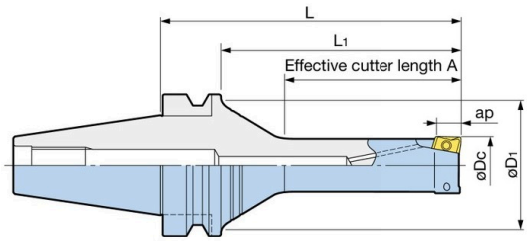
INDEXABLE INSERT ENDMILL CUTTER

# FULLCUT MILL FCR Type

Cutter diameter: ø16 - ø32

## [Long Type]

DUAL CONTACT BIG-PLUS®




BIG-PLUS (BBT Shank) tools can be used on both BIG-PLUS spindles and conventional **BT spindles**.

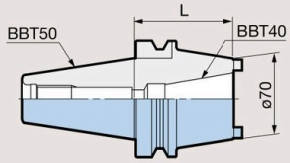
| Cutter diameter øDc | Model | Effective cutting edge length ap | øD1 | L | L1 | A | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | **BBT30-FCR16082L- 85** | 8 | 40 | 85 | 63 | 45 | 2 | BRG1608□□ | 0.5 |
| 20 | **-FCR20082L- 85** | | | 85 | 63 | 50 | 2 | BRG2008□□ | 0.53 |
| 25 | **-FCR25082L- 85** | | | 85 | 63 | 50 | 2 | BRG2508□□ | 0.6 |
| 32 | **-FCR32102L- 85** | 10 | | 85 | 63 | 60 | 2 | BRG3210□□ | 0.68 |
| 16 | **BBT40-FCR16082L-105** | 8 | 60 | 105 | 78 | 45 | 2 | BRG1608□□ | 1.3 |
| | **-120** | | | 120 | 93 | 45 | | | 1.4 |
| 20 | **-FCR20082L-120** | 8 | 60 | 120 | 93 | 60 | 2 | BRG2008□□ | 1.4 |
| | **-135** | | | 135 | 108 | 60 | | | 1.5 |
| 25 | **-FCR25082L-135** | 8 | 60 | 135 | 108 | 75 | 2 | BRG2508□□ | 1.5 |
| | **-150** | | | 150 | 123 | 75 | | | 1.7 |
| 32 | **-FCR32102L-135** | 10 | 60 | 135 | 108 | 80 | 2 | BRG3210□□ | 1.7 |
| | **-150** | | | 150 | 123 | 90 | | | 1.9 |

1. Wrench included. Inserts must be ordered separately.

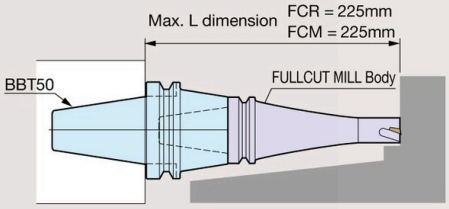
Inserts J6 Cutting conditions J7

## ■ Adapter

・An adapter for use of the BBT40 (FULLCUT MILL) on BBT50/BT50 machines.




| Model | L |
|---|---|
| **BBT50-BBT40-50** | 50 |
| **-90** | 90 |




Combination with the Long Type enables further workpiece interference countermeasures.

J ENDMILLING

INDEXABLE INSERT ENDMILL CUTTER

# FULLCUT MILL *FCR Type*

Cutter diameter: ø16 - ø32

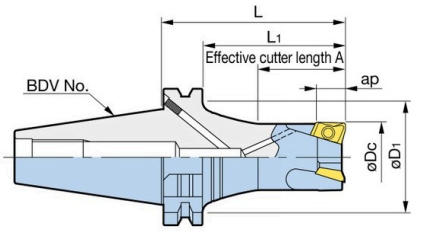
Evolved rigidity realizes both heavy and stable ramping.

## BDV Integrated Type

Slotting | Shoulder milling | Ramping | Helical milling | Peck-drilling

**[Standard Type]**

DUAL CONTACT BIG-PLUS®




BIG-PLUS (BDV Shank) tools can be used on both BIG-PLUS spindles and conventional **DV spindles**.

| Cutter diameter øDc | Model | Effective cutting edge length ap | øD1 | L | L1 | A | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | **BDV40-FCR16082- 85** | 8 | 52 | 85 | 65 | 25 | 2 | BRG1608□□ | 1.3 |
| | **-120** | | | 120 | 100 | 30 | | | 1.5 |
| | **-135** | | | 135 | 115 | 25 | | | 1.6 |
| 20 | **-FCR20083- 85** | 8 | 52 | 85 | 65 | 35 | 3 | BRG2008□□ | 1.2 |
| | **-120** | | | 120 | 100 | 30 | | | 1.6 |
| | **-135** | | | 135 | 115 | 30 | | | 1.7 |
| 25 | **-FCR25083- 85** | 8 | 52 | 85 | 65 | 40 | 3 | BRG2508□□ | 1.3 |
| | **-120** | | | 120 | 100 | 45 | | | 1.6 |
| | **-135** | | | 135 | 115 | 35 | | | 1.8 |
| 32 | **-FCR32103- 85** | 10 | 52 | 85 | 65 | 45 | 3 | BRG3210□□ | 1.4 |
| | **-120** | | | 120 | 100 | 50 | | | 1.7 |
| | **-135** | | | 135 | 115 | 40 | | | 1.9 |

1. Wrench included. Inserts must be ordered separately.

Inserts J6 Cutting conditions J7

INDEXABLE INSERT ENDMILL CUTTER

Cutter diameter: ø16 - ø32

# FULLCUT MILL FCR Type

## HSK Integrated Type

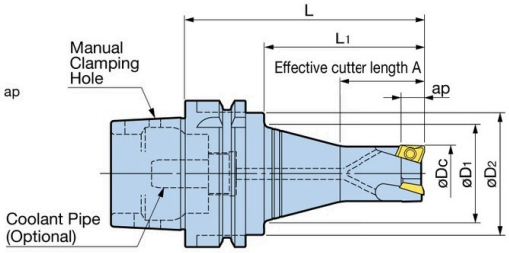
Slotting | Shoulder milling | Ramping | Helical milling | Peck-drilling

### [Standard Type]

● Model Description

HSK-A50 - FCR 16 08 2 - 75

- HSK SHANK No.
- FCR Type
- Cutter diameter øDc
- Effective cutting edge length ap
- Number of inserts
- L dimension




### A Type

| Cutter diameter øDc | Model | Effective cutting edge length ap | øD1 | øD2 | L | L1 | A | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 | HSK-A50-FCR16082- 75 | 8 | 32 | 40 | 75 | 41 | 27 | 2 | BRG1608□□ | 0.5 |
| 20 | -FCR20083- 75 | | | | 75 | 41 | 28 | 3 | BRG2008□□ | 0.6 |
| 25 | -FCR25083- 75 | | | | 75 | 41 | 33 | 3 | BRG2508□□ | 0.6 |
| 32 | -FCR32103- 75 | 10 | — | | 75 | 41 | 39 | 3 | BRG3210□□ | 0.7 |
| 16 | HSK-A63-FCR16082- 85 | 8 | 45 | 50 | 85 | 51 | 25 | 2 | BRG1608□□ | 0.9 |
| | -120 | | | | 120 | 86 | 30 | | | 1.1 |
| | -135 | | | | 135 | 101 | 25 | | | 1.2 |
| 20 | -FCR20083- 85 | 8 | 45 | 50 | 85 | 51 | 32 | 3 | BRG2008□□ | 1.0 |
| | -120 | | | | 120 | 86 | 30 | | | 1.2 |
| | -135 | | | | 135 | 101 | 30 | | | 1.3 |
| 25 | -FCR25083- 85 | 8 | 45 | 50 | 85 | 51 | 35 | 3 | BRG2508□□ | 1.0 |
| | -120 | | | | 120 | 86 | 45 | | | 1.2 |
| | -135 | | | | 135 | 101 | 35 | | | 1.4 |
| 32 | -FCR32103- 85 | 10 | 45 | 50 | 85 | 51 | 40 | 3 | BRG3210□□ | 1.1 |
| | -120 | | | | 120 | 86 | 50 | | | 1.4 |
| | -135 | | | | 135 | 101 | 40 | | | 1.5 |

1. Wrench included. Inserts must be ordered separately.
2. Coolant pipe is not included. J4

Inserts J6 Cutting conditions J7

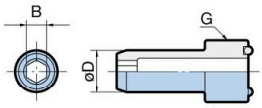
## Coolant Pipe

**Caution**

For machines capable of supplying coolant through the spindle, the Coolant Pipe should be fitted to all the holders to protect against accidental selection of coolant.

### [Mono Block Type]

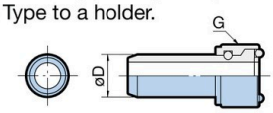
● Some machine tool builders may recommend the Mono Block Type. Check with the machine when selecting Mono Block or 1° Swing Type.




| Model | øD | G | ⬡B |
|---|---|---|---|
| HSK25-CP | 5 | M 8×P1 | 2.5 |
| HSK32-CP | 6 | M10×P1 | 3 |
| HSK40-CP | 8 | M12×P1 | 4 |
| HSK50-CP | 10 | M16×P1 | 5 |
| HSK63-CP | 12 | M18×P1 | 6 |

### [1° Swing Type]

● The DIN standards require movement range of ±1°. An exclusive wrench (optional) is required when attaching the 1° Swing Type to a holder.



