MITSUBISHI
MITSUBISHI MATERIALS

TOOLS NEWS

B005G

MIRACLE COATED
(Al,Ti,Si)N

The great variety for the total of 11 series ! Ultimate endmills for processing high hardness material are now available.

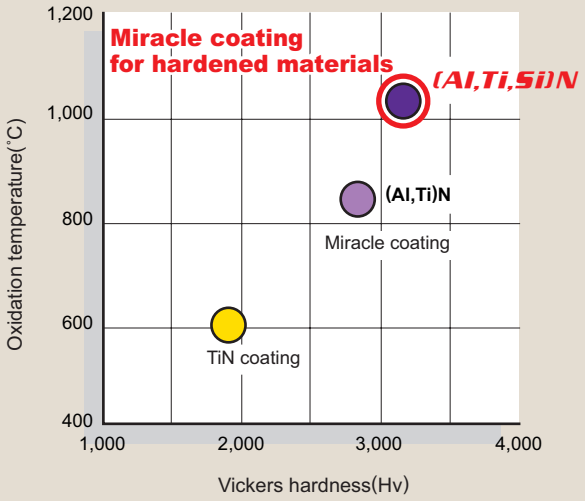
●"Miracle coating with Si" (Al,Ti,Si)N endmill series for hardened materials.

Miracle coating *(Al,Ti,Si)* for hardened materials

High hardness material processing like 70HRC is realized in high speeds milling and tool life as long as when milling 60HRC materials.

Film hardness and heat resistivity needed for milling high hardness materials are supplied by adding Si to previous Miracle coating (Al,Ti,Si)N.
Wear, chipping resistance and long tool life can be achieved by combination of this new coating and ultra micro grain carbide.

The endmill displays excellent performance when machining high hardness materials, and for high-speed milling.

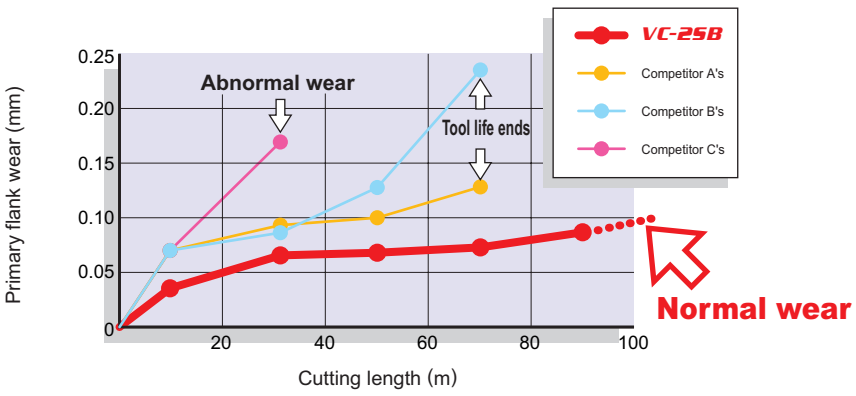


Machining high hardness material SKD11 (62HRC) by VC-2SB

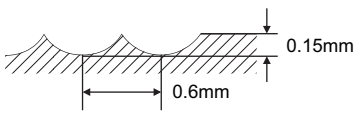
Wear of cutting edge (Cutting length 70m)

VC-2SB | Competitor A's | Competitor B's

Machining work material SKD11 (62HRC)

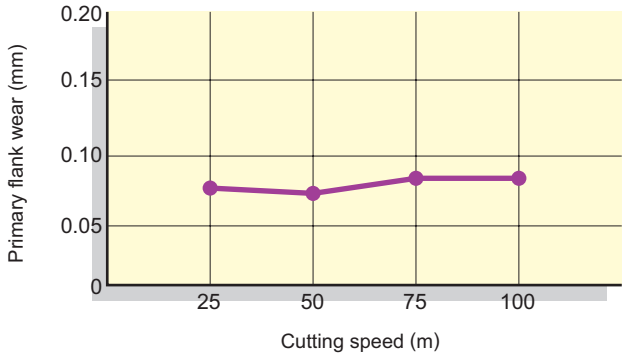


End mill	VC-2SB R3
Work material	SKD11 (62HRC)
Revolution	4,300min^{-1} (81m/min)
Feed rate	640mm/min (0.074mm/tooth)
Cutting method	Down cut, Air blow

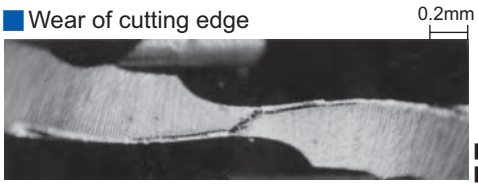


Machining high hardness powder metallurgy HSS (69HRC) by VC-4MB

Relation between cutting speed and primary flank wear (Cutting length 15m)



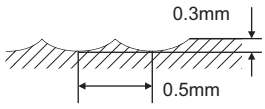
Wear of cutting edge



■ Revolution 10,480min^{-1}
■ Feed rate 1,048mm/min

VC-4MB (Cutting speed 100m/min)

End mill	VC-4MB R4
Work material	powder metallurgy HSS (69HRC)
Revolution	2,620–10,480min^{-1} (25–100m/min)
Feed rate	262–1,048mm/min (0.1mm/rev)
Cutting method	Down cut, Air blow



Ball Nose, Extra Short, 2 flute
VC-2ESB Size up

Medium, For Hardened Material
VC-MD-SC NEW

Medium, For Hardened Material
VC-MD

Medium, For Hardened Material, Long Shank
VC-MDL

Long, For Hardened Material
VC-LD

Corner radius, Short, 6 flute, For Hardened Material
VC-5DRB

Corner radius, Medium, 6 flute, For Hardened Material
VC-MDRB

Ball Nose, Short, 2 flute
VC-2SB

Ball Nose, Extra Short, 2 flute
VC-2SSB

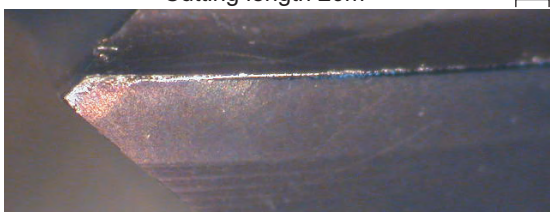
Ball Nose, Medium, 4 flute
VC-4MB

Ball Nose, Short, 4 flute, Taper
VC-4STB Size up

Machining high hardness material SKD11 (62HRC) by VC-MD

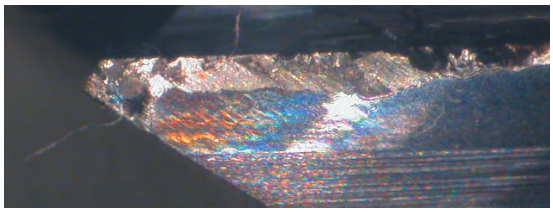
Machining work material SKD11 (62HRC)

