

BOLLER

NEW

BOLLER TECHNOLOGY

F3B02
F3R02
F3S02

Long Neck End Mill
for Hardened Steel



ISO9001:2015

Certificate No:NOA1612250



Innovative Coating from Switzerland

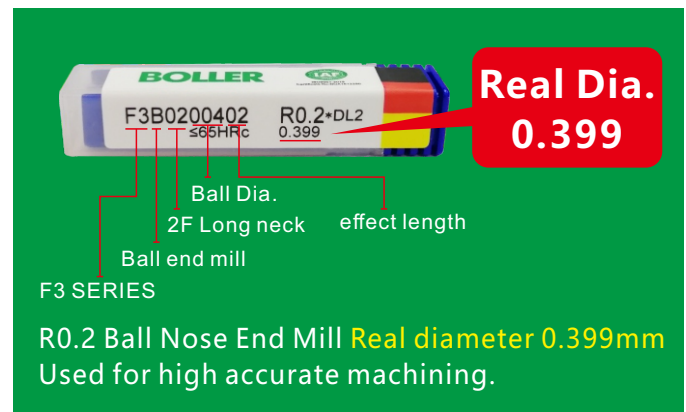
Excellent wear resistance

- 01** Ultra-accurate for ball radius, corner radius and shank diameter
- 02** Innovative coating specially for hardened steel
- 03** High performance cutting design
- 04** Products In Stock

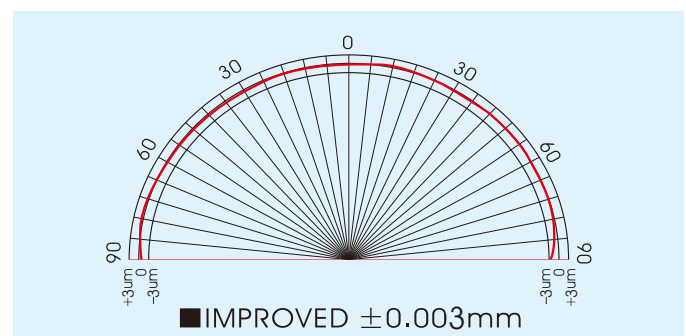


Features **01** BOLLER F3 High Tolerance

F3B02 Ball end mill	Diameter	Diameter Tolerance	Ball radius accuracy	Shank Dia. Tolerance
	R0.1 ~ R1.5	0 -0.005	± 0.003	$+0$ -0.004 (h4)
	R2	-0.005 -0.01		
	R2.5 ~ R3	-0.005 -0.015	± 0.005	



F3S02/F3S04 Square	Diameter	Diameter Tolerance	Shank Dia. Tolerance
	0.1 ~ 2	0 -0.005	$+0$ -0.004 (h4)
	2.5 ~ 3.5	-0.005 -0.01	
	4 ~ 6	-0.005 -0.015	



F3R02/F3R04 Corner radius	Diameter	Diameter Tolerance	Ball radius accuracy	Shank Dia. Tolerance
	0.1 ~ 2	0 -0.005	± 0.003	$+0$ -0.004 (h4)
	2.5 ~ 3.5	-0.005 -0.01		
	4 ~ 6	-0.005 -0.015	± 0.005	

Run-out accuracy within **0.5 μm**

Suitable for
MST UNO
Super accurate Shrink-fit holder



- ▼ Outstanding run-out accuracy together with the shrink fit holder
- ▼ Ideal for ultra high-speed and high-precision machining. Especially good for micro milling.
- ▼ Extends the tool life time
- ▼ Improve the quality of Micro machining

Features 02 BOLLER Innovative coating from Switzerland

NEW

Functional layer with excellent thermal shock resistance

New layer with excellent wear resistance and heat resistance

Applies nano-size composition

Carbide

Heat bring by chips 1200°

Heat Isolation 1100°

Heat distribution 500°

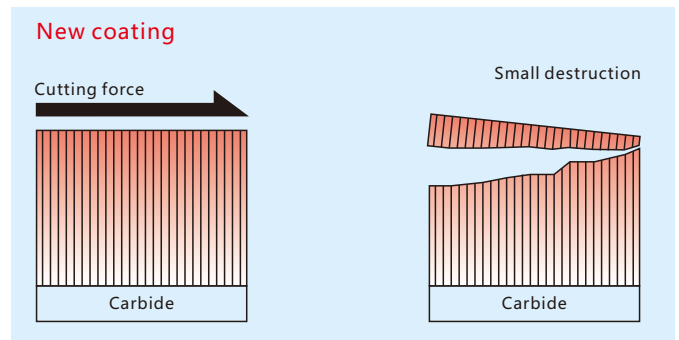
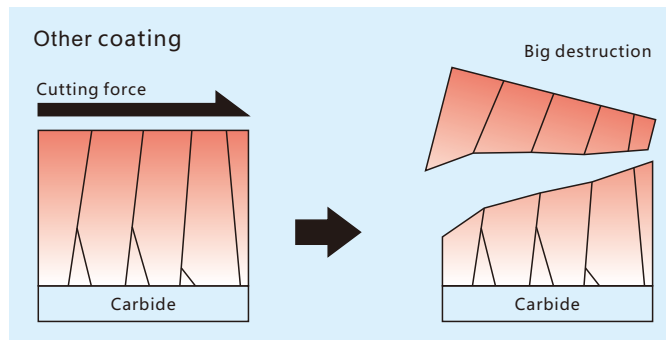
Solid Carbide Protected 300°