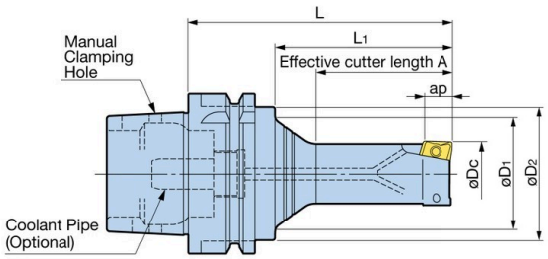

| Model | øD | G | Wrench Model (Optional) |
|---|---|---|---|
| HSK40-CPM | 8 | M12×P1 | CPW-40 |
| HSK50-CPM | 10 | M16×P1 | CPW-50 |
| HSK63-CPM | 12 | M18×P1 | CPW-63 |

INDEXABLE INSERT ENDMILL CUTTER

# FULLCUT MILL FCR Type

Cutter diameter: ø16 - ø33

**[Long Type]**




## A Type

| Cutter diameter øDc | Model | Effective cutting edge length ap | øD1 | øD2 | L | L1 | A | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 | **HSK-A63-FCR16082L- 85** | 8 | 45 | 50 | 85 | 51 | 40 | 2 | BRG1608□□ | 0.9 |
| | **-120** | | | | 120 | 86 | 45 | | | 1.0 |
| 20 | **-FCR20082L-105** | 8 | 45 | 50 | 105 | 71 | 50 | 2 | BRG2008□□ | 1.1 |
| | **-120** | | | | 120 | 86 | 60 | | | 1.2 |
| 25 | **-FCR25082L-105** | 8 | 45 | 50 | 105 | 71 | 55 | 2 | BRG2508□□ | 1.1 |
| | **-120** | | | | 120 | 86 | 65 | | | 1.1 |
| 32 | **-FCR32102L-120** | 10 | 45 | 50 | 120 | 86 | 70 | 2 | BRG3210□□ | 1.4 |
| | **-135** | | | | 135 | 101 | 80 | | | 1.4 |

1. Wrench included. Inserts must be ordered separately.
2. Coolant pipe is not included. J4

Inserts J6 Cutting conditions J7

## Cylindrical Shank Type

Slotting | Shoulder milling | Ramping | Helical milling | Peck-drilling

● Highly versatile Cylindrical Shank Type.
Make cutting easier by combining with the BIG MEGA DOUBLE POWER CHUCK!

We recommend the BIG MEGA DOUBLE POWER CHUCK for chucking.

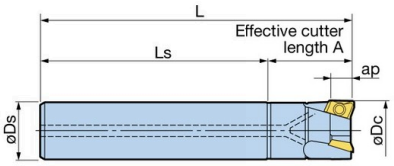
**[Oversize]**

Cutter diameter is **1mm** larger than shank diameter, preventing workpiece interference (except ST28).

● Model Description

ST15 - FCR 16 08 2 - 120

- 120: L dimension
- 2: Number of inserts
- 08: Effective cutting edge length ap
- 16: Cutter diameter øDc
- FCR: FCR Type
- ST15: Cylindrical shank diameter




| Cutter diameter øDc | Model | øDs | Effective cutting edge length ap | L | A | Ls | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | **ST15-FCR16082-120** | 15 | 8 | 120 | 25 | 95 | 2 | BRG1608□□ | 0.2 |
| 17 | **ST16-FCR17082-120** | 16 | 8 | 120 | 25 | 95 | 2 | BRG1608□□ | 0.2 |
| 20 | **ST19-FCR20082-165** | 19 | 8 | 165 | 30 | 135 | 2 | BRG2008□□ | 0.4 |
| | **-FCR20083-135** | | | 135 | | 105 | 3 | | 0.3 |
| 21 | **ST20-FCR21082-165** | 20 | 8 | 165 | 30 | 135 | 2 | BRG2008□□ | 0.4 |
| | **-FCR21083-135** | | | 135 | | 105 | 3 | | 0.3 |
| 25 | **ST24-FCR25082-180** | 24 | 8 | 180 | 35 | 145 | 2 | BRG2508□□ | 0.7 |
| | **-FCR25083-150** | | | 150 | | 115 | 3 | | 0.6 |
| 26 | **ST25-FCR26082-165** | 25 | 8 | 165 | 38 | 127 | 2 | BRG2508□□ | 0.6 |
| | **-FCR26083-150** | | | 150 | | 112 | 3 | | 0.6 |
| 32 | **ST28-FCR32102-180** | 28 | 10 | 180 | 48 | 132 | 2 | BRG3210□□ | 1.1 |
| | **-FCR32103-180** | | | 180 | | 132 | 3 | | 1.0 |
| 33 | **ST32-FCR33102-180** | 32 | 10 | 180 | 48 | 132 | 2 | BRG3210□□ | 1.1 |
| | **-FCR33103-180** | | | 180 | | 132 | 3 | | 1.0 |

1. Wrench included. Inserts must be ordered separately.
2. Lower the cutting parameters as needed for long projection length and 3 inserts models.
3. 2-insert models are recommended for medium or heavy milling of slots or pockets.
4. For medium or heavy slot milling or ramping with projection length exceeding 2.5 times the diameter, 2-insert models are recommended.

Inserts J6 Cutting conditions J7

## ■ Insert

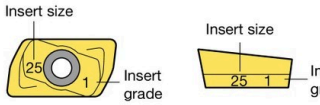
FCR Type exclusive

· Exclusive design with relief angles and rake angles optimized for each cutter size.

● Model Description

BRG16 | 08 | 08 | ACP300
- ACP300: Grade
- 08: Nose Radius
- 08: Effective cutting edge length: ø16 - 26...08 ø32 - 33...10
- BRG16

Insert Marking Description




1: ACZ310
2: DS20
P3: ACP300
3F: ACM300F

| Cutter diameter | Insert Model | Effective cutting edge length | Nose radius | Insert grade | | | |
|---|---|---|---|---|---|---|---|
| | | | | ACP300 (for steel) | ACM300F (for stainless steel) | ACZ310 (for cast iron) | DS20 (for aluminum) |
| ø16, ø17 | **BRG160808** | 8 | 0.8 | ○ | ○ | ○ | ○ |
| ø20, ø21 | **BRG200808** | 8 | | ○ | ○ | ○ | ○ |
| ø25, ø26 | **BRG250808** | 8 | | ○ | ○ | ○ | ○ |
| ø32, ø33 | **BRG321008** | 10 | | ○ | ○ | ○ | ○ |
| | **BRG321032** | 10 | 3.2 | – | – | – | ○ |

1. Inserts are available in packets of 10 pcs.
Please specify the insert model number and grade when ordering.

**Caution**

- Inserts are exclusive for each cutter diameter. Be sure to purchase an insert suited to the cutter diameter, as the use of a different insert may cause problems.
- Not compatible with inserts for FULLCUT MILL FCM Type.

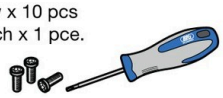
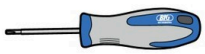
### Insert Grade Description

| ACP300 | ACM300F | ACZ310 |
|---|---|---|
| Material for general steel, with a super multi-layered PVD coating on a super-tough substrate. Excellent chipping and thermal fracture resistance allows interrupted cutting as well. | Uses a new coating with improved smoothness and adhesiveness on a newly developed ultra-hard carbide substrate. Excellent welding and chipping resistance, and capable of stable stainless steel machining. | Material for cast iron and ductile cast iron machining, with a PVD multilayer coating on an ultra-fine particle alloy substrate. Highly wear-resistant and also resistant to machine impact. |

| DS20 |
|---|
| Material for non-ferrous metals, with a special diamond coating (DLC) realizing high adhesion and low friction, on K20 class carbide. |

## ■ Insert Clamping Screw Set

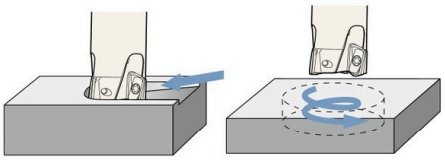
· Insert clamp screws and tightening wrench are consumables. Order periodically for replacement or spares.

| | | ● Insert Clamping Screw Set<br>Screw x 10 pcs<br>Wrench x 1 pce.  | ● Driver-Type Wrench  |
|---|---|---|---|
| Cutter diameter | Insert Model | Set Model | Wrench Model |
| ø16, ø17 | BRG1608□□ | **S2506DS** | **DA-T8** |
| ø20, ø21 | BRG2008□□ | | |
| ø25, ø26 | BRG2508□□ | | |
| ø32, ø33 | BRG3210□□ | **S3508DS** | **DA-T15** |

INDEXABLE INSERT ENDMILL CUTTER

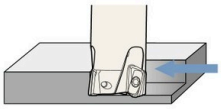
# FULLCUT MILL FCR Type

## Cutting Conditions



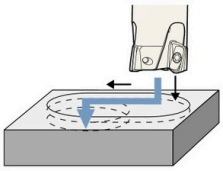
### Ramping/Helical Milling

| Cutter diameter | Material | Carbon Steel Alloy Steel | Unalloyed Steel | Pre-hardened Steel HRC40 or less | Stainless Steel | Tool Steel (SKD11) | Cast Iron | Aluminum |
|---|---|---|---|---|---|---|---|---|
| | Insert grade | ACP300 | | ACM300F | | | ACZ310 | DS20 |
| | Cutting fluid | Dry | | | | | | Dry/Wet |
| ø16 - ø17 | Cutting speed Vc (m/min) | 100 - 200 | 150 - 220 | 60 - 80 | 100 - 150 | 60 - 80 | 100 - 180 | 200 - 1,000 |
| | Feed rate fz (mm/t) | 0.06 - 0.12 | 0.06 - 0.12 | 0.05 - 0.08 | 0.08 - 0.16 | 0.06 - 0.1 | 0.08 - 0.18 | 0.06 - 0.24 |
| ø20 - ø26 | Cutting speed Vc (m/min) | 100 - 200 | 150 - 200 | 60 - 100 | 120 - 150 | 60 - 100 | 100 - 180 | 200 - 1,000 |
| | Feed rate fz (mm/t) | 0.08 - 0.2 | 0.08 - 0.2 | 0.05 - 0.1 | 0.12 - 0.2 | 0.06 - 0.1 | 0.02 - 0.18 | 0.1 - 0.35 |
| ø32 - ø33 | Cutting speed Vc (m/min) | 100 - 200 | 150 - 200 | 60 - 100 | 120 - 150 | 60 - 120 | 100 - 180 | 200 - 1,000 |
| | Feed rate fz (mm/t) | 0.08 - 0.2 | 0.08 - 0.2 | 0.05 - 0.1 | 0.12 - 0.2 | 0.08 - 0.12 | 0.06 - 0.2 | 0.1 - 0.35 |