Cutting length 20m



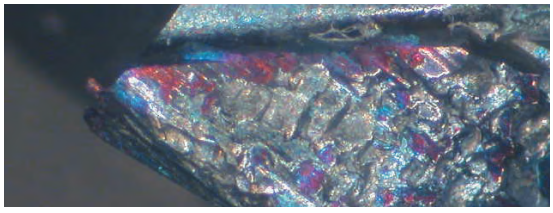
VC-MD

Cutting length 20m Normal wear. Machining can be continued.



Competitor A's

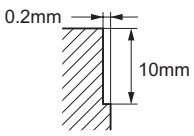
Cutting length 20m Tool life is almost reached.



Competitor B's

Cutting length 20m Tool life is reached due to large wear.

End mill	VC-MD ϕ10
Work material	SKD11 (62HRC)
Revolution	2,400min^{-1} (75m/min)
Feed rate	1,440mm/min (0.1mm/tooth)
Cutting method	Down cut, Air blow



MIRACLE END MILLS

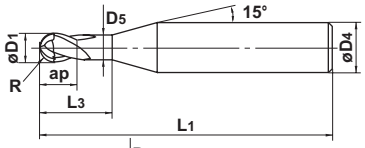
VC-2ESB Size up

Ball Nose, Extra Short, 2 flute

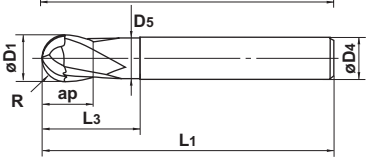
R ±0.01

D1<6 0 — -0.028
6≤D1 0 — -0.038

UWC VC 30°



Type 1



Type 2

● The optimal series for direct milling in compact machining center.

Unit : mm

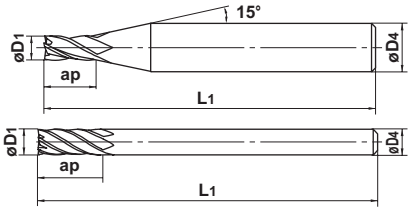
Order Number	Radius of ball nose R	Dia. D1	Length of Cut ap	Neck Length L3	Neck Dia. D5	Overall Length L1	Shank Dia. D4	No. of Flute N	Stock	Type
Size up VC2ESBR0015N006	0.15	0.3	0.3	0.6	0.27	30	4	2	●	1
Size up VC2ESBR0020N008	0.2	0.4	0.4	0.8	0.36	30	4	2	●	1
Size up VC2ESBR0030N012	0.3	0.6	0.6	1.2	0.56	30	4	2	●	1
Size up VC2ESBR0040N016	0.4	0.8	0.8	1.6	0.76	30	4	2	●	1
VC2ESBR0050	0.5	1	1	—	—	30	4	2	●	1
Size up VC2ESBR0050N025	0.5	1	1	2.5	0.96	30	4	2	●	1
VC2ESBR0075	0.75	1.5	1.5	—	—	30	4	2	●	1
Size up VC2ESBR0075N040	0.75	1.5	1.5	4	1.46	30	4	2	●	1
VC2ESBR0100	1	2	2	—	—	40	6	2	●	1
Size up VC2ESBR0100N060	1	2	2	6	1.96	40	6	2	●	1
VC2ESBR0150	1.5	3	3	—	—	40	6	2	●	1
Size up VC2ESBR0150N080	1.5	3	3	8	2.96	40	6	2	●	1
VC2ESBR0200	2	4	4	—	—	40	6	2	●	1
Size up VC2ESBR0200N080	2	4	4	8	3.96	40	6	2	●	1
VC2ESBR0250	2.5	5	5	—	—	40	6	2	●	1
Size up VC2ESBR0250N120	2.5	5	5	12	4.96	40	6	2	●	1
VC2ESBR0300	3	6	6	—	—	40	6	2	●	2
Size up VC2ESBR0300N130	3	6	6	13	5.85	40	6	2	●	2
VC2ESBR0350	3.5	7	7	—	—	50	8	2	●	1
VC2ESBR0400	4	8	8	—	—	50	8	2	●	2
VC2ESBR0500	5	10	10	—	—	60	10	2	●	2
VC2ESBR0600	6	12	12	—	—	65	12	2	●	2

● : Inventory maintained.

VC-MD-SC NEW

Medium, For Hardened Material

-0.005 ~ -0.028



UWC VC 30°


D1<3


3=D1

- VC-MD with sharp corner edge.

Unit : mm

Order Number	Dia. D1	Length of Cut ap	Overall Length L1	Shank Dia. D4	No. of Flute N	Stock	Type
VCMDSCD0050	0.5	1	45	6	4	●	1
VCMDSCD0100	1	2.5	45	6	4	●	1
VCMDSCD0150	1.5	4	45	6	4	●	1
VCMDSCD0200	2	6	45	6	4	●	1
VCMDSCD0250	2.5	8	45	6	4	●	1
VCMDSCD0300	3	8	45	6	6	●	2

VC-MD

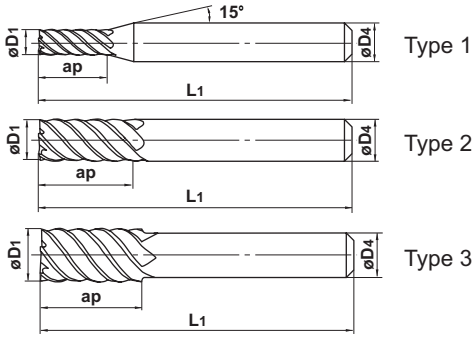
Medium, For Hardened Material

D1≤3	-0.005 — -0.028
3<D1≤6	-0.015 — -0.038
6<D1≤18	-0.020 — -0.047
18<D1	-0.020 — -0.053

UWC VC 30° 45°

D1<3 3≤D1 D1<3 3≤D1

- Best for high efficiency milling for hardened steel milling and high-speed machining center.



