

Diamond Coated End Mills for Hard Brittle Materials

# ***DC end mill series***

**New  
Product**

## **Achieving long tool life by using stable processing of cemented carbide and hard brittle materials**



***DC25B***  
***DC2XLB***

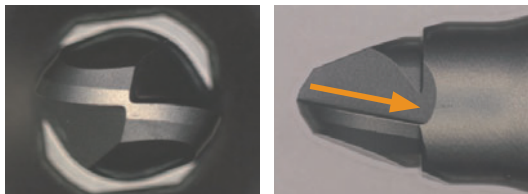
## Diamond Coated End Mills for Hard Brittle Materials

# *DC end mill series*

## Long tool life with stable processing

### An edge shape made with coexisting sharpness and high edge strength

Straight flute rake angle has improved sharpness. As a result, chips are discharged to the tool axis and sudden damage near the ball center is restricted.



An image showing the occurrence of chip discharge

### Newly developed DC

Uniquely developed coating technology not only dramatically improves coating adhesiveness and wear resistance but also inhibits peeling of the coating and sudden abrasions. As a result, stable and long-life processing of hard brittle materials such as cemented carbide and alumina is achieved.



### **DC25B**

Suitable DC ball end mill for cemented carbide and other hard brittle materials processing



Finish cutting / Rough cutting



### **DC2XLB**

Suitable DC long neck ball end mill for cemented carbide and other hard brittle materials processing



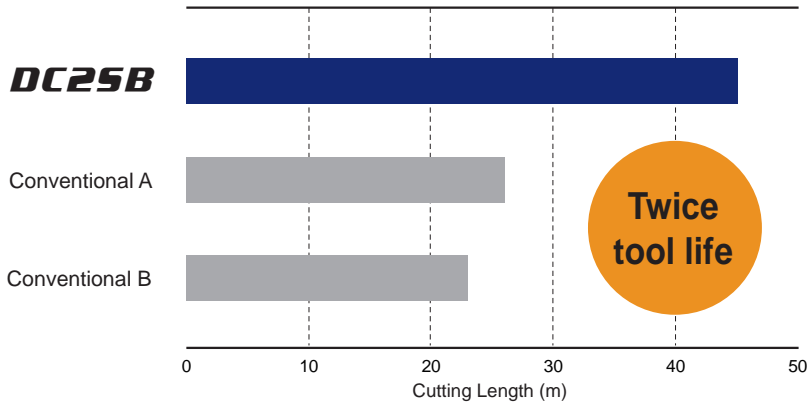
Finish cutting / Rough cutting



# Cutting Performance

## Cemented carbide Dry

Twice the longevity compared with conventional products

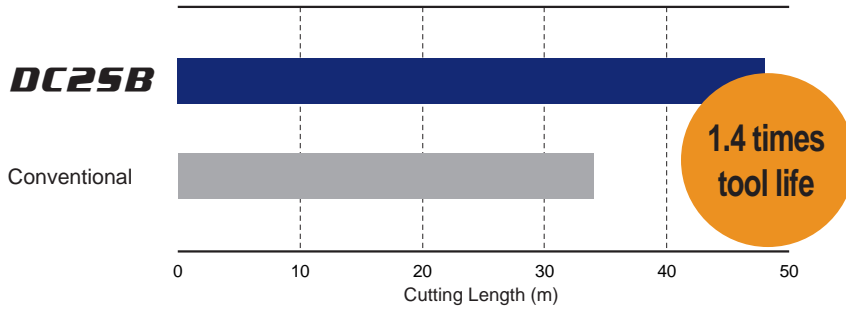
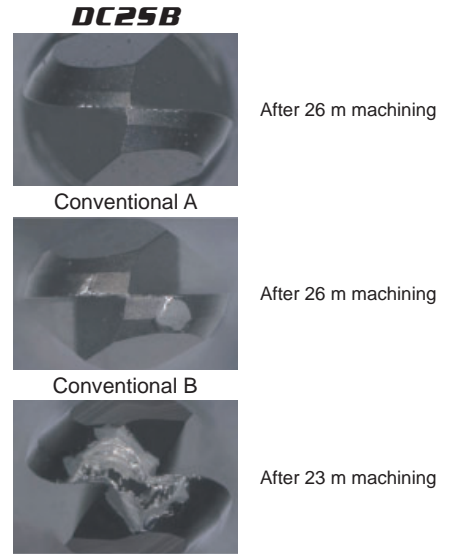