### Shoulder Milling/Slotting

| Cutter diameter | Material | Carbon Steel Alloy Steel | Unalloyed Steel | Pre-hardened Steel HRC40 or less | Stainless Steel | Tool Steel (SKD11) | Cast Iron | Aluminum |
|---|---|---|---|---|---|---|---|---|
| | Insert grade | ACP300 | | ACM300F | | | ACZ310 | DS20 |
| | Cutting fluid | Dry | | | | | | Dry/Wet |
| ø16 - ø21 | Cutting speed Vc (m/min) | 100 - 200 | 100 - 200 | 60 - 80 | 120 - 180 | 80 - 120 | 100 - 180 | 200 - 1,000 |
| | Feed rate fz (mm/t) | 0.08 - 0.18 | 0.08 - 0.18 | 0.05 - 0.1 | 0.12 - 0.18 | 0.08 - 0.12 | 0.08 - 0.18 | 0.1 - 0.3 |
| ø25 - ø33 | Cutting speed Vc (m/min) | 100 - 200 | 100 - 200 | 60 - 100 | 120 - 180 | 80 - 120 | 100 - 180 | 200 - 1,500 |
| | Feed rate fz (mm/t) | 0.08 - 0.2 | 0.08 - 0.2 | 0.05 - 0.1 | 0.12 - 0.2 | 0.08 - 0.12 | 0.08 - 0.2 | 0.1 - 0.35 |



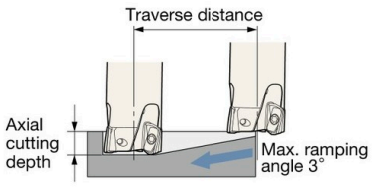
### Peck-drilling

| Cutter diameter | Material | Carbon Steel Alloy Steel | Unalloyed Steel | Pre-hardened Steel HRC40 or less | Stainless Steel | Tool Steel (SKD11) | Cast Iron | Aluminum |
|---|---|---|---|---|---|---|---|---|
| | Insert grade | ACP300 | | ACM300F | | | ACZ310 | DS20 |
| | Cutting fluid | Dry/Air Blow | | | | | | Air/Wet |
| ø16 - ø17 | Cutting speed Vc (m/min) | 80 - 120 | 80 - 120 | 60 | 80 - 120 | 60 - 80 | 80 - 160 | 200 - 350 |
| | Feed rate per rev. f (mm/rev) | 0.06 - 0.1 | 0.06 - 0.1 | 0.04 - 0.06 | 0.05 - 0.08 | 0.05 - 0.08 | 0.06 - 0.1 | 0.06 - 0.1 |
| ø20 - ø26 | Cutting speed Vc (m/min) | 100 - 160 | 100 - 160 | 60 - 100 | 100 - 160 | 60 - 100 | 80 - 180 | 200 - 500 |
| | Feed rate per rev. f (mm/rev) | 0.1 - 0.25 | 0.1 - 0.25 | 0.1 - 0.25 | 0.12 - 0.25 | 0.1 - 0.2 | 0.08 - 0.3 | 0.1 - 0.3 |
| ø32 - ø33 | Cutting speed Vc (m/min) | 100 - 160 | 100 - 160 | 60 - 100 | 100 - 160 | 60 - 100 | 80 - 180 | 200 - 600 |
| | Feed rate per rev. f (mm/rev) | 0.1 - 0.3 | 0.1 - 0.3 | 0.1 - 0.3 | 0.12 - 0.3 | 0.1 - 0.2 | 0.08 - 0.4 | 0.1 - 0.3 |

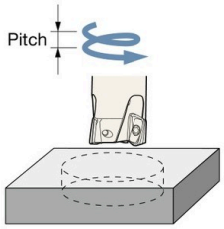
**Caution**

- This table is a guideline for selecting cutting parameters. Adjust them as needed according to the machine and workpiece conditions.
- Be sure to use safety enclosures, as chips may scatter.
- Do not use oil-based cutting fluid, as there is a risk of fire.
- Dry cutting is recommended for stainless steel as well; however, wet cutting may extend insert life in case severe built-up edge occurs.

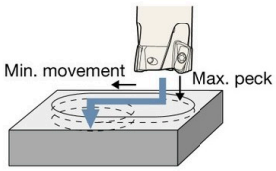
● Ramping




● Helical milling




● Peck-drilling




| Cutter diameter | Ramping | | Blind Hole Helical Milling | | | | Through Hole Helical Milling | | Peck-drilling | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Max. ramping angle | Min. traverse distance | Max. diameter | Max. pitch | Min. diameter | Max. pitch | Min. diameter | Max. pitch | Max. peck | Min. movement |
| ø16 | 3° | 153 | ø30 | 2.3 | ø27 | 1.8 | ø22 | 0.9 | 0.5 | 14 |
| ø17 | | | ø32 | 2.4 | ø29 | 1.9 | ø24 | 1.1 | | 15 |
| ø20 | | | ø38 | 2.9 | ø35 | 2.4 | ø29 | 1.4 | 1 | 18 |
| ø21 | | | ø40 | 3.1 | ø37 | 2.6 | ø31 | 1.6 | | 19 |
| ø25 | | | ø48 | 3.7 | ø45 | 3.2 | ø39 | 2.3 | | 23 |
| ø26 | | | ø50 | 3.9 | ø47 | 3.4 | ø41 | 2.4 | | 24 |
| ø32 | | 191 | ø62 | 4.9 | ø59 | 4.4 | ø48 | 2.6 | 2 | 30 |
| ø33 | | | ø64 | 5.1 | ø61 | 4.6 | ø50 | 2.7 | | 31 |

1. Helical milling values are the values when corner radius is R0.8.
2. Use a ramping angle of 3° or below for ramping and helical milling.
3. Minimum traverse distance values for ramping are the values at maximum ramping angle and maximum axial cutting depth. Maximum axial cutting depth values are the values at effective cutting edge length.

## Ramping calculation

$ap = L \times \tan\theta$

$L = \dfrac{ap}{\tan\theta}$

ap : Axial cutting depth [mm]
L : Traverse distance [mm]
$\theta$ : Ramping angle [°]

## Helical milling calculation

$P = Lc \times \tan\theta$

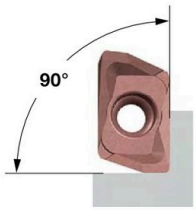
$Lc = \pi \times (D - Dc)$

P : Pitch [mm] $\theta$ : Ramping angle [°]
Lc : Circumference length of tool center trajectory [mm]
Dc : Cutter diameter [mm] D : Machining hole diameter [mm]

INDEXABLE INSERT ENDMILL CUTTER

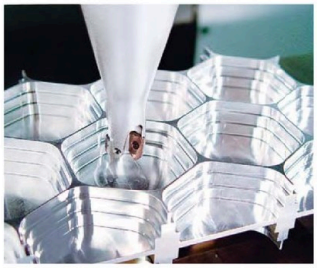
# FULLCUT MILL FCR Type

## APPLICATION EXAMPLES



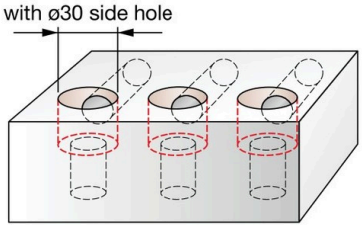

S50C helical machining was accomplished stably at 1,100mm/min feed, with excellent perpendicularity.

| FULLCUT MILL Model | **BBT40-FCR20083-120** |
|---|---|
| Insert Model | BRG200808 (ACP300) |
| Workpiece material | S50C/Air blow |
| Cutting speed Vc (m/min) | 150 |
| Feed Vf (mm/min) | 1,100 |
| Axial cutting depth ap (mm) | 2mm x 3 times |
| Machining hole diameter | ø38 |



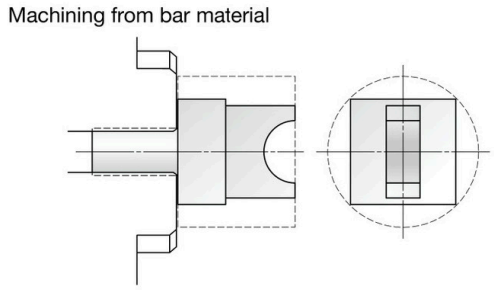

Even with less-rigid workpiece with 3mm bottom thickness clamped by a vise, machining at 4,300mm/min feed on both sides of the workpiece is achieved.

| FULLCUT MILL Model | **BBT40-FCR20083-85** |
|---|---|
| Insert Model | BRG200808 (DS20) |
| Workpiece material | A2017/Air blow |
| Cutting speed Vc (m/min) | 750 |
| Feed Vf (mm/min) | 4,300 |
| Axial cutting depth ap (mm) | 6mm x 3 times |
| Radial cutting depth ae (mm) | Max. 20 |



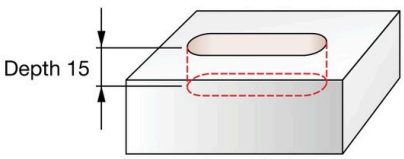

Side holes caused frequent machining defects with conventional ø30 drilling, while helical machining achieved excellent stability.
No problems with machining surface or steps either.

| FULLCUT MILL Model | **BBT40-FCR25083-85** |
|---|---|
| Insert Model | BRG250808 (ACP300) |
| Workpiece material | SS400/Dry cutting |
| Cutting speed Vc (m/min) | 160 |
| Feed Vf (mm/min) | 600 |
| Hole depth (mm) | 25 |




Even with less-rigid cantilever chucking of a workpiece on a millturn machine, low cutting resistance allowed high-precision, high-efficiency machining with no problems.

| FULLCUT MILL Model | **BBT40-FCR16082-85** |
|---|---|
| Insert Model | BRG160808 (ACP300) |
| Workpiece material | S45C/Dry cutting |
| Cutting speed Vc (m/min) | 160 |
| Feed Vf (mm/min) | 650 |
| Axial cutting depth ap (mm) | 2 |
| Radial cutting depth ae (mm) | 10 |




Excellent surface finish for indexable insert endmills, and no finishing required. No problems with steps either. Achieved 7 times greater cutting efficiency than conventional carbide drills and endmills.

| FULLCUT MILL Model | **BBT40-FCR20083-85** |
|---|---|
| Insert Model | BRG200808 (DS20) |
| Workpiece material | A2017/Wet cutting |
| Cutting speed Vc (m/min) | 350 |
| Feed Vf (mm/min) | 2,000 |
| Axial cutting depth ap (mm) | 5mm Peck-drilling |
| Radial cutting depth ae (mm) | 20 |

J

ENDMILLING

Indexable insert endmills which combine sharpness and toughness are comparable to solid endmills.

