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TECH-NEWS

S-Star Endmill

Endmill for Stainless steel machining

- Stable machinability minimizing unexpected chipping from optimal cutting edge design for Stainless steel cutting
- High performance in Stainless steel series, Titanium and Nickel cutting from applying new coating with high oxidation resistance and hardness

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Endmill for Stainless steel cutting

S-Star Endmill

Stainless steel is widely used not only in daily life but also in various industries because it has high corrosion resistance and smooth surface. Stainless steel reduces tool life as it has characteristics like high work hardening, high shear resistance and high tendency of chip's welding on a tool. Therefore, it is recommended to use exclusive tools for effective Stainless steel machining.

S-Star Endmill dramatically increased wear resistance and welding resistance than existing tool through applying high toughness substrate and new coating layer with wear resistance, oxidation resistance and high hardness. In addition, the optimal cutting edge minimizes cutting load and chattering for Stainless steel cutting and reduces fracture due to unexpected chipping.

KORLOY recommends S-Star Endmill not only for Stainless steel cutting but general cuttings with Titanium, Nickel, Inconel and Hard-To-Cut materials for your high productivity.

» **Good chipping resistance**
- Strong cutting edge and high toughness substrate

» **Lower cutting load and better chip evacuation**
- Uneven flute spacing and R-type gash shape
- High rake angle and streamlined chip pocket

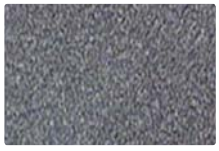
» **Higher welding resistance and wear resistance**
- AlCrN series coating layer

» **Good surface finish**
- Added finishing flute

Code system

S	F	51	4	120	03	H
S-Star Endmill	Type B : Ball E : Flat R : Radius F : Roughing	Length/shank type 50 : Standard 51 : Straight, Neck	No. of flute 4 : 4 flutes	Tool dia. 120 : Ø12.0 mm	Corner R 03 : 0.3 mm	Helix H : High helix

Features

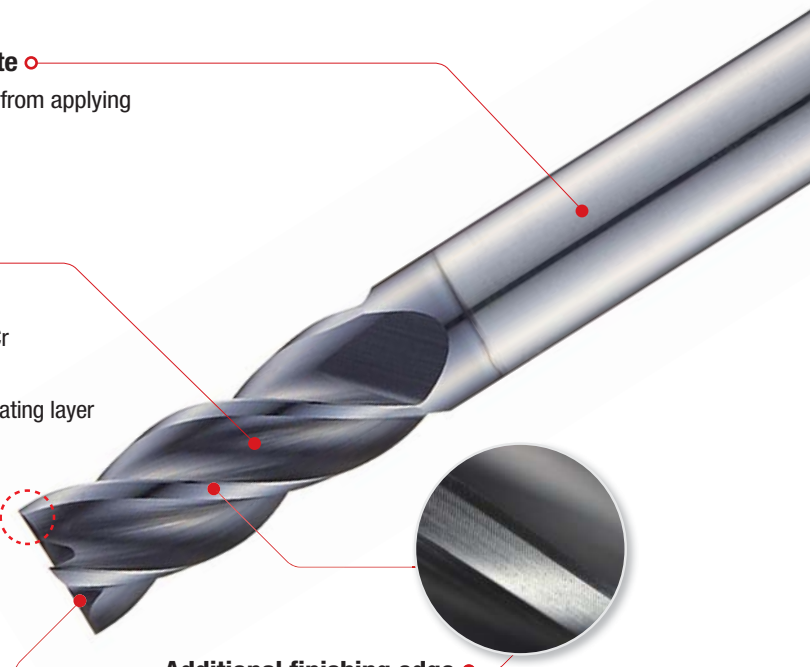


Applying high toughness substrate

- Chipping resistance and stable cutting from applying high toughness substrate

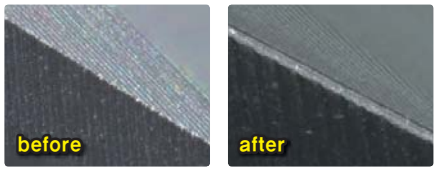
Applying different width and size of AlCrN based layer

- Applying multi layers
- Increased lubrication due to containing Cr
- Ensured stability against frictional heat
- Secured wear resistance from thicker coating layer