<Cutting Condition>

Work Material : Ultra Micro-particle cemented carbide HRA91.0  
 Tool : DC2SBR0100  
 Revolution : 30,000 min<sup>-1</sup>  
 Cutting Speed : 82 m/min (ap 0.1 mm)

Feed Rate : 300 mm/min  
 Feed per Tooth : 0.005 mm/t.  
 Depth of Cut : ap 0.1 mm, ae 0.3 mm  
 Cutting Mode : Dry  
 Machine : MC(HSK-E25)

### Damage of the cutting edge

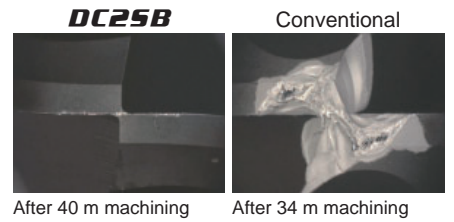


<Cutting Condition>

Work Material: Ultra Micro-particle cemented carbide HRA91.0  
 Tool : DC2SBR0300  
 Revolution : 20,000 min<sup>-1</sup>  
 Cutting Speed : 135 m/min (ap 0.2 mm)

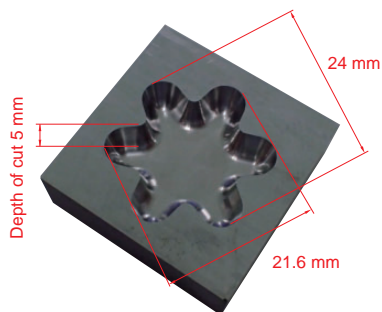
Feed Rate : 200 mm/min  
 Feed per Tooth : 0.005 mm/t.  
 Depth of Cut : ap 0.2 mm, ae 0.4 mm  
 Cutting Mode : Dry  
 Machine : MC(RS20)

### Damage of the cutting edge



# Case study

## Cemented carbide mold



## Hexalobular

Process	Size	Revolution min <sup>-1</sup>	Feed rate mm/min	ap mm	ae mm	Finishing allowance mm	Cutting time h:m:s	Number of tools pcs
Rough cutting	R2	24,000	240	0.2	0.4	0.1	2:12:24	2
Medium cutting	R1	30,000	300	0.1	0.3	0.05	0:49:20	1
Finish cutting	R1	30,000	300	0.1	0.1	0	0:37:30	1

Model Size : 24x21.6x5 mm  
 Work Material: CIS VM-20 (92HRA)  
 Tool : DC2SB

Cutting Mode : Air blow  
 Machine : MC (RS20)

**Cutting time : 219 min**

**Tools used : 4**

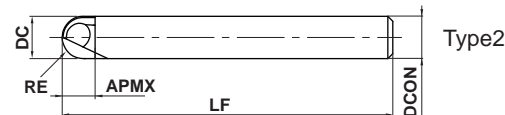
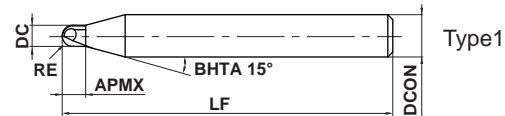
# Diamond Coated End Mills for Hard Brittle Materials

## DC2SB

Ball nose, Short cut length, 2 flute, For hard brittle materials



Cemented carbide	Alumina Zirconia	Silicon carbide Silicon nitride	Quartz glass
○	○	○	○



R	0.1 ≤ RE ≤ 3				
	±0.01				
h6	4 ≤ DCON ≤ 6				
	<sup>0</sup> / <sub>-0.008</sub>				

● Suitable DC ball end mill for cemented carbide and other hard brittle materials processing.