● Abundant variations from cylindrical shanks to DUAL CONTACT integrated types.

## BBT Integrated Type

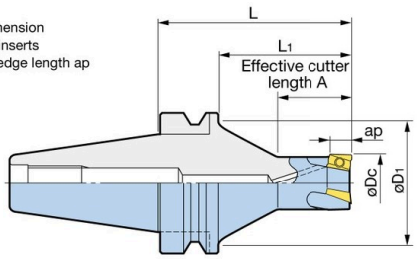
Slotting Shoulder milling

**[Standard Type]**

DUAL CONTACT BIG-PLUS®

● Model Description

BBT30 - FCM 16 09 2 - 65
- BBT30 - BIG-PLUS BT No.
- FCM - FCM Type
- 16 - Cutter diameter øDc
- 09 - Effective cutting edge length ap
- 2 - Number of inserts
- 65 - L dimension




BIG-PLUS (BBT Shank) tools can be used on both BIG-PLUS spindles and conventional **BT spindles**.

| Cutter diameter øDc | Model | Effective cutting edge length ap | øD1 | L | L1 | A | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | **BBT30-FCM16092- 65** | 9 | 40 | 65 | 43 | 23 | 2 | ARG1609□□ | 0.48 |
| 20 | **-FCM20093- 65** | | | | 43 | 28 | 3 | ARG2009□□ | 0.49 |
| 25 | **-FCM25093- 65** | | | | 43 | 33 | | ARG2509□□ | 0.52 |
| | **-105** NEW | | 42 | 105 | 83 | 34 | | | 0.72 |
| 32 | **-FCM32113- 65** | 11 | 40 | 65 | 43 | 38 | | ARG3211□□ | 0.56 |
| | **-105** NEW | | 42 | 105 | 83 | 44 | | | 0.83 |
| 40 | **-FCM40114- 50** | | – | 50 | 28 | 25 | 4 | ARG4011□□ | 0.54 |
| 50 | **-FCM50115- 50** | | | | | 28 | 5 | | 0.65 |
| 16 | **BBT40-FCM16092- 85** | 9 | 55 | 85 | 58 | 23 | 2 | ARG1609□□ | 1.2 |
| | **-105** | | 58 | 105 | 78 | 30 | | | 1.3 |
| | **-120** | | 60 | 120 | 93 | 25 | | | 1.4 |
| | **-150** | | | 150 | 123 | | | | 1.7 |
| 20 | **-FCM20093- 85** | 9 | 55 | 85 | 58 | 28 | 3 | ARG2009□□ | 1.2 |
| | **-105** | | 58 | 105 | 78 | 35 | | | 1.3 |
| | **-120** | | 60 | 120 | 93 | 30 | | | 1.4 |
| | **-150** | | | 150 | 123 | | | | 1.8 |
| 25 | **-FCM25093- 85** | 9 | 55 | 85 | 58 | 33 | 3 | ARG2509□□ | 1.2 |
| | **-120** | | 58 | 120 | 93 | 45 | | | 1.5 |
| | **-135** | | 60 | 135 | 108 | 40 | | | 1.6 |
| | **-165** | | | 165 | 138 | | | | 1.9 |
| 32 | **-FCM32113- 85** | 11 | 55 | 85 | 58 | 38 | 3 | ARG3211□□ | 1.3 |
| | **-120** | | 58 | 120 | 93 | 60 | | | 1.6 |
| | **-135** | | 60 | 135 | 108 | 50 | | | 1.7 |
| | **-165** | | | 165 | 138 | 40 | | | 2.2 |
| 40 | **-FCM40114- 85** | 11 | 55 | 85 | 58 | 43 | 4 | ARG4011□□ | 1.4 |
| | **-120** | | 58 | 120 | 93 | 65 | | | 1.8 |
| | **-135** | | 60 | 135 | 108 | 60 | | | 2.0 |
| | **-165** | | | 165 | 138 | 50 | | | 2.5 |
| 50 | **-FCM50115- 70** | 11 | – | 70 | 43 | 38 | 5 | | 1.4 |
| | **-120** | | 60 | 120 | 93 | 65 | | | 2.2 |
| | **-135** | | | 135 | 108 | 60 | | | 2.4 |
| | **-165** | | | 165 | 138 | 50 | | | 3.0 |

1. Wrench included. Inserts must be ordered separately.
2. For medium/heavy grooving exceeding L = 120mm at ø20 or L = 135mm at ø25 or more, we recommend the LONG TYPE (next page). In such cases, 2-flute LONG TYPEs can perform machining using several times greater axial cutting depth, achieving machining efficiency significantly higher than 3-flute models.

Inserts J18
Cutting conditions J19

INDEXABLE INSERT ENDMILL CUTTER

# FULLCUT MILL *FCM Type*

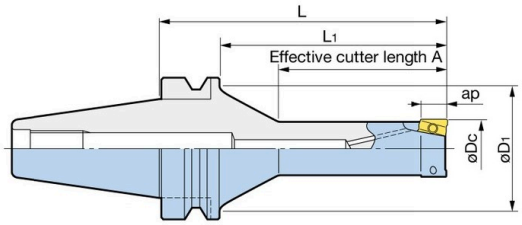
Cutter diameter: ø16 - ø32

## BBT Integrated Type

Slotting Shoulder milling

**[Long Type]**

DUAL CONTACT BIG-PLUS®




BIG-PLUS (BBT Shank) tools can be used on both BIG-PLUS spindles and conventional **BT spindles**.

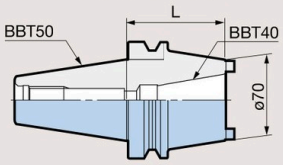
| Cutter diameter øDc | Model | Effective cutting edge length ap | øD1 | L | L1 | A | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | **BBT30-FCM16092L- 85** | 9 | 40 | 85 | 63 | 45 | 2 | ARG1609□□ | 0.5 |
| 20 | **-FCM20092L- 85** | | | | 63 | 50 | | ARG2009□□ | 0.54 |
| 25 | **-FCM25092L- 85** | | | | 63 | 50 | | ARG2509□□ | 0.6 |
| 32 | **-FCM32112L- 85** | 11 | | | 63 | 60 | | ARG3211□□ | 0.69 |
| 16 | **BBT40-FCM16092L-105** | 9 | 60 | 105 | 78 | 45 | 2 | ARG1609□□ | 1.3 |
| | **-120** | | | 120 | 93 | | | | 1.4 |
| 20 | **-FCM20092L-120** | 9 | 60 | 120 | 93 | 60 | 2 | ARG2009□□ | 1.4 |
| | **-135** | | | 135 | 108 | | | | 1.5 |
| 25 | **-FCM25092L-135** | 9 | 60 | 135 | 108 | 75 | 2 | ARG2509□□ | 1.5 |
| | **-150** | | | 150 | 123 | | | | 1.7 |
| 32 | **-FCM32112L-135** | 11 | 60 | 135 | 108 | 80 | 2 | ARG3211□□ | 1.7 |
| | **-150** | | | 150 | 123 | 90 | | | 1.9 |

1. Wrench included. Inserts must be ordered separately.

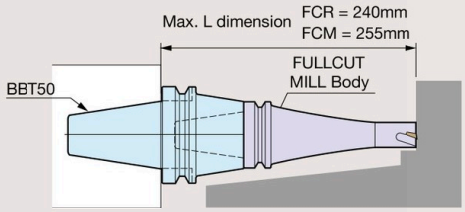
Inserts J18 Cutting conditions J19

## ■ Adapter

・An adapter for use of the BBT40 (FULLCUT MILL) on BBT50/BT50 machines.




| Model | L |
|---|---|
| **BBT50-BBT40-50** | 50 |
| **-90** | 90 |



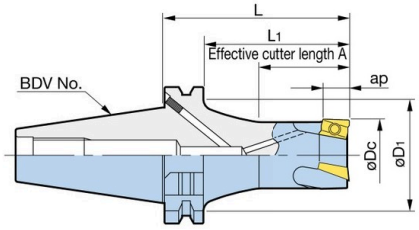

Combination with the Long Type enables further workpiece interference countermeasures.