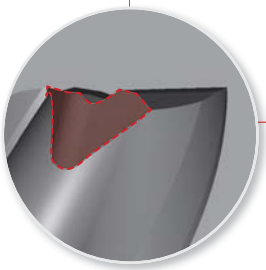
Cutting edge treatment

- Improved chipping resistance in the beginning of cutting
- Better wear resistance and stable cutting
- High quality of product from cutting edge treatment stabilization



Additional finishing edge

- Enhanced surface finish due to increased 1st O.D grinding roughness
- High quality cutting edge and good welding resistance

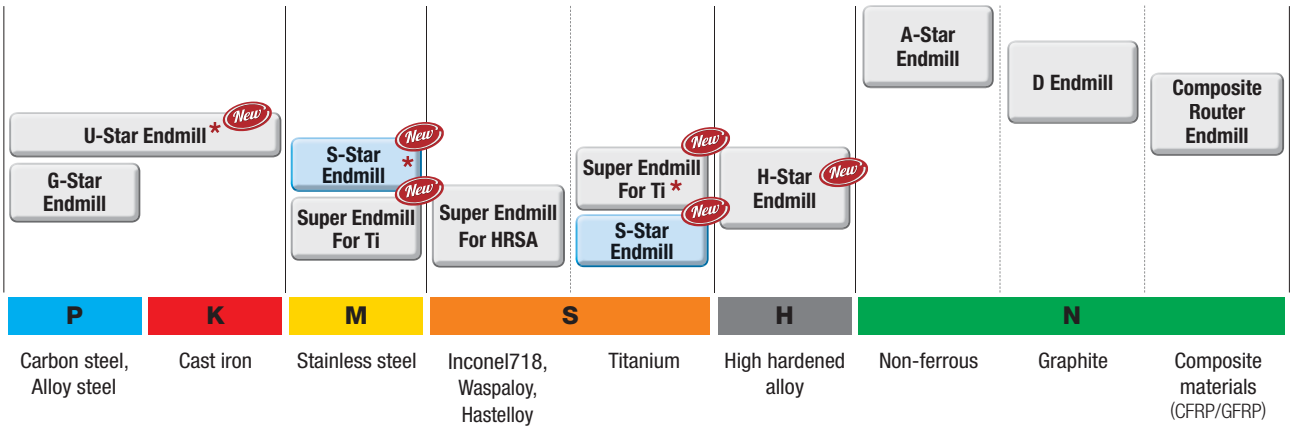


Uneven flute spacing / R gash

- High chip evacuation through R gash shape
- Stability in shouldering machining

Tool selection guide

*: 1st recommendation



Line-up

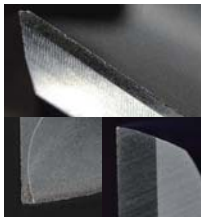
Type	Designation	Picture	Product name	No. of flute	Size (Ø)	
					Min.	Max.
Flat	SE502		2 flutes flat Endmill	2	1	20
	SE503		3 flutes flat Endmill	3	1	20
	SE504		4 flutes flat Endmill	4	1	20
	SE506		6 flutes flat Endmill	6	6	20
Radius	SR504		4 flutes radius Endmill	4	1	20
	SR505		5 flutes nick type radius Endmill	5	6	20
	SR507		7 flutes nick type radius Endmill	7	6	20
Ball	SB502		2 flutes ball Endmill	2	1	12
	SB504		4 flutes ball Endmill	4	3	20
Roughing	SF513H SF514H SF515H		3~5 flutes roughing Endmill	3~5	3	20

Application examples

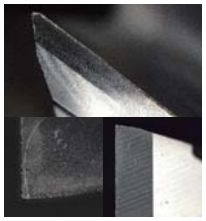
Stainless steel (X5CrNiMo17-12-2)

Cutting Condition vc(m/min) = 60, fz(mm/t) = 0.03, ap(mm) = 9.0, ae(mm) = 0.6, wet(emulsion)

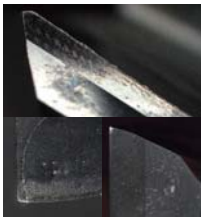
Tool SE504060 (Diameter = Ø6mm)