Unit : mm

Order Number	Dia. D1	Length of Cut ap	Overall Length L1	Shank Dia. D4	No. of Flute N	Stock	Type
VCMDD0100	1	2.5	45	6	4	●	1
VCMDD0150	1.5	4	45	6	4	●	1
VCMDD0200	2	6	45	6	4	●	1
VCMDD0250	2.5	8	45	6	4	●	1
VCMDD0300	3	8	45	6	6	●	1
VCMDD0350	3.5	10	45	6	6	●	1
VCMDD0400	4	11	45	6	6	●	1
VCMDD0450	4.5	11	50	6	6	●	1
VCMDD0500	5	13	50	6	6	●	1
VCMDD0550	5.5	13	50	6	6	●	1
VCMDD0600	6	13	50	6	6	●	2
VCMDD0800	8	19	60	8	6	●	2
VCMDD1000	10	22	70	10	6	●	2
VCMDD1200	12	26	75	12	6	●	2
VCMDD1400	14	26	75	12	6	●	3
VCMDD1500	15	30	80	16	6	●	1
VCMDD1600	16	32	90	16	6	●	2
VCMDD1800	18	32	90	16	6	●	3
VCMDD2000	20	38	100	20	6	●	2
VCMDD2200	22	38	100	20	6	●	3
VCMDD2500	25	60	160	25	6	●	2

● : Inventory maintained.

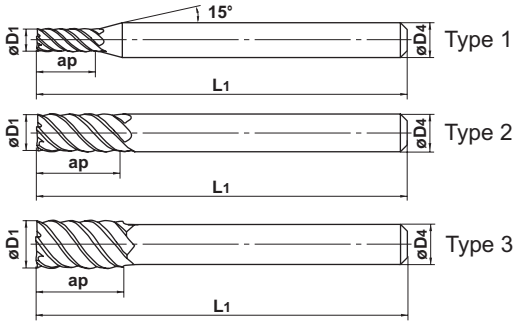
VC-MDL

Medium, For Hardened Material, Long Shank

D_1=3	-0.005 — -0.028
3<D_1≤6	-0.015 — -0.038
6<D_1≤18	-0.020 — -0.047
18<D_1	-0.020 — -0.053

UWC VC 45°

- VC-MD with long shank.



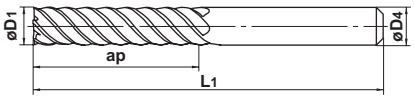
Unit : mm

Order Number	Dia. D_1	Length of Cut ap	Overall Length L_1	Shank Dia. D_4	No. of Flute N	Stock	Type
VCMDLD0300S06	3	8	60	6	6	●	1
VCMDLD0400S06	4	11	60	6	6	●	1
VCMDLD0500S06	5	13	70	6	6	●	1
VCMDLD0600S06	6	13	70	6	6	●	2
VCMDLD0800S08	8	19	90	8	6	●	2
VCMDLD1000S08	10	22	100	8	6	●	3
VCMDLD1000S10	10	22	100	10	6	●	2
VCMDLD1200S10	12	26	110	10	6	●	3
VCMDLD1200S12	12	26	110	12	6	●	2
VCMDLD1600S16	16	32	130	16	6	●	2
VCMDLD1800S16	18	32	130	16	6	●	3
VCMDLD2000S20	20	38	140	20	6	●	2
VCMDLD2200S20	22	38	140	20	6	●	3
VCMDLD2500S25	25	60	180	25	6	●	2

VC-LD

Long, For Hardened Material

D1=6 -0.015 — -0.038
6<D1≤18 -0.020 — -0.047
18<D1 -0.020 — -0.053



Type 1

● VC-MD with long flute.

Unit : mm

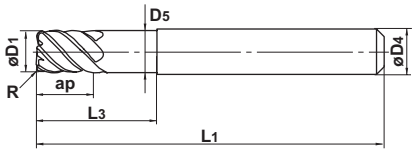
Order Number	Dia. D1	Length of Cut ap	Overall Length L1	Shank Dia. D4	No. of Flute N	Stock	Type
VCLDD0600	6	26	70	6	6	●	1
VCLDD0800	8	36	90	8	6	●	1
VCLDD1000	10	46	100	10	6	●	1
VCLDD1200	12	56	110	12	6	●	1
VCLDD1600	16	66	130	16	6	●	1
VCLDD2000	20	76	140	20	6	●	1
VCLDD2500	25	92	180	25	6	●	1

● : Inventory maintained. ■ : Inventory maintained in Japan.

VC-SDRB

Corner Radius, Short, 6 flute, For Hardened Material

D1≤6 -0.015 — -0.038
6<D1 -0.020 — -0.047



Type 1

- The length of cut that is identical to the diameter ensures high rigidity and permits high-speed and high feed rate machining.

Unit : mm

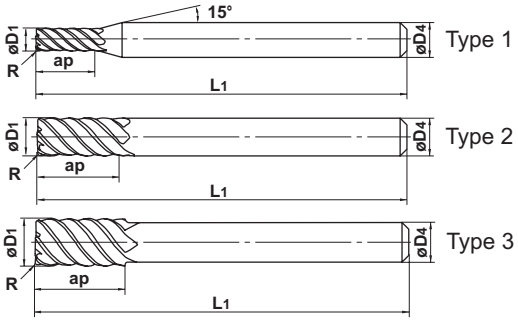
Order Number	Dia. D1	Length of Cut ap	Neck Length L3	Neck Dia. D5	Overall Length L1	Shank Dia. D4	Corner R R	Stock	Type
VCSDRBD0600R0050	6	6	18	5.8	50	6	0.5	■	1
VCSDRBD0800R0050	8	8	24	7.8	60	8	0.5	■	1
VCSDRBD1000R0100	10	10	30	9.7	70	10	1	■	1
VCSDRBD1200R0100	12	12	36	11.7	75	12	1	■	1

VC-MDRB

Corner Radius, Medium, 6 flute, For Hardened Material

D1=3	-0.005 — -0.028
3<D1≤6	-0.015 — -0.038
6<D1≤18	-0.020 — -0.047
18<D1	-0.020 — -0.053

● VC-MD with corner radius.