J ENDMILLING

## BDV Integrated Type

**[Standard Type]**

DUAL CONTACT
BIG-PLUS®




BIG-PLUS (BDV Shank) tools can be used on both BIG-PLUS spindles and conventional **DV spindles**.

| Cutter diameter øDc | Model | Effective cutting edge length ap | øD1 | L | L1 | A | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | **BDV40-FCM16092- 85** | 9 | 52 | 85 | 65 | 23 | 2 | ARG1609□□ | 1.2 |
| | **-105** | | | 105 | 85 | 35 | | | 1.3 |
| | **-120** | | | 120 | 100 | 34 | | | 1.4 |
| 20 | **-FCM20093- 85** | 9 | 52 | 85 | 65 | 35 | 3 | ARG2009□□ | 1.2 |
| | **-105** | | | 105 | 85 | 40 | | | 1.3 |
| | **-120** | | | 120 | 100 | 39 | | | 1.4 |
| 25 | **-FCM25093- 85** | 9 | 52 | 85 | 65 | 33 | 3 | ARG2509□□ | 1.2 |
| | **-120** | | | 120 | 100 | 45 | | | 1.4 |
| | **-135** | | | 135 | 115 | 40 | | | 1.6 |
| 32 | **-FCM32113- 85** | 11 | 52 | 85 | 65 | 38 | 3 | ARG3211□□ | 1.3 |
| | **-120** | | | 120 | 100 | 60 | | | 1.5 |
| | **-135** | | | 135 | 115 | 50 | | | 1.7 |
| 40 | **-FCM40114- 85** | 11 | 52 | 85 | 65 | 45 | 4 | ARG4011□□ | 1.4 |
| | **-120** | | | 120 | 100 | 65 | | | 1.7 |
| | **-135** | | | 135 | 115 | 60 | | | 2.0 |
| 50 | **-FCM50115- 70** | 11 | 52 | 70 | 50 | 50 | 5 | ARG4011□□ | 1.5 |
| | **-120** | | | 120 | 100 | 100 | | | 2.2 |
| | **-135** | | | 135 | 115 | 115 | | | 2.4 |

1. Wrench included. Inserts must be ordered separately.

Inserts J18 Cutting conditions J19

INDEXABLE INSERT ENDMILL CUTTER

# FULLCUT MILL FCM Type

Cutter diameter: ø16 - ø50

## HSK Integrated Type

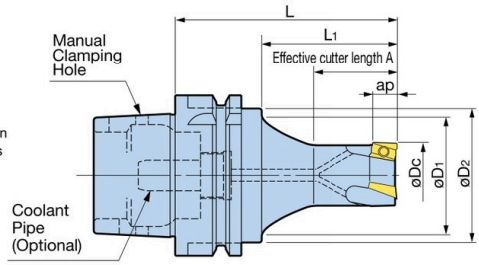
Slotting Shoulder milling

**[Standard Type]** (HSK-A)

● Model Description

HSK-A40 - FCM 16 09 2 - 65

- HSK SHANK No.
- FCM Type
- Cutter diameter øDc
- Effective cutting edge length ap
- Number of inserts
- L dimension




### A Type

| Cutter diameter øDc | Model | Effective cutting edge length ap | øD1 | øD2 | L | L1 | A | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 | HSK-A40-FCM16092- 65 | 9 | 25 | 34 | 65 | 37 | 23 | 2 | ARG1609□□ | 0.28 |
| 20 | -FCM20093- 65 | | | | | | 28 | 3 | ARG2009□□ | 0.3 |
| 25 | -FCM25093- 65 | | – | | | | 35 | | ARG2509□□ | 0.34 |
| 32 | -FCM32113- 65 | 11 | | | | | | | ARG3211□□ | 0.39 |
| 40 | -FCM40114- 65 | | | – | | – | 45 | 4 | ARG4011□□ | 0.47 |
| 50 | -FCM50115- 65 | | | | | | | 5 | | 0.59 |
| 16 | HSK-A50-FCM16092- 75 | 9 | 32 | 40 | 75 | 41 | 23 | 2 | ARG1609□□ | 0.6 |
| 20 | -FCM20093- 75 | | | | | | 28 | 3 | ARG2009□□ | 0.6 |
| 25 | -FCM25093- 75 | | | | | | 33 | | ARG2509□□ | 0.6 |
| 32 | -FCM32113- 75 | 11 | – | | | | 39 | | ARG3211□□ | 0.7 |
| 40 | -FCM40114- 75 | | | – | | – | 48 | 4 | ARG4011□□ | 0.9 |
| 50 | -FCM50115- 75 | | | | | | | 5 | | 1.0 |
| 16 | HSK-A63-FCM16092- 85 | 9 | 45 | 50 | 85 | 51 | 23 | 2 | ARG1609□□ | 0.9 |
| | -105 | | | | 105 | 71 | 30 | | | 1.0 |
| | -120 | | | | 120 | 86 | 25 | | | 1.1 |
| | -150 | | | | 150 | 116 | 25 | | | 1.3 |
| 20 | -FCM20093- 85 | 9 | 45 | 50 | 85 | 51 | 28 | 3 | ARG2009□□ | 1.0 |
| | -105 | | | | 105 | 71 | 35 | | | 1.1 |
| | -120 | | | | 120 | 86 | 30 | | | 1.2 |
| | -150 | | | | 150 | 116 | 30 | | | 1.4 |
| 25 | -FCM25093- 85 | 9 | 45 | 50 | 85 | 51 | 33 | 3 | ARG2509□□ | 1.0 |
| | -120 | | | | 120 | 86 | 45 | | | 1.2 |
| | -135 | | | | 135 | 101 | 40 | | | 1.3 |
| | -165 | | | | 165 | 131 | 40 | | | 1.5 |
| 32 | -FCM32113- 85 | 11 | 45 | 50 | 85 | 51 | 38 | 3 | ARG3211□□ | 1.1 |
| | -120 | | | | 120 | 86 | 60 | | | 1.3 |
| | -135 | | | | 135 | 101 | 50 | | | 1.4 |
| | -165 | | | | 165 | 131 | 40 | | | 1.7 |
| 40 | -FCM40114- 85 | 11 | 45 | 50 | 85 | 51 | 43 | 4 | ARG4011□□ | 1.3 |
| | -120 | | | | 120 | 86 | 65 | | | 1.5 |
| | -135 | | | | 135 | 101 | 60 | | | 1.7 |
| | -165 | | | | 165 | 131 | 50 | | | 2.1 |
| 50 | -FCM50115- 70 | 11 | – | 53 | 70 | 28 | 28 | 5 | ARG4011□□ | 1.3 |
| | -120 | | | | 120 | 78 | 78 | | | 1.9 |
| | -135 | | | | 135 | 93 | 93 | | | 2.2 |
| | -165 | | | | 165 | 123 | 123 | | | 2.8 |

1. Wrench included. Inserts must be ordered separately.
2. Coolant pipe is not included. See page J4

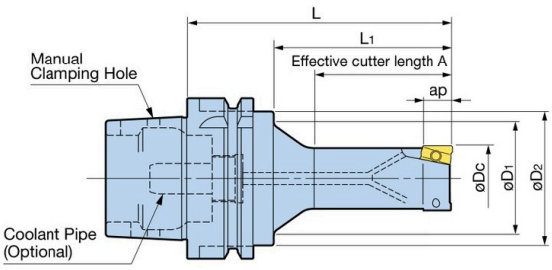
Inserts J18
Cutting conditions J19

J ENDMILLING

## HSK Integrated Type

Slotting Shoulder milling

### [Long Type] (HSK-A)




### A Type

| Cutter diameter øDc | Model | Effective cutting edge length ap | øD1 | øD2 | L | L1 | A | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 | HSK-A63-FCM16092L- 85 | 9 | 45 | 50 | 85 | 51 | 40 | 2 | ARG1609□□ | 0.9 |
| | -120 | | | | 120 | 86 | 45 | | | 1.0 |
| 20 | -FCM20092L-105 | 9 | 45 | 50 | 105 | 71 | 50 | 2 | ARG2009□□ | 1.1 |
| | -120 | | | | 120 | 86 | 60 | | | 1.2 |
| 25 | -FCM25092L-105 | 9 | 45 | 50 | 105 | 71 | 55 | 2 | ARG2509□□ | 1.1 |
| | -120 | | | | 120 | 86 | 65 | | | 1.2 |
| 32 | -FCM32112L-120 | 11 | 45 | 50 | 120 | 86 | 70 | 2 | ARG3211□□ | 1.3 |
| | -135 | | | | 135 | 101 | 80 | | | 1.4 |

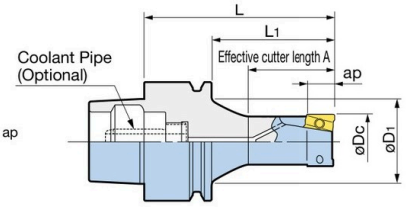
1. Wrench included. Inserts must be ordered separately.
2. Coolant pipe is not included. See page J4

Inserts J18 Cutting conditions J19

### [Standard Type] (HSK-E)

● Model Description

HSK-E25 - FCM 16 09 2 - 45
- 45: L dimension
- 2: Number of inserts
- 09: Effective cutting edge length ap
- 16: Cutter diameter ø16
- FCM: FCM Type
- HSK-E25: HSK-E SHANK No.




### E Type

| Cutter diameter øDc | Model | Effective cutting edge length ap | øD1 | L | L1 | A | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | HSK-E25-FCM16092-45 | 9 | 19 | 45 | 35 | 23 | 2 | ARG1609□□ | 0.08 |
| | -E32-FCM16092-55 | | 26 | 55 | 35 | 23 | | | 0.17 |
| | -E40-FCM16092-65 | | 34 | 65 | 45 | 28 | | | 0.27 |

1. Wrench included. Inserts must be ordered separately.
2. Coolant pipe is not included. See page J4

Inserts J18 Cutting conditions J19

**Caution**

As the HSK-E type interface does not have drive key grooves, there is a risk that it may slip in the machine spindle and damage it if cutting load exceeds clamping force of the machine tool. Starting from the lowest possible conditions, increase them gradually while observing the cutting status, and find the optimum with sufficient safety margin.

INDEXABLE INSERT ENDMILL CUTTER

# FULLCUT MILL FCM Type

Cutter diameter: ø16 - ø50

## BIG CAPTO Integrated Type

Slotting Shoulder milling

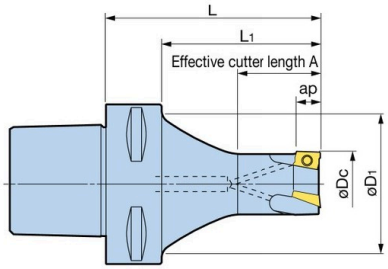


**[Standard Type]**

● Model Description

C5 - FCM 16 09 2 - 65

- 65: L dimension
- 2: Number of inserts
- 09: Effective cutting edge length ap
- 16: Cutter diameter øDc
- FCM: FCM Type
- C5: Shank No.