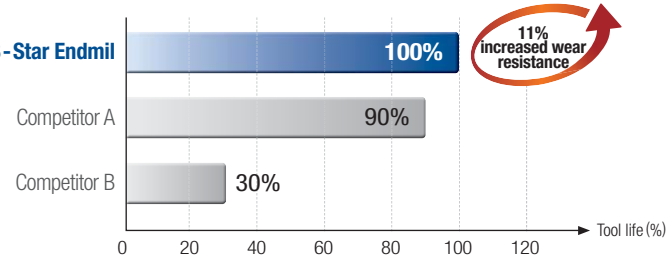
[S-Star Endmil]



[Competitor A]



[Competitor B]



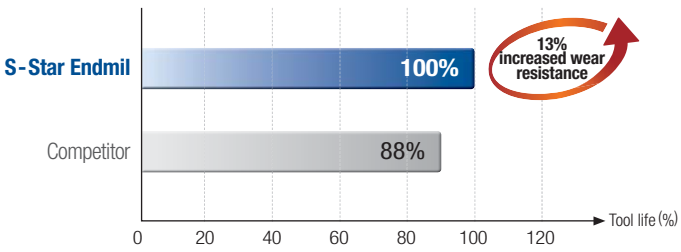
Titanium (Ti-6Al-4V)

Cutting Condition vc(m/min) = 65, fz(mm/t) = 0.07, ap(mm) = 0.6, wet(emulsion)

Tool SR50403003 (Diameter = Ø3mm)

[S-Star Endmil]

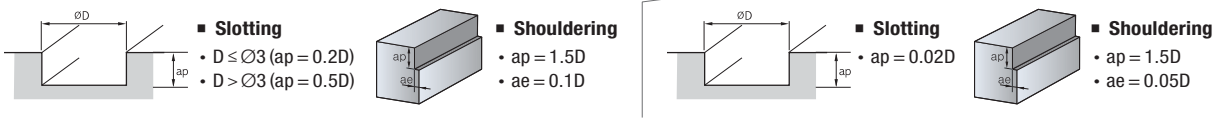
[Competitor]



Recommended cutting conditions _ SE502 (Flat)

Workpiece	Carbon steel, Alloy steel, Tool steel						Stainless steel				Titanium alloy		Inconel alloy	
Condition	~HRC20		~HRC30		HRC30~45		300 Series		400 Series					
Diameter (Ø)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)
1	31,800	570	30,100	570	28,700	570	22,300	450	31,800	640	22,300	520	9,600	190
1.2	26,500	480	25,100	480	23,900	480	18,600	370	26,500	530	18,600	430	8,000	160
1.5	21,200	380	20,100	380	19,100	380	14,900	300	21,200	420	14,900	340	6,400	130
2	15,900	430	15,000	430	14,300	430	11,100	270	15,900	380	11,100	260	4,800	100
2.5	12,700	410	12,000	410	11,500	410	8,900	250	12,700	360	8,900	310	3,800	110
3	11,700	420	11,100	420	10,600	420	8,500	340	11,700	470	8,500	290	4,200	130
4	8,800	480	8,400	480	8,000	480	6,400	380	8,800	530	6,400	300	3,200	130
5	7,000	510	6,700	510	6,400	510	5,100	410	7,000	560	5,100	290	2,500	130
6	5,800	520	5,600	530	5,300	530	4,200	420	5,800	580	4,200	290	2,100	130
8	4,400	520	4,200	520	4,000	520	3,200	420	4,400	570	3,200	260	1,600	110
10	3,500	440	3,300	440	3,200	450	2,500	350	3,500	490	2,500	250	1,300	110
12	2,900	420	2,800	430	2,700	430	2,100	340	2,900	460	2,100	240	1,100	110
14	2,500	370	2,400	380	2,300	380	1,800	200	2,500	280	1,800	250	900	110
16	2,200	340	2,100	340	2,000	340	1,600	270	2,200	370	1,600	260	800	110
18	1,900	310	1,900	320	1,800	320	1,400	270	1,900	360	1,400	240	700	110
20	1,800	320	1,700	320	1,600	320	1,300	260	1,800	360	1,300	240	600	100

<Application tip for depth of cut>



■ **Slotting**
- D ≤ Ø3 (ap = 0.2D)
- D > Ø3 (ap = 0.5D)