Unit : mm

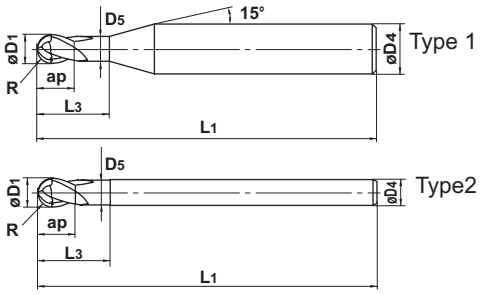
Order Number	Dia. D1	Length of Cut ap	Overall Length L1	Shank Dia. D4	Corner R R	No. of Flute N	Stock	Type
VCMDRBD0300R0030	3	8	60	6	0.3	6	●	1
VCMDRBD0400R0030	4	11	60	6	0.3	6	●	1
VCMDRBD0500R0030	5	13	70	6	0.3	6	●	1
VCMDRBD0600R0030	6	13	70	6	0.3	6	●	2
VCMDRBD0600R0050	6	13	70	6	0.5	6	●	2
VCMDRBD0700R0030	7	16	70	6	0.3	6	●	3
VCMDRBD0700R0050	7	16	70	6	0.5	6	●	3
VCMDRBD0800R0030	8	19	90	8	0.3	6	●	2
VCMDRBD0800R0050	8	19	90	8	0.5	6	●	2
VCMDRBD0900R0030	9	19	90	8	0.3	6	●	3
VCMDRBD0900R0050	9	19	90	8	0.5	6	●	3
VCMDRBD1000R0030	10	22	100	10	0.3	6	●	2
VCMDRBD1000R0050	10	22	100	10	0.5	6	●	2
VCMDRBD1000R0100	10	22	100	10	1	6	●	2
VCMDRBD1100R0050	11	22	100	10	0.5	6	●	3
VCMDRBD1100R0100	11	22	100	10	1	6	●	3
VCMDRBD1200R0050	12	26	110	12	0.5	6	●	2
VCMDRBD1200R0100	12	26	110	12	1	6	●	2
VCMDRBD1300R0050	13	26	110	12	0.5	6	●	3
VCMDRBD1300R0100	13	26	110	12	1	6	●	3
VCMDRBD1600R0100	16	32	130	16	1	6	●	2
VCMDRBD1600R0150	16	32	130	16	1.5	6	●	2
VCMDRBD1800R0100	18	32	130	16	1	6	●	3
VCMDRBD1800R0150	18	32	130	16	1.5	6	●	3
VCMDRBD2000R0100	20	38	140	20	1	6	●	2
VCMDRBD2000R0150	20	38	140	20	1.5	6	●	2
VCMDRBD2000R0200	20	38	140	20	2	6	●	2
VCMDRBD2200R0100	22	38	140	20	1	6	●	3
VCMDRBD2200R0150	22	38	140	20	1.5	6	●	3
VCMDRBD2200R0200	22	38	140	20	2	6	●	3

● : Inventory maintained.

VC-SDRB

Ball Nose, Short, 2 flute

R	R≤6	±0.01	D1<6	0 — -0.028
	6<R	±0.02	6≤D1	0 — -0.038



● Best for Direct Milling.

Unit : mm

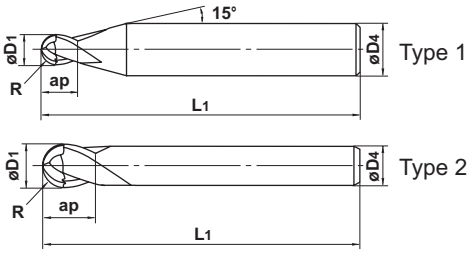
Order Number	Radius of ball nose R	Dia. D1	Length of Cut ap	Neck Length L3	Neck Dia. D5	Overall Length L1	Shank Dia. D4	No. of Flute N	Stock	Type
VC2SBR0015	0.15	0.3	0.3	0.6	0.27	50	6	2	●	1
VC2SBR0020	0.2	0.4	0.4	0.8	0.36	50	6	2	●	1
VC2SBR0030	0.3	0.6	0.6	1.2	0.56	50	6	2	●	1
VC2SBR0040	0.4	0.8	0.8	1.6	0.76	50	6	2	●	1
VC2SBR0050	0.5	1	1	2.5	0.96	50	6	2	●	1
VC2SBR0060	0.6	1.2	1.2	3	1.16	50	6	2	●	1
VC2SBR0070	0.7	1.4	1.4	3	1.36	50	6	2	●	1
VC2SBR0075	0.75	1.5	1.5	4	1.46	50	6	2	●	1
VC2SBR0080	0.8	1.6	1.6	4	1.56	50	6	2	●	1
VC2SBR0090	0.9	1.8	1.8	5	1.76	50	6	2	●	1
VC2SBR0100	1	2	2	6	1.96	60	6	2	●	1
VC2SBR0125	1.25	2.5	2.5	6	2.46	60	6	2	●	1
VC2SBR0150	1.5	3	3	8	2.96	60	6	2	●	1
VC2SBR0175	1.75	3.5	3.5	8	3.46	60	6	2	●	1
VC2SBR0200	2	4	4	8	3.96	60	6	2	●	1
VC2SBR0225	2.25	4.5	4.5	10	4.46	60	6	2	●	1
VC2SBR0250	2.5	5	5	12	4.96	60	6	2	●	1
VC2SBR0275	2.75	5.5	5.5	12	5.46	60	6	2	●	1
VC2SBR0300	3	6	6	13	5.85	60	6	2	●	2
VC2SBR0400	4	8	8	14	7.85	90	8	2	●	2
VC2SBR0500	5	10	10	18	9.85	100	10	2	●	2
VC2SBR0600	6	12	12	22	11.85	110	12	2	●	2
VC2SBR0800	8	16	16	30	15.85	140	16	2	●	2
VC2SBR1000	10	20	20	38	19.85	160	20	2	●	2

VC-2SSB

Ball Nose, Extra Short, 2 flute

R ±0.01

D1<6 0 — -0.028
6≤D1 0 — -0.038



● Best for direct Milling.