## C5/C6

| Cutter diameter øDc | Model | Effective cutting edge length ap | øD1 | L | L1 | A | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | C5-FCM16092 - 65 | 9 | 40 | 65 | 45 | 23 | 2 | ARG1609□□ | 0.5 |
| | - 90 | | 44 | 90 | 70 | 30 | | | 0.6 |
| 20 | -FCM20093 - 65 | 9 | 40 | 65 | 45 | 28 | 3 | ARG2009□□ | 0.5 |
| | - 90 | | 44 | 90 | 70 | 35 | | | 0.6 |
| 25 | -FCM25093 - 65 | 9 | 40 | 65 | 45 | 33 | 3 | ARG2509□□ | 0.6 |
| | - 90 | | 44 | 90 | 70 | 40 | | | 0.7 |
| 32 | -FCM32113 - 65 | 11 | 40 | 65 | 45 | 38 | 3 | ARG3211□□ | 0.6 |
| | - 90 | | 44 | 90 | 70 | 45 | | | 0.8 |
| 40 | -FCM40114 - 50 | 11 | — | 50 | 30 | 25 | 4 | ARG4011□□ | 0.6 |
| | - 90 | | 46 | 90 | 70 | 60 | | | 1.0 |
| 50 | -FCM50115 - 50 | 11 | — | 50 | 30 | 25 | 5 | | 0.7 |
| | - 90 | | | 90 | 70 | 65 | | | 1.0 |
| 16 | C6-FCM16092 - 85 NEW | 9 | 58 | 85 | 63 | 24 | 2 | ARG1609□□ | 1.1 |
| | -110 NEW | | | 110 | 88 | 30 | | | 1.2 |
| | -135 NEW | | 60 | 135 | 113 | 27 | | | 1.3 |
| 20 | -FCM20093 - 85 NEW | 9 | 58 | 85 | 63 | 28 | 3 | ARG2009□□ | 1.1 |
| | -110 NEW | | | 110 | 88 | 34 | | | 1.2 |
| | -135 NEW | | 60 | 135 | 113 | 32 | | | 1.4 |
| 25 | -FCM25093 - 85 NEW | 9 | 58 | 85 | 63 | 33 | 3 | ARG2509□□ | 1.1 |
| | -110 NEW | | | 110 | 88 | 47 | | | 1.2 |
| | -135 NEW | | 60 | 135 | 113 | 44 | | | 1.4 |
| 32 | -FCM32113 - 85 NEW | 11 | 58 | 85 | 63 | 38 | 3 | ARG3211□□ | 1.2 |
| | -110 NEW | | | 110 | 88 | 61 | | | 1.4 |
| | -135 NEW | | 60 | 135 | 113 | 54 | | | 1.6 |
| 40 | -FCM40114 - 85 NEW | 11 | 58 | 85 | 63 | 44 | 4 | ARG4011□□ | 1.4 |
| | -110 NEW | | | 110 | 88 | 65 | | | 1.6 |
| | -135 NEW | | 60 | 135 | 113 | 61 | | | 2.0 |
| 50 | -FCM50115 - 70 NEW | 11 | 59 | 70 | 48 | 43 | 5 | | 1.5 |
| | -110 NEW | | 60 | 110 | 88 | 70 | | | 2.0 |
| | -135 NEW | | | 135 | 113 | 72 | | | 2.4 |

1. Wrench included. Inserts must be ordered separately.

Inserts J18 Cutting conditions J19

J ENDMILLING

INDEXABLE INSERT ENDMILL CUTTER

# FULLCUT MILL FCM Type

Cutter diameter: ø12 - ø50

## Cylindrical Shank Type

Slotting Shoulder milling

We recommend the BIG MEGA DOUBLE POWER CHUCK for chucking.

●Highly versatile Cylindrical Shank Type.
Make cutting easier by combining with the BIG MEGA DOUBLE POWER CHUCK!

Cutter diameter from ø12 -

● Model Description

ST16 - FCM 12 09 1 - 90

- 90: L dimension
- 1: Number of inserts
- 09: Effective cutting edge length ap
- 12: Cutter diameter øDc
- FCM: FCM Type
- ST16: Cylindrical shank diameter

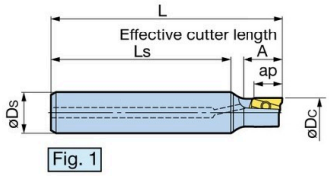



Fig. 1

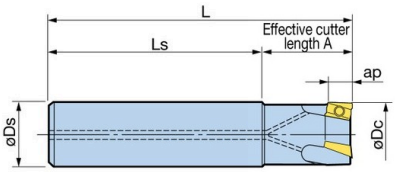



Fig. 2

| Cutter diameter øDc | Model | Fig. | øDs | Effective cutting edge length ap | L | A | Ls | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| 12 | **ST16-FCM12091- 90** | 1 | 16 | 9 | 90 | 15 | 70 | 1 | ARG1609□□ | 0.1 |
| 14 | **-FCM14091- 90** | | | | | 17 | | | | 0.1 |
| 16 | **-FCM16092- 90** | 2 | | | | 25 | 65 | 2 | | 0.1 |
| 20 | **ST20-FCM20093-110** | | 20 | | 110 | 30 | 80 | 3 | ARG2009□□ | 0.2 |
| 25 | **ST25-FCM25093-120** | | 25 | | 120 | 35 | 85 | | ARG2509□□ | 0.4 |
| 32 | **ST32-FCM32113-130** | | 32 | 11 | 130 | 35 | 95 | 3 | ARG3211□□ | 0.7 |
| 40 | **-FCM40114-130** | | | | | 40 | 90 | 4 | ARG4011□□ | 0.8 |
| | **-180** | | | | 180 | | 140 | | | 1.2 |
| 50 | **-FCM50115-130** | | | | 130 | | 90 | 5 | | 1.0 |

1. Wrench included. Inserts must be ordered separately.

Inserts J18 Cutting conditions J19

INDEXABLE INSERT ENDMILL CUTTER

# FULLCUT MILL FCM Type

Cutter diameter: ø16 - ø33

## Cylindrical Shank Type

Slotting Shoulder milling

We recommend the BIG MEGA DOUBLE POWER CHUCK for chucking.

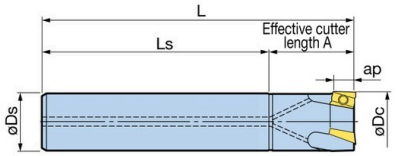
**[Oversize]**

Cutter diameter is **1mm** larger than shank diameter, preventing workpiece interference.

● Model Description

ST15 - FCM 16 09 2 - 120

- ST15: Cylindrical shank diameter
- FCM: FCM Type
- 16: Cutter diameter øDc
- 09: Effective cutting edge length ap
- 2: Number of inserts
- 120: L dimension




| Cutter diameter øDc | Model | øDs | Effective cutting edge length ap | L | A | Ls | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|
| 16 | **ST15-FCM16092-120** | 15 | 9 | 120 | 25 | 95 | 2 | ARG1609□□ | 0.2 |
| 17 | **ST16-FCM17092-120** | 16 | 9 | 120 | 25 | 95 | 2 | ARG1609□□ | 0.2 |
| 20 | **ST19-FCM20092-165** | 19 | 9 | 165 | 30 | 135 | 2 | ARG2009□□ | 0.4 |
| | **-FCM20093-135** | | | 135 | | 105 | 3 | | 0.3 |
| 21 | **ST20-FCM21092-165** | 20 | 9 | 165 | 30 | 135 | 2 | ARG2009□□ | 0.4 |
| | **-FCM21093-135** | | | 135 | | 105 | 3 | | 0.3 |
| 25 | **ST24-FCM25092-180** | 24 | 9 | 180 | 35 | 145 | 2 | ARG2509□□ | 0.7 |
| | **-FCM25093-150** | | | 150 | | 115 | 3 | | 0.6 |
| 26 | **ST25-FCM26092-165** | 25 | 9 | 165 | 38 | 127 | 2 | ARG2509□□ | 0.6 |
| | **-FCM26093-150** | | | 150 | | 112 | 3 | | 0.6 |
| 32 | **ST28-FCM32112-180** | 28 | 11 | 180 | 48 | 132 | 2 | ARG3211□□ | 1.1 |
| | **-FCM32113-180** | | | | | | 3 | | 1.0 |
| 33 | **ST32-FCM33112-180** | 32 | 11 | 180 | 48 | 132 | 2 | ARG3211□□ | 1.1 |
| | **-FCM33113-180** | | | | | | 3 | | 1.0 |

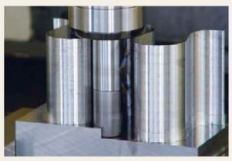
1. Wrench included. Inserts must be ordered separately.
2. We recommend 2-flute models for medium/heavy grooving.
3. For medium or heavy slot milling with projection length exceeding 2.5 times the diameter, 2-insert models are recommended.

Inserts J18 Cutting conditions J19

### Machining of S55C

| Model | ST32-FCM33112-180 |
|---|---|
| Cutting speed Vc (m/min) | 120 |
| Feed rate fz (mm/t) | 0.1 |

| Axial DOC ap (mm) | 10mm x 10 steps |
|---|---|
| Radial DOC ae (mm) | Max. 33mm |



**Result** Machining was problem-free even under heavy cutting conditions of projection 110mm and ap 10mm.

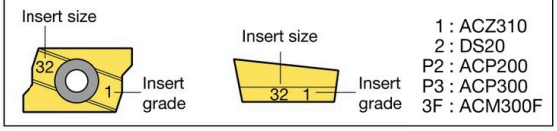
## ■ Insert

FCM Type exclusive

● Model Description

ARG16 | 09 | 02 | ACP300
- ACP300 ● Grade
- 02 ● Nose Radius
- 09 ● Effective cutting edge length: ø12 - 26...09 ø32 - 50...11
- ARG16

Insert Marking Description




| Cutter diameter | Insert Model | Effective cutting edge length | Nose radius | Insert grade | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | ACP300 (for steel) | ACP200 (for pre-hardened steel) | ACM300F (for stainless steel) | ACZ310 (for cast iron) | DS20 (for aluminum) |
| ø12 - ø17 | **ARG160902** | 9 | 0.2 | ○ | – | ○ | ○ | ○ |
| | **160904** | | 0.4 | ○ | ○ | ○ | ○ | ○ |
| ø20, ø21 | **ARG200902** | 9 | 0.2 | ○ | – | ○ | ○ | ○ |
| | **200904** | | 0.4 | ○ | ○ | ○ | ○ | ○ |
| ø25, ø26 | **ARG250902** | 9 | 0.2 | ○ | – | ○ | ○ | ○ |
| | **250904** | | 0.4 | ○ | ○ | ○ | ○ | ○ |
| ø32, ø33 | **ARG321102** | 11 | 0.2 | ○ | – | ○ | ○ | ○ |
| | **321104** | | 0.4 | ○ | ○ | ○ | ○ | ○ |
| ø40, ø50 | **ARG401102** | 11 | 0.2 | ○ | – | ○ | ○ | ○ |
| | **401104** | | 0.4 | ○ | ○ | ○ | ○ | ○ |

1. Inserts are available in packets of 10 pcs.
Please specify the insert model number and grade when ordering.

**Caution**

- Inserts are exclusive for each cutter diameter. Be sure to purchase an insert suited to the cutter diameter, as the use of a non-compatible insert may cause problems.
- Not compatible with inserts for FULLCUT MILL FCR Type.
- Insert with nose radius 0.2 is for light cutting.