Unit : mm

Order Number	RE	DC	APMX	LF	DCON	No. of Flutes	Stock	Type
DC2SBR0010	0.1	0.2	0.12	50	4	2	●	1
DC2SBR0020	0.2	0.4	0.24	50	4	2	●	1
DC2SBR0030	0.3	0.6	0.42	50	4	2	●	1
DC2SBR0040	0.4	0.8	0.56	50	4	2	●	1
DC2SBR0050	0.5	1	0.7	50	4	2	●	1
DC2SBR0075	0.75	1.5	1	50	4	2	●	1
DC2SBR0100	1	2	1.4	50	4	2	●	1
DC2SBR0150	1.5	3	2.1	60	6	2	●	1
DC2SBR0200	2	4	2.8	60	6	2	●	1
DC2SBR0250	2.5	5	3.5	60	6	2	●	1
DC2SBR0300	3	6	4.2	60	6	2	●	2

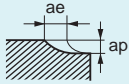
RE = Radius of Ball Nose  
DC = Dia.

APMX = Length of Cut  
LF = Overall Length

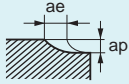
DCON = Shank Dia.

● : Inventory maintained in Japan.

## RECOMMENDED CUTTING CONDITIONS

Work material		Cemented carbide				Alumina Zirconia			
DC (mm)	RE (mm)	Revolution (min <sup>-1</sup> )	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Revolution (min <sup>-1</sup> )	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
0.2	0.1	30000	100	0.01	0.01	30000	100	0.01	0.01
0.4	0.2	30000	150	0.02	0.08	30000	150	0.02	0.08
0.6	0.3	30000	200	0.03	0.14	30000	200	0.03	0.14
0.8	0.4	30000	250	0.04	0.19	30000	250	0.04	0.19
1	0.5	30000	300	0.05	0.25	30000	300	0.05	0.25
1.5	0.75	30000	300	0.075	0.275	30000	300	0.075	0.275
2	1	30000	300	0.1	0.3	30000	300	0.1	0.3
3	1.5	27500	275	0.125	0.33	27500	275	0.125	0.33
4	2	24000	240	0.15	0.35	24000	240	0.15	0.35
5	2.5	22000	220	0.175	0.37	22000	220	0.175	0.37
6	3	20000	200	0.2	0.4	20000	200	0.2	0.4
Depth of cut									

Work material		Silicon carbide Silicon nitride				Quartz glass			
DC (mm)	RE (mm)	Revolution (min <sup>-1</sup> )	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Revolution (min <sup>-1</sup> )	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
0.2	0.1	30000	50	0.005	0.005	30000	150	0.015	0.015
0.4	0.2	30000	75	0.01	0.04	30000	225	0.03	0.12
0.6	0.3	30000	100	0.015	0.07	30000	300	0.045	0.21
0.8	0.4	30000	125	0.02	0.095	30000	375	0.06	0.285
1	0.5	30000	150	0.025	0.125	30000	450	0.075	0.375
1.5	0.75	30000	150	0.038	0.138	30000	450	0.113	0.413
2	1	30000	150	0.05	0.15	30000	450	0.15	0.45
3	1.5	27500	138	0.063	0.165	27500	413	0.188	0.495
4	2	24000	120	0.075	0.175	24000	360	0.225	0.525
5	2.5	22000	110	0.088	0.185	22000	330	0.263	0.555
6	3	20000	100	0.1	0.2	20000	300	0.3	0.6
Depth of cut									

- 1) The cemented carbide in the above mentioned cutting conditions table is based on CIS standard VM-40(90HRA).
- 2) Air blow or dry processing is recommended with cemented carbide processing.  
\*Note: Using coolants or oil mists may decrease tool longevity.
- 3) The use of a water soluble cutting oil is recommended with the processing of hard brittle materials other than the cemented carbide mentioned in the above table. Be sure to refuel the oil and eliminate any chip discharge that adheres to the tool.
- 4) Cutting conditions may need adjustments depending on the type of work material.
- 5) Reduce the rotation speed and feedrate shown in the above table at a similar ratio when no rigidity in the machinery or work mounting and occurrence of chatter or abnormal sound.
- 6) Implementation of special countermeasures is recommended since fine chip discharge may enter gaps in the processing machinery.