Unit : mm

Order Number	Rudius of ball nose R	Dia. D1	Length of Cut ap	Overall Length L1	Shank Dia. D4	No. of Flute N	Stock	Type
VC2SSBR0050	0.5	1	1	40	4	2	■	1
VC2SSBR0050S06	0.5	1	1	40	6	2	■	1
VC2SSBR0075	0.75	1.5	1.5	40	4	2	■	1
VC2SSBR0075S06	0.75	1.5	1.5	40	6	2	■	1
VC2SSBR0100	1	2	2	45	6	2	■	1
VC2SSBR0150	1.5	3	3	45	6	2	■	1
VC2SSBR0200	2	4	4	45	6	2	■	1
VC2SSBR0250	2.5	5	5	50	6	2	■	1
VC2SSBR0300	3	6	6	50	6	2	■	2
VC2SSBR0350	3.5	7	7	60	8	2	■	1
VC2SSBR0400	4	8	8	60	8	2	■	2
VC2SSBR0500	5	10	10	70	10	2	■	2
VC2SSBR0600	6	12	12	75	12	2	■	2

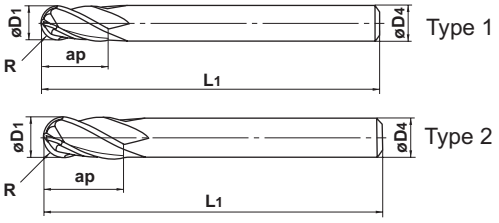
■ :Inventory maintained in Japan.

VC-4MB

Ball Nose, Medium, 4 flute

R≤6 ±0.01
6≤R ±0.02

0 — -0.038



UWC VC 30°

- Best for high efficiency milling of hardened steels, or milling in high-speed machining centers.

Unit : mm

Order Number	Radius of ball nose R	Dia. D1	Length of Cut ap	Overall Length L1	Shank Dia. D4	No. of Flute N	Stock	Type
VC4MBR0300	3	6	12	80	6	4	■	1
VC4MBR0400	4	8	14	90	8	4	■	1
VC4MBR0500	5	10	18	100	10	4	■	1
VC4MBR0600	6	12	22	110	12	4	■	1
VC4MBR0700	7	14	26	120	12	4	■	2
VC4MBR0800	8	16	30	140	16	4	■	1
VC4MBR0900	9	18	34	140	16	4	■	2
VC4MBR1000	10	20	38	160	20	4	■	1

MIRACLE END MILLS

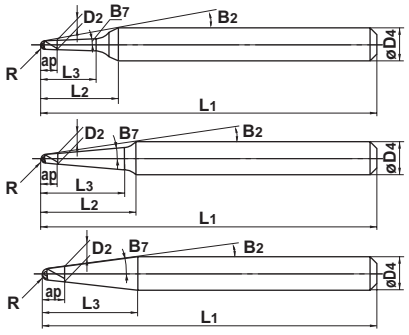
VC-4STB Size up

Ball Nose, Short, 4 flute, Taper

±0.01

UWC VC 30°

- The taper neck and short cutting length are adopted in order to increase the rigidity to the fullest extent, ensuring the maximum performance when machining any kind of work material.



*Relief Neck type.

Unit : mm

Order Number	Radius of ball nose R	Taper Angle on Side B7	Length of Cut ap	Neck Length L3	Under Shank Length L2	Large Mill Dia. D2	Cutting edge to shamk Angle B2	Overall Length L1	Shank Dia. D4	Stock	Type
VC4STBR0030T0130N05	0.3	1°30'	1	5	9.0	0.64	17.2°	60	6	■	1
VC4STBR0030T0200N05	0.3	2°	1	5	9.0	0.65	17.2°	60	6	■	1
VC4STBR0030T0500N05	0.3	5°	1	5	8.8	0.70	17.5°	60	6	■	1
VC4STBR0030T1000N15	0.3	10°	1	15	—	0.90	10°	60	6	■	3
VC4STBR0040T0130N10	0.4	1°30'	2	10	14.0	0.88	10.8°	60	6	■	1
VC4STBR0040T0130N15	0.4	1°30'	2	15	19.0	0.88	7.9°	60	6	■	1
VC4STBR0040T0200N10	0.4	2°	2	10	14.0	0.91	10.8°	60	6	■	1
VC4STBR0040T0500N10	0.4	5°	2	10	13.5	1.08	11.2°	60	6	■	1
VC4STBR0040T0700N10	0.4	7°	7	10	12.2	2.43	12.4°	60	6	■	2
VC4STBR0040T1000N15	0.4	10°	3	15	—	1.73	10°	60	6	■	3
VC4STBR0050T0130N10	0.5	1°30'	2	10	14.0	1.08	10.5°	60	6	■	1
VC4STBR0050T0200N10	0.5	2°	2	10	14.0	1.10	10.5°	60	6	■	1
Size up VC4STBR0050T0130N15	0.5	1°30'	2	15	—	—	—	60	6	■	3
Size up VC4STBR0050T0130N20	0.5	1°30'	2	20	—	—	—	60	6	■	3
VC4STBR0050T0200N15	0.5	2°	2	15	18.9	1.10	7.7°	60	6	■	1
Size up VC4STBR0050T0200N20	0.5	2°	3	20	—	—	—	60	6	■	3
VC4STBR0050T0500N10	0.5	5°	3	10	13.6	1.40	10.8°	60	6	■	1
VC4STBR0050T0500N15	0.5	5°	3	15	17.2	1.40	8.5°	60	6	■	2
VC4STBR0050T0500N20	0.5	5°	3	20	21.8	1.40	6.7°	60	6	■	2
VC4STBR0050T0700N10	0.5	7°	7	10	12.1	2.60	12.1°	60	6	■	2
VC4STBR0050T0700N15	0.5	7°	7	15	16.6	2.60	8.8°	60	6	■	2
VC4STBR0050T0700N20	0.5	7°	7	20	—	2.60	7°	60	6	■	3
VC4STBR0050T1000N14	0.5	10°	3	14	—	1.90	10°	60	6	■	3
VC4STBR0075T0200N10	0.75	2°	3	10	14.0	1.66	9.6°	60	6	■	1
VC4STBR0075T0500N15	0.75	5°	3	15	17.0	1.90	7.9°	60	6	■	2
VC4STBR0100T0130N10	1	1°30'	4	10	13.5	2.16	9°	60	6	■	1
VC4STBR0100T0130N15	1	1°30'	4	15	18.5	2.16	6.5°	60	6	■	1
VC4STBR0100T0130N20	1	1°30'	4	20	23.5	2.16	5.1°	60	6	■	1
VC4STBR0100T0200N06	1	2°	4	6	8.7	2.20	14.3°	60	6	■	2
VC4STBR0100T0200N10	1	2°	4	10	13.8	2.20	8.8°	60	6	■	1
VC4STBR0100T0200N15	1	2°	4	15	17.5	2.20	6.9°	60	6	■	2
VC4STBR0100T0500N10	1	5°	4	10	12.2	2.50	10°	60	6	■	2
VC4STBR0100T0500N15	1	5°	4	15	16.8	2.50	7.2°	60	6	■	2
VC4STBR0100T0500N23	1	5°	4	23	—	2.50	5°	60	6	■	3
VC4STBR0100T0700N17	1	7°	7	17	—	3.49	7°	60	6	■	3
VC4STBR0100T1000N12	1	10°	4	12	—	3.10	10°	60	6	■	3
VC4STBR0125T0500N15	1.25	5°	4	15	16.5	2.99	6.5°	60	6	■	2
VC4STBR0150T0130N15	1.5	1°30'	4	15	17.3	3.13	5.4°	60	6	■	2