### Insert Grade Description

| ACP300 | ACP200 | ACM300F | ACZ310 |
|---|---|---|---|
| Material for general steel, with a PVD multilayer coating on an ultra-tough substrate. Excellent chipping and thermal fracture resistance allows interrupted cutting as well. | With multilayers of nano-order TiAlN and AlCrN on a high-hardness base, it has superior wear resistance in pre-hardened steel machining. | Uses a new coating with improved smoothness and adhesiveness on a newly developed ultrahard carbide substrate. Excellent welding and chipping resistance, and capable of stable stainless steel machining. | Material for cast iron and ductile cast iron machining, with a PVD multilayer coating on an ultra-fine particle alloy substrate. Highly wear-resistant and also resistant to machine impact. |

| DS20 |
|---|
| Material for non-ferrous metals, with a special diamond coating (DLC) realizing high adhesion and low friction, on K20 class carbide. |

**Both ACP300 and ACP200 can be used for steel machining**

ACP200 has excellent wear resistance, while ACP300 has superb chipping resistance. For steel machining, we recommend ACP300 the most highly. ACP300 provides stable machining, but for even higher speeds or when wear resistance is required, use ACP200. Note that ACP200 is not recommended for heavy interrupted cutting or heavy cutting.

## ■ Insert Clamping Screw Set

・Insert clamp screw and tightening wrench are consumables. Order periodically for replacement or spares.

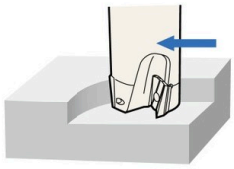
| | | ● Insert Clamping Screw Set<br>Screw x 10 pcs<br>Wrench x 1 pce. | ● Driver-Type Wrench |
|---|---|---|---|
| Cutter diameter | Insert Model | Set Model | Wrench Model |
| ø12 | ARG1609□□ | **S2505DS** | **DA-T8** |
| ø14, ø16, ø17 | | **S2506DS** | |
| ø20, ø21 | ARG2009□□ | | |
| ø25, ø26 | ARG2509□□ | | |
| ø32, ø33 | ARG3211□□ | **S3508DS** | **DA-T15** |
| ø40 | ARG4011□□ | | |
| ø50 | | | |

INDEXABLE INSERT ENDMILL CUTTER

# FULLCUT MILL FCM Type

## Cutting Conditions

### Shoulder Milling/Slotting



**Caution**

- FULLCUT MILL FCM Type cannot be used for machining with Z-direction tool feed, such as ramping or drilling.

### Light to medium cutting

| Cutter diameter | Material | Carbon Steel Alloy Steel | Unalloyed Steel | Pre-hardened Steel HRC40 or less | Stainless Steel | Cast Iron | Aluminum |
|---|---|---|---|---|---|---|---|
| | Insert grade | ACP300 | | ACP200 | ACM300F | ACZ310 | DS20 |
| | Cutting fluid | Dry | | | | | Dry/Wet |
| ø12 - ø14 | Cutting speed Vc (m/min) | 150 - 250 | 180 - 250 | 80 - 140 | 140 - 180 | 100 - 200 | 200 - 750 |
| | Feed rate fz (mm/t) | 0.1 - 0.2 | 0.1 - 0.2 | 0.08 - 0.12 | 0.12 - 0.18 | 0.1 - 0.2 | 0.10 - 0.3 |
| ø16 - ø21 | Cutting speed Vc (m/min) | 150 - 250 | 180 - 250 | 80 - 140 | 140 - 180 | 100 - 200 | 200 - 1,000 |
| | Feed rate fz (mm/t) | 0.1 - 0.2 | 0.1 - 0.2 | 0.08 - 0.12 | 0.12 - 0.18 | 0.1 - 0.2 | 0.10 - 0.3 |
| ø25 - ø33 | Cutting speed Vc (m/min) | 180 - 280 | 200 - 280 | 80 - 140 | 140 - 200 | 100 - 200 | 200 - 1,500 |
| | Feed rate fz (mm/t) | 0.1 - 0.24 | 0.1 - 0.22 | 0.08 - 0.14 | 0.12 - 0.2 | 0.1 - 0.2 | 0.10 - 0.35 |
| ø40 - ø50 | Cutting speed Vc (m/min) | 180 - 280 | 200 - 280 | 80 - 140 | 140 - 200 | 80 - 200 | 200 - 1,500 |
| | Feed rate fz (mm/t) | 0.1 - 0.24 | 0.1 - 0.22 | 0.08 - 0.14 | 0.12 - 0.2 | 0.1 - 0.2 | 0.10 - 0.35 |

### Heavy interrupted cutting/Heavy cutting

| Cutter diameter | Material | Carbon Steel Alloy Steel | Unalloyed Steel | Stainless Steel | Cast Iron | Aluminum |
|---|---|---|---|---|---|---|
| | Insert grade | ACP300 | | ACM300F | ACZ310 | DS20 |
| | Cutting fluid | Dry | | | | Dry/Wet |
| ø12 - ø14 | Cutting speed Vc (m/min) | 100 - 200 | 150 - 200 | 120 - 180 | 100 - 180 | 200 - 750 |
| | Feed rate fz (mm/t) | 0.08 - 0.14 | 0.1 - 0.15 | 0.12 - 0.15 | 0.08 - 0.18 | 0.10 - 0.2 |
| ø16 - ø21 | Cutting speed Vc (m/min) | 100 - 200 | 150 - 200 | 120 - 180 | 100 - 180 | 200 - 1,000 |
| | Feed rate fz (mm/t) | 0.08 - 0.14 | 0.1 - 0.15 | 0.12 - 0.15 | 0.08 - 0.18 | 0.10 - 0.2 |
| ø25 - ø33 | Cutting speed Vc (m/min) | 100 - 200 | 160 - 220 | 120 - 180 | 100 - 200 | 200 - 1,500 |
| | Feed rate fz (mm/t) | 0.1 - 0.16 | 0.1 - 0.15 | 0.12 - 0.15 | 0.08 - 0.2 | 0.10 - 0.3 |
| ø40 - ø50 | Cutting speed Vc (m/min) | 100 - 200 | 160 - 220 | 120 - 180 | 100 - 220 | 200 - 1,500 |
| | Feed rate fz (mm/t) | 0.1 - 0.16 | 0.1 - 0.15 | 0.12 - 0.15 | 0.08 - 0.2 | 0.10 - 0.3 |

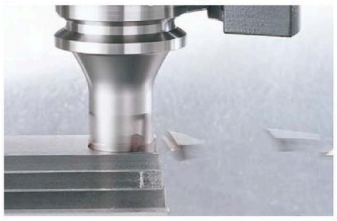
**Caution**

- As the nose radius 0.2 insert is for light cutting, pay attention to the axial and radial cutting depth and the feed rate.
- This table is a guideline for selecting cutting parameters. Adjust them as needed according to the machine and workpiece conditions, considering the cutting width as well.
- For the oversize type, we recommend 2-flute models for medium/heavy slotting.
- Dry (or air blow) cutting is recommended for steel machining, except finishing. Dry cutting is recommended for stainless steel as well; however, wet cutting may extend insert life in case severe built-up edge occurs.

## APPLICATION EXAMPLES

※ All the following examples are dry cutting.

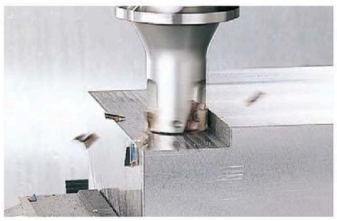
### Slotting



Only the FULLCUT MILL was able to achieve these parameters on a BT40 machine.

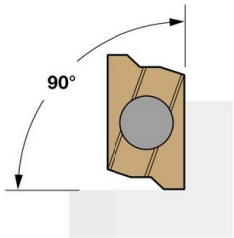
| FULLCUT MILL Model | **BBT40-FCM32113-85** |
|---|---|
| Insert Model | ARG321104 (ACP300) |
| Workpiece material | S50C |
| Cutting speed Vc (m/min) | 150 |
| Feed rate fz (mm/t) | 0.12 |
| Axial DOC ap (mm) | 9 |

### Shoulder Milling



Excellent perpendicularity was achieved.

| FULLCUT MILL Model | **BBT40-FCM32113-85** |
|---|---|
| Insert Model | ARG321104 (ACP300) |
| Workpiece material | S50C |
| Cutting speed Vc (m/min) | 200 |
| Feed rate fz (mm/t) | 0.15 |
| Axial DOC ap (mm) | 11 |
| Radial DOC ae (mm) | 5 |




### Face Milling

Even at Vc = 200 and fz = 0.15, finishing surface roughness of Rz = 2.53 was achieved.

| FULLCUT MILL Model | **BBT40-FCM50115-70** |
|---|---|
| Insert Model | ARG401104 (ACP300) |
| Workpiece material | S50C |
| Cutting speed Vc (m/min) | 200 |
| Feed rate fz (mm/t) | 0.15 |
| Axial DOC ap (mm) | 1 |
| Radial DOC ae (mm) | 30 |

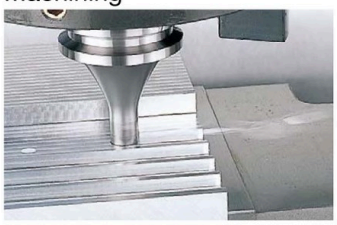
| | Bottom surface roughness Rz |
|---|---|
| BIG | 2.53 |
| General Cutter A | 3.75 |
| General Cutter B | 4.32 |