■ **Shouldering**
- ap = 1.5D
- ae = 0.1D

■ **Slotting**
- ap = 0.02D

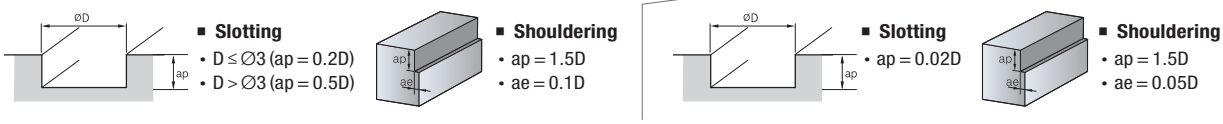
■ **Shouldering**
- ap = 1.5D
- ae = 0.05D

※ The data on the chart above is the shouldering cutting condition. In slotting, set the RPM and feed to 70% of the condition shown above.

Recommended cutting conditions _ SE503 (Flat)

Workpiece	Carbon steel, Alloy steel, Tool steel						Stainless steel				Titanium alloy		Inconel alloy	
Condition	~HRC20		~HRC30		HRC30~45		300 Series		400 Series					
Diameter (Ø)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)
1	35,000	950	33,400	950	31,800	950	22,300	670	31,800	950	22,300	770	9,600	290
1.2	29,200	790	27,900	800	26,500	800	18,600	560	26,500	800	18,600	640	8,000	240
1.5	23,400	630	22,300	640	21,200	640	14,900	450	21,200	640	14,900	520	6,400	190
2	17,500	710	16,700	710	15,900	720	11,100	400	15,900	570	11,100	380	4,800	140
2.5	14,000	680	13,400	690	12,700	690	8,900	370	12,700	530	8,900	460	3,800	170
3	12,700	690	12,300	700	11,700	700	8,500	510	11,700	700	8,500	440	4,200	190
4	9,600	780	9,200	790	8,800	790	6,400	580	8,800	790	6,400	440	3,200	190
5	7,600	820	7,400	840	7,000	840	5,100	610	7,000	840	5,100	440	2,500	190
6	6,400	870	6,100	870	5,800	870	4,200	630	5,800	870	4,200	440	2,100	190
8	4,800	840	4,600	850	4,400	860	3,200	620	4,400	860	3,200	390	1,600	170
10	3,800	720	3,700	740	3,500	740	2,500	530	3,500	740	2,500	370	1,300	170
12	3,200	690	3,100	710	2,900	700	2,100	500	2,900	700	2,100	360	1,100	170
14	2,700	610	2,600	620	2,500	620	1,800	300	2,500	410	1,800	370	900	160
16	2,400	550	2,300	560	2,200	560	1,600	410	2,200	560	1,600	390	800	170
18	2,100	510	2,000	510	1,900	510	1,400	400	1,900	540	1,400	360	700	160
20	1,900	510	1,800	510	1,800	540	1,300	390	1,800	540	1,300	360	600	140

<Application tip for depth of cut>



■ **Slotting**
- D ≤ Ø3 (ap = 0.2D)
- D > Ø3 (ap = 0.5D)

■ **Shouldering**
- ap = 1.5D
- ae = 0.1D

■ **Slotting**
- ap = 0.02D

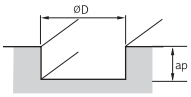
■ **Shouldering**
- ap = 1.5D
- ae = 0.05D

※ The data on the chart above is the shouldering cutting condition. In slotting, set the RPM and feed to 70% of the condition shown above.

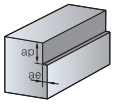
Recommended cutting conditions _ SE504 (Flat) / SR504 (Radius)