■ : Inventory maintained in Japan.

Unit : mm

Order Number	Radius of ball nose R	Taper Angle on Side B_7	Length of Cut ap	Neck Length L_3	Under Shank Length L_2	Large Mill Dia. D_2	Cutting edge to shamk Angle B_2	Overall Length L_1	Shank Dia. D_4	Stock	Type
VC4STBR0150T0130N20	1.5	1°30'	4	20	22.2	3.13	4.1°	60	6	■	2
VC4STBR0150T0300N15	1.5	3°	4	15	16.9	3.27	5.5°	60	6	■	2
VC4STBR0150T0500N10	1.5	5°	4	10	11.7	3.50	8.3°	60	6	■	2
VC4STBR0150T0500N18	1.5	5°	4	18	—	3.50	5°	60	6	■	3
VC4STBR0175T0500N15	1.75	5°	4	15	—	3.91	5°	60	6	■	3
VC4STBR0200T0130N15	2	1°30'	5	15	16.8	4.16	3.8°	60	6	■	2
VC4STBR0200T0130N20	2	1°30'	5	20	21.6	4.16	2.9°	60	6	■	2
VC4STBR0200T0300N21	2	3°	4	21	—	4.22	3°	60	6	■	3
VC4STBR0200T0500N13	2	5°	4	13	—	4.40	5°	60	6	■	3
VC4STBR0200T0700N18	2	7°	7	18	—	5.26	7°	60	8	■	3
VC4STBR0300T0130N15	3	1°30'	6	15	16.8	6.16	4.1°	90	8	■	2
VC4STBR0300T0130N20	3	1°30'	6	20	21.7	6.16	3.1°	90	8	■	2
VC4STBR0300T0300N22	3	3°	6	22	—	6.32	3°	90	8	■	3
VC4STBR0400T0130N15	4	1°30'	8	15	16.9	8.21	4.4°	90	10	■	2
VC4STBR0400T0300N22	4	3°	8	22	—	8.43	3°	90	10	■	3

STANDARD CUTTING CONDITIONS OF MIRACLE END MILL

Medium, For Hardened Material **VC-MD**

Medium, For Hardened Material **VC-MD-SC**

Corner Radius, Short, 6 flute, For Hardened Material **VC-SDRB**

Corner Radius, Medium, 6 flute, For Hardened Material **VC-MDRB**

Work material	Alloy steel, Tool steel, Pre-hardened steel (−55HRC) AISI D2, AISI H13, NAK etc.		Hardened steel (55−60HRC) AISI H13, AISI D2, STAVAX etc.		Hardened steel (60−65HRC) AISI D2, SKH, SKS etc.	
Dia. (mm)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)
0.5	40,000	500	30,000	350	—	—
1	40,000	1,000	20,000	500	10,000	240
2	32,000	1,500	16,000	750	8,000	400
3	27,000	3,200	13,000	1,600	6,900	830
4	21,000	3,800	10,000	1,800	5,600	1,000
5	18,000	4,300	8,900	2,100	4,500	1,100
6	16,000	5,800	8,000	2,900	4,000	1,400
8	12,000	5,800	6,000	2,900	3,000	1,400
10	9,500	5,700	4,800	2,900	2,400	1,400
12	8,000	4,800	4,000	2,400	2,000	1,200
16	6,000	3,600	3,000	1,800	1,500	900
20	4,800	2,900	2,400	1,400	1,200	720
25	3,800	2,300	1,900	1,100	950	570
Depth of cut	≤0.05D ≤1.5D		≤0.03D (D<ϕ3) ≤0.05D (D≥ϕ3) (MAX.0.5mm) ≤1D		≤0.03D (MAX.0.2mm) ≤1D	

D:Dia.