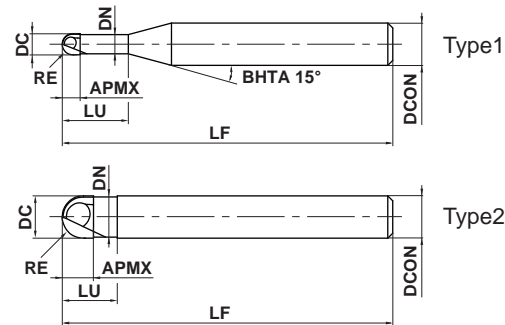
# Diamond Coated End Mills for Hard Brittle Materials

## DC2XLB

Ball nose, Short cut length, 2 flute, Long neck, For hard brittle materials



Cemented carbide	Alumina Zirconia	Silicon carbide Silicon nitride	Quartz glass
○	○	○	○



<b>R</b>	$0.1 \leq RE \leq 3$				
	$\pm 0.01$				
<b>h6</b>	$4 \leq DCON \leq 6$				
	$\begin{matrix} 0 \\ -0.008 \end{matrix}$				

● Suitable DC long neck ball end mill for cemented carbide and other hard brittle materials processing.

Unit : mm

Order Number	RE	DC	APMX	LU	DN	LF	DCON	No. of Flutes	Stock	Type
DC2XLBR0010N005	0.1	0.2	0.12	0.5	0.18	50	4	2	●	1
DC2XLBR0020N010	0.2	0.4	0.24	1	0.36	50	4	2	●	1
DC2XLBR0030N015	0.3	0.6	0.36	1.5	0.56	50	4	2	●	1
DC2XLBR0040N020	0.4	0.8	0.48	2	0.76	50	4	2	●	1
DC2XLBR0050N025	0.5	1	0.6	2.5	0.96	50	4	2	●	1
DC2XLBR0050N050	0.5	1	0.6	5	0.96	50	4	2	●	1
DC2XLBR0075N038	0.75	1.5	0.9	3.8	1.44	50	4	2	●	1
DC2XLBR0100N060	1	2	1.2	6	1.94	50	4	2	●	1
DC2XLBR0100N100	1	2	1.2	10	1.94	50	4	2	●	1
DC2XLBR0150N080	1.5	3	1.8	8	2.9	60	6	2	●	1
DC2XLBR0200N100	2	4	2.4	10	3.9	60	6	2	●	1
DC2XLBR0250N100	2.5	5	3	10	4.9	60	6	2	●	1
DC2XLBR0300N100	3	6	3.6	10	5.85	60	6	2	●	2

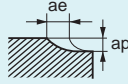
RE = Radius of Ball Nose  
DC = Dia.  
APMX = Length of Cut

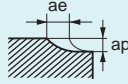
LU = Neck Length  
DN = Neck Dia.  
LF = Overall Length

DCON = Shank Dia.

● : Inventory maintained in Japan.