Workpiece	Carbon steel, Alloy steel, Tool steel						Stainless steel				Titanium alloy		Inconel alloy	
Condition	~HRC20		~HRC30		HRC30~45		300 Series		400 Series					
Diameter (Ø)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)
1	35,000	1,260	33,400	1,270	31,800	1,270	22,300	890	31,800	1,270	22,300	1,030	9,600	380
1.2	29,200	1,050	27,900	1,060	26,500	1,060	18,600	740	26,500	1,060	18,600	860	8,000	320
1.5	23,400	840	22,300	850	21,200	850	14,900	600	21,200	850	14,900	690	6,400	260
2	17,500	950	16,700	950	15,900	950	11,100	530	15,900	760	11,100	510	4,800	190
2.5	14,000	910	13,400	920	12,700	910	8,900	500	12,700	710	8,900	620	3,800	230
3	12,700	920	12,300	930	11,700	940	8,500	680	11,700	940	8,500	590	4,200	250
4	9,600	1,040	9,200	1,050	8,800	1,060	6,400	770	8,800	1,060	6,400	590	3,200	260
5	7,600	1,100	7,400	1,120	7,000	1,120	5,100	820	7,000	1,120	5,100	590	2,500	250
6	6,400	1,160	6,100	1,160	5,800	1,160	4,200	840	5,800	1,160	4,200	580	2,100	250
8	4,800	1,130	4,600	1,140	4,400	1,140	3,200	830	4,400	1,140	3,200	520	1,600	220
10	3,800	960	3,700	980	3,500	980	2,500	700	3,500	980	2,500	500	1,300	220
12	3,200	920	3,100	940	2,900	930	2,100	670	2,900	930	2,100	490	1,100	220
14	2,700	810	2,600	820	2,500	830	1,800	400	2,500	550	1,800	500	900	220
16	2,400	740	2,300	740	2,200	750	1,600	540	2,200	750	1,600	520	800	220
18	2,100	680	2,000	680	1,900	680	1,400	530	1,900	720	1,400	490	700	210
20	1,900	690	1,800	680	1,800	720	1,300	520	1,800	720	1,300	480	600	190

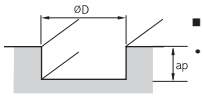
<Application tip for depth of cut>



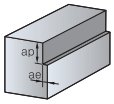
■ **Slotting**
- D ≤ Ø3 (ap = 0.2D)
- D > Ø3 (ap = 0.5D)



■ **Shouldering**
- ap = 1.5D
- ae = 0.1D



■ **Slotting**
- ap = 0.2D



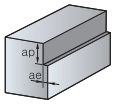
■ **Shouldering**
- ap = 1.5D
- ae = 0.05D

※ The data on the chart above is the shouldering cutting condition. In slotting, set the RPM and feed to 70% of the condition shown above.

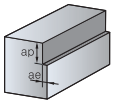
Recommended cutting conditions _ SE506 (Flat)

Workpiece	Carbon steel, Alloy steel, Tool steel						Stainless steel				Titanium alloy		Inconel alloy	
Condition	~HRC20		~HRC30		HRC30~45		300 Series		400 Series					
Diameter (Ø)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)
6	6,400	1,730	6,100	1,740	5,800	1,160	4,200	840	5,800	1,160	4,200	580	2,100	250
8	4,800	1,690	4,600	1,700	4,400	1,140	3,200	830	4,400	1,140	3,200	520	1,600	220
10	3,800	1,440	3,700	1,480	3,500	980	2,500	700	3,500	980	2,500	500	1,300	220
12	3,200	1,390	3,100	1,410	2,900	930	2,100	670	2,900	930	2,100	490	1,100	220
16	2,400	1,100	2,300	1,110	2,200	750	1,600	540	2,200	750	1,600	520	800	220
20	1,900	1,030	1,800	1,030	1,800	720	1,300	520	1,800	720	1,300	480	600	190

<Application tip for depth of cut>



■ **Shouldering**
- ap = 1.5D
- ae = 0.1D

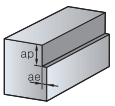


■ **Shouldering**
- ap = 1.5D
- ae = 0.05D

Recommended cutting conditions _ SR505/SR507 (Radius)

Workpiece	Carbon steel, Alloy steel, Tool steel						Stainless steel				Titanium alloy		인코넬 합금	
Condition	~HRC20		~HRC30		HRC30~45		300 Series		400 Series					
Diameter (Ø)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)
6	6,400	1,370	6,100	1,450	5,800	1,450	4,200	1,050	5,800	1,450	4,200	730	2,100	320
8	4,800	1,330	4,600	1,420	4,400	1,430	3,200	1,040	4,400	1,430	3,200	650	1,600	280
10	3,800	1,140	3,700	1,230	3,500	1,230	2,500	880	3,500	1,230	2,500	620	1,300	280
12	3,200	1,090	3,100	1,180	2,900	1,160	2,100	840	2,900	1,160	2,100	610	1,100	280
16	2,400	870	2,300	930	2,200	940	1,600	680	2,200	940	1,600	650	800	280
20	1,900	810	1,800	860	1,800	900	1,300	650	1,800	900	1,300	600	600	240