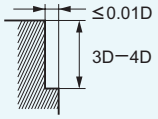
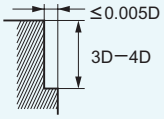
For general purpose MC and NC milling machine

Work material	Alloy steel, Tool steel, Pre-hardened steel (30−45HRC) SCM, AISI H13 etc.				Hardened steel (45−55HRC) AISI H13 etc.		Hardened steel (55−60HRC) AISI D2 etc.		Hardened steel (60−65HRC) AISI D2 etc.		Hardened steel (65−70HRC) SKH etc.	
	Side milling		Grooving or slotting									
Dia. (mm)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)
0.5	20,000	200	20,000	200	14,000	90	13,000	80	11,000	60	—	—
1	18,000	350	15,000	300	7,000	90	6,600	80	5,700	70	—	—
2	9,000	350	7,500	300	3,500	90	3,300	80	2,800	70	—	—
3	6,400	650	5,300	250	2,300	110	2,200	110	1,900	100	1,400	70
4	5,200	930	4,400	260	1,900	110	1,800	110	1,500	100	1,100	70
5	4,300	1,000	3,700	310	1,600	140	1,500	130	1,200	110	900	80
6	3,700	1,300	3,200	350	1,500	200	1,350	150	1,050	120	800	90
8	2,800	1,300	2,400	350	1,100	200	1,000	150	800	120	600	90
10	2,200	1,300	1,900	340	960	200	800	150	650	120	480	90
12	1,900	1,100	1,600	290	800	170	650	120	530	100	400	75
16	1,400	840	1,200	220	600	125	500	90	400	70	300	50
20	1,100	660	950	170	480	100	400	70	310	55	240	45
25	890	530	760	140	380	80	320	55	250	45	190	35
Depth of cut	≤0.05D ≤1.5D		D ≤0.05D (D<ϕ3) ≤0.2D (D≥ϕ3)		≤0.05D ≤1D		D ≤0.05D		≤0.03D (MAX.0.2mm) ≤1D		D ≤0.05D	

D:Dia.

1) If the rigidity of the machine or the work material installation is very low, or chattering and noise are generated, please reduce the revolution and the feed rate proportionately.
2) Climb cut is recommended for side milling.
3) Air blow are recommended to get rid of chips compulsorily.

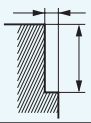
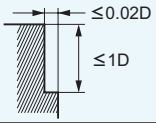
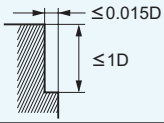
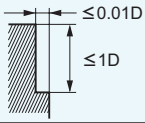
VC-LD
Long, For Hardened Material

Work material	Alloy steel, Tool steel, pre-hardened steel (−45HRC) SCM, AISI H13, AISI D2 NAK etc.		Hardened steel (45−55HRC) AISI H13, AISI D2, SUS420 etc.		Hardened steel (55−60HRC) AISI D2, SKH, SKS etc.		Hardened steel (60−65HRC) AISI D2, SKH, SKS etc.	
Dia. (mm)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)
6	2,100	450	1,600	330	1,300	240	1,100	190
8	1,600	430	1,200	310	1,000	230	800	170
10	1,300	420	960	290	800	220	640	150
12	1,100	380	800	260	660	200	530	140
16	800	310	600	220	500	160	400	120
20	640	270	480	190	400	140	320	110
25	510	230	380	160	320	120	260	90
Depth of cut								

D:Dia.

1) If the rigidity of the machine or the work material installation is very low, or chattering and noise are generated, please reduce the revolution and the feed rate proportionately.
2) Climb cut is recommended.
3) Please reduce the depth of cut or feed rate when deflection of the machined surface is important.
4) We recommend that you set the depth of cut as small as possible and divide machining into several times if the deflection of the roughing surface is large.

VC-MDL
Medium, For Hardened Material, Long Shank

Work material	Alloy steel, Tool steel, pre-hardened steel (−45HRC) SCM, AISI H13, AISI D2 NAK etc.		Hardened steel (45−55HRC) AISI H13, AISI D2, SUS420 etc.		Hardened steel (55−60HRC) AISI D2, SKH, SKS etc.		Hardened steel (60−65HRC) AISI D2, SKH, SKS etc.	
Dia. (mm)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)
3	8,500	700	6,900	600	5,800	500	5,300	400
4	6,400	900	5,200	700	4,400	600	4,000	500
5	5,100	900	4,100	700	3,500	600	3,200	600
6	4,200	1,100	3,400	800	2,900	720	2,700	670
8	3,200	1,000	2,600	800	2,200	680	2,000	620
10	2,500	900	2,100	630	1,800	540	1,600	480
12	2,100	870	1,700	660	1,500	590	1,300	510
16	1,600	750	1,300	570	1,090	480	990	440
20	1,300	670	1,000	490	880	430	800	390
25	1,000	540	830	420	700	360	640	330
Depth of cut								

D:Dia.

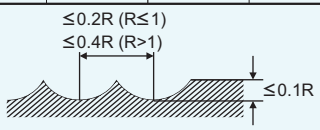
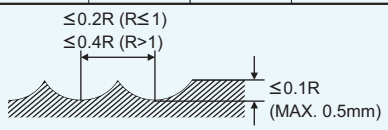
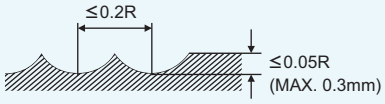
1) The above table shows cutting conditions which about 5d (d: shank length) of end mill.
2) If the overhang is shortened, depth of cut, the revolution and feed rate can be increased.
3) If using an end mill with a long overhang or the rigidly of the machine or the work material installation is very low, or chattering and noise are generated, please shallow the depth of cut and reduce the revolution and the feed rate proportionately.
4) Climb cut, air blow and mist oil is recommended.