## RECOMMENDED CUTTING CONDITIONS

Work material			Cemented carbide				Alumina Zirconia			
DC (mm)	RE (mm)	LU (mm)	Revolution (min <sup>-1</sup> )	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Revolution (min <sup>-1</sup> )	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
0.2	0.1	0.5	30000	30	0.005	0.01	30000	30	0.005	0.01
0.4	0.2	1	30000	100	0.015	0.08	30000	100	0.015	0.08
0.6	0.3	1.5	30000	200	0.03	0.14	30000	200	0.03	0.14
0.8	0.4	2	30000	250	0.04	0.19	30000	250	0.04	0.19
1	0.5	2.5	30000	300	0.05	0.25	30000	300	0.05	0.25
1	0.5	5	30000	300	0.05	0.25	30000	300	0.05	0.25
1.5	0.75	3.8	30000	300	0.075	0.275	30000	300	0.075	0.275
2	1	6	30000	300	0.1	0.3	30000	300	0.1	0.3
2	1	10	30000	300	0.1	0.3	30000	300	0.1	0.3
3	1.5	8	27500	275	0.125	0.33	27500	275	0.125	0.33
4	2	10	24000	240	0.15	0.35	24000	240	0.15	0.35
5	2.5	10	22000	220	0.175	0.37	22000	220	0.175	0.37
6	3	10	20000	200	0.2	0.4	20000	200	0.2	0.4
Depth of cut										

Work material			Silicon carbide Silicon nitride				Quartz glass			
DC (mm)	RE (mm)	LU (mm)	Revolution (min <sup>-1</sup> )	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)	Revolution (min <sup>-1</sup> )	Feed rate (mm/min)	Depth of cut ap (mm)	Depth of cut ae (mm)
0.2	0.1	0.5	30000	15	0.003	0.005	30000	45	0.008	0.015
0.4	0.2	1	30000	50	0.008	0.04	30000	150	0.023	0.12
0.6	0.3	1.5	30000	100	0.015	0.07	30000	300	0.045	0.21
0.8	0.4	2	30000	125	0.02	0.095	30000	375	0.06	0.285
1	0.5	2.5	30000	150	0.025	0.125	30000	450	0.075	0.375
1	0.5	5	30000	150	0.025	0.125	30000	450	0.075	0.375
1.5	0.75	3.8	30000	150	0.038	0.138	30000	450	0.113	0.413
2	1	6	30000	150	0.05	0.15	30000	450	0.15	0.45
2	1	10	30000	150	0.05	0.15	30000	450	0.15	0.45
3	1.5	8	27500	138	0.063	0.165	27500	413	0.188	0.495
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6	3	10	20000	100	0.1	0.2	20000	300	0.3	0.6
Depth of cut										

- 1) The cemented carbide in the above mentioned cutting conditions table is based on CIS standard VM-40(90HRA).
- 2) Air blow or dry processing is recommended with cemented carbide processing.  
\*Note: Using coolants or oil mists may decrease tool longevity.
- 3) The use of a water soluble cutting oil is recommended with the processing of hard brittle materials other than the cemented carbide mentioned in the above table. Be sure to refuel the oil and eliminate any chip discharge that adheres to the tool.
- 4) Cutting conditions may need adjustments depending on the type of work material.
- 5) Reduce the rotation speed and feedrate shown in the above table at a similar ratio when no rigidity in the machinery or work mounting and occurrence of chatter or abnormal sound.
- 6) Implementation of special countermeasures is recommended since fine chip discharge may enter gaps in the processing machinery.

# The Diamond Coated Drill Series for hard brittle materials drilling

For Hard, Brittle Materials **DC-BSS**  $\varnothing$ 0.05–3.0mm

For Non-ferrous Materials **DC-SSS**  $\varnothing$ 0.2–2.0mm

**DC-SSM**  $\varnothing$ 2.1–3.0mm

**Ideal for drilling  
fine ceramics, quartz glass  
and non-ferrous metals.**

**For Your Safety**

●Don't handle inserts and chips without gloves. ●Please machine within the recommended application range and exchange expired tools with new ones in advance of breakage. ●Please use safety covers and wear safety glasses. ●When using compounded cutting oils, please take fire precautions. ●When attaching inserts or spare parts, please use only the correct wrench or driver. ●When using rotating tools, please make a trial run to check run-out, vibration and abnormal sounds etc.

## **MITSUBISHI MATERIALS CORPORATION**

MITSUBISHI MATERIALS CORPORATION

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(Tools specifications subject to change without notice.)