<Application tip for depth of cut>

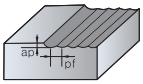


■ **Shouldering**
- ap = 1.0D
- ae = 0.05D

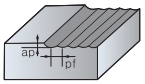
Recommended cutting conditions _ SB502 (Ball)

Workpiece	Carbon steel, Alloy steel, Tool steel						Stainless steel				Titanium alloy		Inconel alloy	
Condition	~HRC20		~HRC30		HRC30~45		300 Series		400 Series					
Diameter (Ø)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)
2	27,100	1,850	25,500	1,940	23,900	1,910	15,900	950	23,900	1,430	20,700	480	9,600	190
4	17,500	1,200	16,700	1,270	15,900	1,270	11,900	830	14,300	1,000	11,900	550	6,400	260
6	11,700	1,000	11,100	1,050	10,600	1,060	8,000	700	9,600	840	8,000	550	4,200	250
8	8,800	900	8,400	960	8,000	960	6,000	700	7,200	840	6,000	490	3,200	220
10	7,000	840	6,700	890	6,400	900	4,800	650	5,700	780	4,800	480	2,500	220
12	5,800	790	5,600	850	5,300	850	4,000	650	4,800	780	4,000	460	2,100	210

<Application tip for depth of cut>



■ **Shouldering**
- ap = 0.1D
- pf = 0.2D

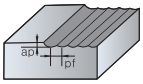


■ **Shouldering**
- ap = 0.05D
- pf = 0.1D

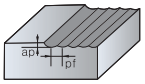
Recommended cutting conditions _ SB504 (Ball)

Workpiece	Carbon steel, Alloy steel, Tool steel						Stainless steel				Titanium alloy		Inconel alloy	
Condition	~HRC20		~HRC30		HRC30~45		300 Series		400 Series					
Diameter (Ø)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)
3	21,200	2,900	20,200	3,070	19,100	3,060	15,900	1,910	19,100	2,290	15,900	1,100	8,500	510
4	17,500	2,630	16,700	2,790	15,900	2,800	11,900	1,670	14,300	2,000	11,900	1,100	6,400	510
5	14,000	2,390	13,400	2,550	12,700	2,540	9,600	1,500	11,500	1,790	9,600	1,110	5,100	510
6	11,700	2,000	11,100	2,110	10,600	2,120	8,000	1,410	9,600	1,690	8,000	1,110	4,200	500
8	8,800	1,810	8,400	1,920	8,000	1,920	6,000	1,390	7,200	1,670	6,000	970	3,200	450
10	7,000	1,680	6,700	1,780	6,400	1,790	4,800	1,310	5,700	1,550	4,800	950	2,500	430
12	5,800	1,690	5,600	1,810	5,300	1,800	4,000	1,300	4,800	1,560	4,000	920	2,100	420
16	4,400	1,350	4,200	1,440	4,000	1,440	3,000	1,020	3,600	1,220	3,000	970	1,600	450
20	3,500	1,140	3,300	1,190	3,200	1,220	2,400	860	2,900	1,040	2,400	890	1,300	420

<Application tip for depth of cut>



■ **Shouldering**
- ap = 0.1D
- pf = 0.2D

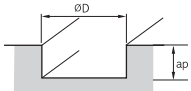


■ **Shouldering**
- ap = 0.05D
- pf = 0.1D

Recommended cutting conditions _ SF51H (Roughing)

Workpiece	Stainless steel			
Condition	300 Series		400 Series	
Diameter (Ø)	RPM n (min⁻¹)	Feed vf (mm/min)	RPM n (min⁻¹)	Feed vf (mm/min)
3	5,300	360	6,400	440
4	4,800	350	5,700	410
5	4,800	360	5,700	430
6	4,500	360	5,400	430
7	3,900	360	4,600	420
8	3,400	340	4,100	410
9	3,000	320	3,600	390
10	2,700	320	3,200	380
12	2,300	290	2,700	330
14	1,900	240	2,300	290
16	1,700	220	2,000	260
20	1,400	190	1,600	220

<Application tip for depth of cut>



■ **Slotting**
- D3~D5 = 0.3D
- D6~D10 = 0.25D
- D12~D16 = 0.15D
- D18~D20 = 0.1D

∗ If chattering is occurred even though workpiece is rigidly clamped, lower RPM and feed at the same rate shown in the chart above.