STANDARD CUTTING CONDITIONS OF MIRACLE END MILL

VC-2SB
Ball Nose, Short, 2 flute

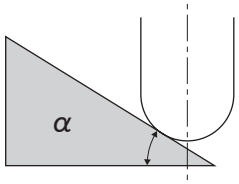
VC-2SSB
Ball Nose, Extra Short, 2 flute

VC-2ESB
Ball Nose, Extra Short, 2 flute

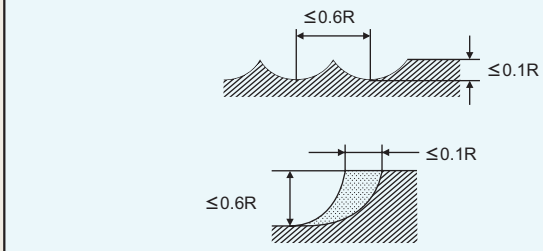
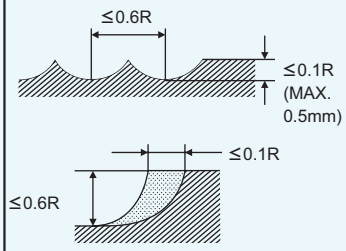
Work material	Alloy steel, Tool steel, Pre-hardened steel (−45HRC) SCM, AISI H13, AISI D2, NAK etc.				Hardened steel (45−55HRC) AISI H13, AISI D2, SUS420 etc.				Hardened steel (55−62HRC) AISI D2, SKH, SKS etc.			
R (mm)	α≤15°		α>15°		α≤15°		α>15°		α≤15°		α>15°	
	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)
R 0.15	40,000	600	40,000	450	40,000	510	40,000	380	40,000	510	40,000	380
R 0.2	40,000	800	40,000	600	40,000	680	40,000	510	40,000	680	32,000	400
R 0.3	40,000	1,300	40,000	980	40,000	1,100	40,000	830	32,000	880	22,000	450
R 0.4	40,000	1,900	40,000	1,400	40,000	1,600	35,000	1,100	25,000	1,000	18,000	540
R 0.5	40,000	2,400	35,000	1,600	35,000	1,800	30,000	1,100	21,000	1,000	15,000	570
R 0.75	40,000	3,000	30,000	1,700	30,000	1,900	25,000	1,200	14,000	890	10,000	470
R 1	35,000	3,000	25,000	1,700	25,000	1,800	20,000	1,100	11,000	800	8,000	430
R 1.25	33,000	3,000	24,000	1,700	22,000	1,700	17,000	1,000	9,300	710	6,500	370
R 1.5	30,000	3,000	23,000	1,700	20,000	1,700	15,000	1,000	8,000	670	5,600	350
R 2	25,000	3,000	20,000	1,700	17,000	1,700	13,000	1,000	6,400	640	4,500	340
R 2.5	23,000	3,000	17,000	1,700	15,000	1,700	11,000	1,000	5,000	550	3,500	290
R 3	20,000	3,000	15,000	1,700	13,000	1,700	10,000	1,000	4,200	530	2,900	270
R 4	15,000	3,000	11,000	1,700	10,000	1,700	7,500	1,000	3,200	540	2,200	280
R 5	12,000	2,900	9,000	1,600	8,000	1,600	6,000	900	2,500	510	1,800	270
R 6	10,000	2,500	7,500	1,400	6,600	1,400	5,000	800	2,100	440	1,500	230
R 8	7,500	1,900	5,600	1,100	5,000	1,100	3,700	600	1,600	340	1,100	170
R10	6,000	1,600	4,500	900	4,000	900	3,000	500	1,300	290	900	150
Depth of cut												

R:Radius

1) α is the inclination of machining surface.
2) If the rigidity of the machine or the work material installation is very low, or chattering and noise are generated, please reduce the revolution and the feed rate proportionately.
   When high machining accuracy is especially needed, we recommend lowering feed rate.
3) Cutting condition may be considerably different due to the overhang (milling depth and neck length), depth of cut, and machine tools.
   Please see the above table as a standard.
4) If the depth of cut is shallow, the revolution and feed rate can be increased.



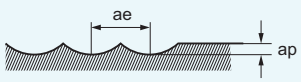
VC-4MB
Ball Nose, Medium, 4 flute

Work material	Alloy steel, Tool steel Pre-hardened steel (−45HRC) SCM, AISI H13, AISI D2, NAK etc.		Hardened steel (45−55HRC) AISI H13, AISI D2, SUS420 etc.		Hardened steel (55−62HRC) AISI D2, SKH, SKS etc.	
R (mm)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)	Revolution (min^{-1})	Feed rate (mm/min)
R 3	20,000	1,800−5,500	13,000	1,200−3,700	8,300	700−1,500
R 4	15,000	2,200−5,000	10,000	1,400−3,400	6,200	700−1,300
R 5	12,000	2,300−4,600	8,000	1,500−3,000	5,000	800−1,200
R 6	10,000	1,900−4,100	6,600	1,300−2,700	4,100	700−1,000
R 8	7,500	1,600−3,200	5,000	1,100−2,200	3,100	600− 800
R10	6,000	1,300−2,600	4,000	900−1,700	2,500	500− 700
Depth of cut						

R:Radius

1) Please use a machining center and a NC milling machine with rigidity.
   If the rigidity of the machine or the work material installation is very low, or chattering is generated, please reduce the revolution and the feed rate proportionately.
2) The above table shows cutting conditions in contour line machining (side milling). In shape milling like mould, cutting condition changes considerably due to the machined shape, milling method and depth of cut (pick feeduaxis).
   Feed rate should be the upper limit in the range if the shape of the material is gentle, and the reduce limit if undulating.
3) When the overhang of the end mill (milling depth) is long, reduce the revolution and feed rate proportionally to prevent chattering.
4) And air blow are recommended to get rid of chips compulsorily.

VC-4STB
Ball Nose, Short, 4 flute, Taper

Work material		Alloy steel, Tool steel Pre-hardened steel (−45HRC) SCM, AISI H13, AISI D2, NAK etc.			Hardened steel (45−55HRC) AISI H13, AISI D2, SUS420 etc.			Hardened steel (55−62HRC) AISI D2, SKH, SKS etc.		
R (mm)	Taper Angle on side (°)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap, ae (mm)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap, ae (mm)	Revolution (min^{-1})	Feed rate (mm/min)	Depth of cut ap, ae (mm)
R 0.3	**5°**	10,000 I 30,000	500 I 30,000	0.05	10,000 I 30,000	400 I 3,000	0.05	5,000 I 20,000	200 I 1,000	0.05
	10°									
R 0.5	**2°**			0.2			0.1		300 I 2,000	0.1
	5°									
	7°	10,000 I 20,000			10,000 I 20,000			3,000 I 12,000		
	10°									
R 1	**2°**			0.3			0.3			0.3
	5°									
	10°	6,000 I 15,000			6,000 I 15,000			2,000 I 10,000		
R 1.5	**5°**									
R 2	**5°**									
R 3	**3°**	4,000 I 10,000		0.4	4,000 I 10,000		0.4	2,000 I 6,000	300 I 1,500	0.4
R 4	**3°**									
Depth of cut										

R:Radius

1) The adove standard cutting conditions are applicable for high-speed machining center only. If a high-speed machining center is not used, the revolution and feed rate should be adjusted proportionately.
2) Revolution and feed rates shown are ranges because they may change depending upon the taper angles on side of the end mills and the rigidity of the machine tool used.

JQA-2522
JQA-EM0941

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