### Difficult-to-Cut Material Machining

High-efficiency machining with SUS304 (feed Vf = 1,140mm/min) was achieved stably.

| FULLCUT MILL Model | **ST25-FCM25093-120** |
|---|---|
| Holder Model | BBT50-MEGA25D-105 |
| Insert Model | ARG250904 (ACM300F) |
| Workpiece material | SUS304 |
| Cutting speed Vc (m/min) | 150 |
| Feed rate fz (mm/t) | 0.2 |
| Axial DOC ap (mm) | 9 |
| Radial DOC ae (mm) | 3 |

### Aluminum High-Speed Machining



Excellent chips and surface roughness were achieved even in high-speed machining of duralumin A2017 (spindle speed n = 12,000min$^{-1}$).

| FULLCUT MILL Model | **BBT40-FCM16092-85** |
|---|---|
| Insert Model | ARG16094 (DS20) |
| Workpiece material | A2017 |
| Cutting speed Vc (m/min) | 600 |
| Feed rate fz (mm/t) | 0.15 |
| Axial DOC ap (mm) | 9 |

INDEXABLE INSERT ENDMILL CUTTER

# FULLCUT MILL FCM Type

Cutter diameter: ø50, ø63, ø80, ø100

## Arbor Type

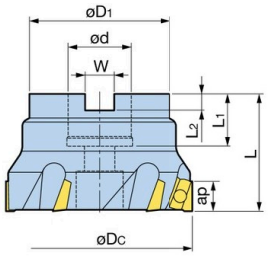
Slotting Shoulder milling

● Compatible with the new-standard Face Mill Arbor type H. Exhibits incredible cutting capacity even with #40 machining centers or millturn machines.


● Model Description

FMH 22 - FCM 50 11 5 - 40

- FMH: FACE MILL ARBOR Type (H Type)
- 22: Mounting part bore
- FCM: FCM Type
- 50: Cutter diameter øDc
- 11: Effective cutting edge length ap
- 5: Number of inserts
- 40: L dimension




| Cutter diameter øDc | Model | Effective cutting edge length ap | ød | øD1 | L | L1 | L2 | W | Number of inserts | Insert Model | Weight (kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | **FMH22-FCM 50115-40** | 11 | 22 | 47 | 40 | 20 | 6 | 10.4 | 5 | ARG4011□□ | 0.5 |
| 63 | **-FCM 63116-40** | | | | | | | | 6 | ARG6311□□ | 0.7 |
| 80 | **FMH27-FCM 80116-50** | | 27 | 60 | 50 | 22 | 7 | 12.4 | 6 | ARG8011□□ | 1.2 |
| 100 | **-FCM100116-50** | | | 76 | | | | | | | 2.0 |

1. A wrench and screws are included. Inserts must be ordered separately.
2. The □□ at the end of the Insert Model is the nose radius. Order them putting 02 for 0.2, 04 for 0.4 and 08 for 0.8 nose radius.

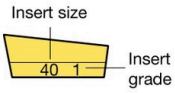
## ■Insert

● Model Description

ARG40 11 04 ACP300

- ARG40: Effective cutting edge length
- 11: Nose Radius
- 04: Grade
- ACP300

Insert Marking Description




1: ACZ310
2: DS20
P2: ACP200
P3: ACP300
3F: ACM300F

| Cutter diameter | Insert Model | Effective cutting edge length | Nose radius | Insert Grade | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | ACP300 (for steel) | ACP200 (for pre-hardened steel) | ACM300F (for stainless steel) | ACZ310 (for cast iron) | DS20 (for aluminum) |
| ø50 | **ARG401102** | 11 | 0.2 | ○ | – | ○ | ○ | ○ |
| | **ARG401104** | 11 | 0.4 | ○ | ○ | ○ | ○ | ○ |
| ø63 | **ARG631104** | 11 | 0.4 | ○ | – | ○ | – | ○ |
| | **ARG631108** | 11 | 0.8 | ○ | ○ | ○ | ○ | ○ |
| ø80, ø100 | **ARG801104** | 11 | 0.4 | ○ | – | ○ | – | ○ |
| | **ARG801108** | 11 | 0.8 | ○ | ○ | ○ | ○ | ○ |

1. Inserts are available in packets of 10 pcs.
   Please specify the insert model number and grade when ordering.

**Caution**

- Be sure to purchase an insert suited to the cutter diameter, as the use of a non-compatible insert may cause problems.
- Not compatible with inserts for FULLCUT MILL FCR Type.
- Insert with nose radius 0.2 is for light cutting.

## Insert Grade Description

| ACP300 | ACP200 | ACM300F | ACZ310 |
|---|---|---|---|
| Material for general steel, with a PVD multilayer coating on an ultra-tough substrate. Excellent chipping and thermal fracture resistance allows interrupted cutting as well. | With multilayers of nano-order TiAlN and AlCrN on a high-hardness base, it has superior wear resistance in pre-hardened steel machining. | Uses a new coating with improved smoothness and adhesiveness on a newly developed ultrahard carbide substrate. Excellent welding and chipping resistance, and capable of stable stainless steel machining. | Material for cast iron and ductile cast iron machining, with a PVD multilayer coating on an ultra-fine particle alloy substrate. Highly wear-resistant and also resistant to machine impact. |

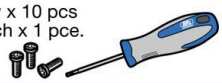
| DS20 |
|---|
| Material for non-ferrous metals, with a special diamond coating (DLC) realizing high adhesion and low friction, on K20 class carbide. |

**Both ACP300 and ACP200 can be used for steel machining**

ACP200 has excellent wear resistance, while ACP300 has superb chipping resistance. For steel machining, we recommend ACP300 the most highly. ACP300 provides stable machining, but for even higher speeds or when wear resistance is required, use ACP200. Note that ACP200 is not recommended for heavy interrupted cutting or heavy cutting.

## ■Insert Clamping Screw Set

・Insert clamping screws and tightening wrench are consumables. Order periodically for replacement or spares.

| | | ● Insert Clamping Screw Set<br>Screw x 10 pcs<br>Wrench x 1 pce.<br>  | ● Driver-Type Wrench<br>  |
|---|---|---|---|
| Cutter Diameter | Insert Model | Set Model | Wrench Model |
| ø50 | ARG401102 | **S3508DS** | **DA-T15** |
| | ARG401104 | | |
| ø63 | ARG631104 | | |
| | ARG631108 | | |
| ø80, ø100 | ARG801104 | | |
| | ARG801108 | | |

## Cutting Conditions

### Shoulder Milling/Slotting

**Caution**
- FULLCUT MILL FCM Type cannot be used for machining with Z-direction tool feed, such as ramping or drilling.

**Light to medium cutting**

| Cutter diameter | Material | Carbon Steel Alloy Steel | Unalloyed Steel | Pre-hardened Steel HRC40 or less | Stainless Steel | Cast Iron | Aluminum |
|---|---|---|---|---|---|---|---|
| | Insert grade | ACP300 | | ACP200 | ACM300F | ACZ310 | DS20 |
| | Cutting fluid | Dry | | | | | Dry/Wet |
| ø 50<br>ø 63<br>ø 80<br>ø100 | Cutting speed Vc (m/min) | 100 - 220 | 150 - 240 | 80 - 120 | 120 - 180 | 100 - 200 | 200 - 1,500 |
| | Feed rate fz (mm/t) | 0.10 - 0.24 | 0.10 - 0.22 | 0.08 - 0.14 | 0.12 - 0.20 | 0.10 - 0.25 | 0.10 - 0.35 |

**Heavy interrupted cutting/Heavy cutting**

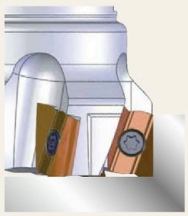
| Cutter diameter | Material | Carbon Steel Alloy Steel | Unalloyed Steel | Stainless Steel | Cast Iron | Aluminum |
|---|---|---|---|---|---|---|
| | Insert grade | ACP300 | | ACM300F | ACZ310 | DS20 |
| | Cutting fluid | Dry | | | | Dry/Wet |
| ø 50<br>ø 63<br>ø 80<br>ø100 | Cutting speed Vc (m/min) | 100 - 220 | 150 - 240 | 120 - 180 | 100 - 200 | 200 - 1,500 |
| | Feed rate fz (mm/t) | 0.08 - 0.18 | 0.08 - 0.16 | 0.12 - 0.15 | 0.10 - 0.20 | 0.10 - 0.30 |

**Caution**
- As the nose radius 0.2 insert is for light cutting, pay attention to the axial and radial cutting depth and the feed rate.
- This table is a guideline for selecting cutting parameters. Adjust them as needed according to the machine and workpiece conditions, considering the cutting width as well.
- Dry (or air blow) cutting is recommended for steel machining, except finishing. Dry cutting is recommended for stainless steel as well; however, wet cutting may extend insert life in case severe built-up edge occurs.

### Perpendicularity and excellent surface finish unrivaled in indexable insert cutters

Machined with holder BBT40-FMH22-47-45 and Fullcut Mill FMH22-FCM63116-40

※ The perpendicularity and surface roughness will vary depending on the cutting conditions, material, machine tool and workpiece rigidity.



| Perpendicularity | | |
|---|---|---|
| | Cutting speed Vc (m/min) | 150 |
| | Feed rate fz (mm/t) | 0.1 |
| | Axial DOC ap (mm) | 5 |
| | Radial DOC ae (mm) | 0.1 |

| | |
|---|---|
| BIG DAISHOWA | 10 μm |
| General Cutter | 40 μm |

| Surface roughness | | |
|---|---|---|
| | Cutting speed Vc (m/min) | 250 |
| | Feed rate fz (mm/t) | 0.2 |
| | Axial DOC ap (mm) | 0.1 |
| | Radial DOC ae (mm) | 50 |

| | Ra(μm) | Rz(μm) |
|---|---|---|
| BIG DAISHOWA | 0.51 | 2.89 |
| General Cutter | 1.56 | 7.77 |