※ Notice

- Please adjust the recommended cutting conditions properly, according to the condition of your machines, the target shapes, and your purpose for machining.
- Please set the machine with high rigidity and check the workpiece's clamping status.
- Please select proper coolant oil for workpiece materials and check if the pressure and amount of coolant oil is adequate for machining.
- In case of chattering, reduce RPM and feed rate by the same ratio.

⚠ For the safe metalcutting

- Use safety supplies such as protective gloves to prevent possible injury while touching the edge of tools.
- Use safety glasess or safety cover to hedge possible dangers. Inappropriate usage or excessive cutting condition may lead tool's breakage or even the fragment's scattering.
- Clamp the workpiece tightly enough to prevent its movement while its machining.
- Properly manage the tool change phase because the inordinately used tool can be easily broken under the excessive cutting load or severe wear, and it may threat the operator's safety.
- Use safety cover because chips evacuated during cutting are hot and sharp and may cause burns and cuts. To remove chips safely, stop machining, put on protective gloves, and use a hook or other tools.
- Prepare for fire prevention measures as the use of the non-water soluble cutting oil may cause fire.
- Use safety cover and other safety supplies because the spare parts or the inserts can be pulled out due to centrifugal force while high speed machining.

KORLOY

Head Office: Holystar B/D, 326, Seocho-daero, Seocho-gu, Seoul, 06633, Republic of Korea
Tel: +82-2-522-3181 Fax: +82-2-522-3184, +82-2-3474-4744 Web: www.korloy.com E-mail: sales.khq@korloy.com

KORLOY AMERICA
620 Maple Avenue, Torrance, CA 90503, USA
Tel: +1-310-782-3800 Toll Free: +1-888-711-0001 Fax: +1-310-782-3885
E-mail: sales.kai@korloy.com

KORLOY INDIA
Plot No. 415, Sector 8, IMT Manesar, Gurgaon 122051, Haryana, India
Tel: +91-124-439-1790 Fax: +91-124-405-0032
E-mail: sales.kip@korloy.com

KORLOY TURKIYE
Serifali Mahallesi, Burhan Sokak NO: 34
Dudullu OSB/Umraniye/Istanbul, 34775, Turkiye
Tel: +90-216-415-8874 E-mail: sales.ktl@korloy.com

KORLOY RUSSIA
Krasivy Dom office No. 305, Bld. 5, Novovladykinskiy proezd 8, 127106, Moscow, Russia
Tel: +7-495-280-1486 Fax: +7-495-280-1459 E-mail: sales.krc@korloy.com

KORLOY FACTORY INDIA
Plot No. 415, Sector 8, IMT Manesar, Gurgaon 122051, Haryana, India
Tel: +91-124-439-1818 Fax: +91-124-405-0032
E-mail: pro.kim@korloy.com

KORLOY EUROPE
Gablonzer Str. 25-27, 61440 Oberursel, Germany
Tel: +49-6171-27783-0 Fax: +49-6171-27783-59
E-mail: sales.keg@korloy.com

KORLOY BRASIL
Av. Aruana 280, conj.12, WLC, Alphaville, Barueri, CEP06460-010, SP, Brasil
Tel: +55-114-193-3810 Fax: +55-114-193-5837
E-mail: sales.kbl@korloy.com

KORLOY CHILE
Av. Providencia 1650, Office 1009, 7500027
Providencia-Santiago, Chile
Tel: +56-229-295-490 E-mail: sales.kcs@korloy.com

KORLOY MEXICO
Calle R. M. Clemencia Borja Taboada 522, Jurica Acueducto,
76230 Juriquilla, Qro., Mexico
Tel: +52-442-673-73-88 E-mail: sales.kml@korloy.com

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