Performance

- High hardness layer with excellent wear resistance and heat resistance
- Excellent shock resistance enables to restrain the sudden abrasion of the tool
- Long tool life time when machining high hardened material (>HRC50°)

! Function of the coating

New coating reduces the destruction unit of the layer by applying "nano-tissue"

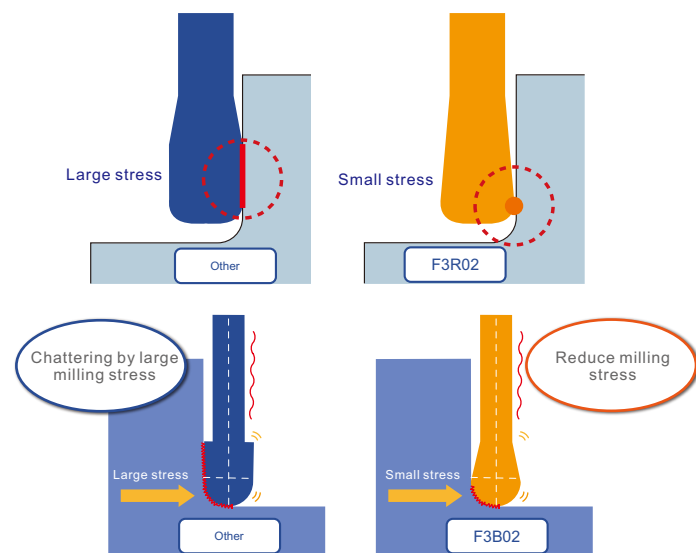


Features 03 BOLLER F3 High performance design

▶ Back draft effect

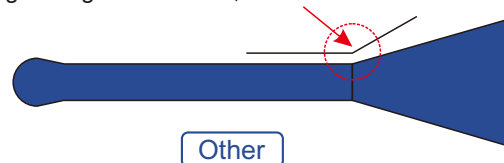
Achieves good quality processed surfaces.

Reduces chattering by performing point cutting



▶ Transition between neck and taper arc

Right-angle transition, stress concentration



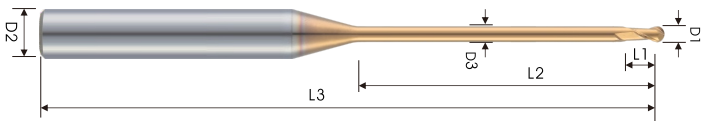
Arc transition to reduce stress concentration



R0.5 DI10, Neck length 10mm

It is possible to suppress deflection by increasing the neck rigidity.
10% of deflection is suppressed.
 (Theoretical value by our calculation)

F3B02 2-FLUTE LONG NECK BALL



ITEM CODE	RADIUS R	OUTSIDE DIA. D1	FLUTE LENGTH L1	EFFECTIVE LENGTH L2	NECK DIA. D3	SHANK DIA. D2	OVERALL LENGTH L3
F3B02001003	R0.05	0.1	0.07	0.3	0.085	4	45
F3B02001005				0.5			
F3B020015003	R0.075	0.15	0.1	0.3	0.13		
F3B020015005				0.5			
F3B02001501				1			
F3B02002005	R0.1	0.2	0.2	0.5	0.18		
F3B020020075				0.75			
F3B0200201				1			
F3B020020125				1.25			
F3B02002015				1.5			
F3B020020175				1.75			
F3B0200202				2			
F3B02002025				2.5			
F3B0200203				3			
F3B02003005	R0.15	0.3	0.3	0.5	0.28		
F3B02003006				0.6			
F3B020030075				0.75			
F3B0200301				1			
F3B020030125				1.25			
F3B02003015				1.5			
F3B020030175				1.75			
F3B0200302				2			
F3B020030225				2.25			
F3B02003025				2.5			
F3B0200303	R0.2	0.4	0.4	3	0.37		
F3B02003035				3.5			
F3B0200304				4			
F3B020040075				0.75			
F3B0200401				1			
F3B02004015				1.5			
F3B0200402				2			
F3B02004025				2.5			
F3B0200403				3			
F3B02004035				3.5			
F3B0200404	R0.25	0.5	0.4	4	0.46		
F3B02004045				4.5			
F3B0200405				5			
F3B0200406				6			
F3B0200501				1			
F3B02005015				1.5			
F3B0200502				2			
F3B02005025				2.5			
F3B0200503				3			
F3B02005035				3.5			

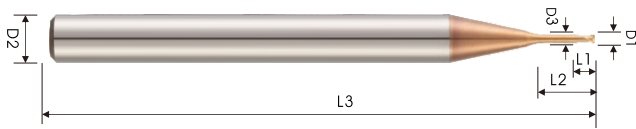
ITEM CODE	RADIUS R	OUTSIDE DIA. D1	FLUTE LENGTH L1	EFFECTIVE LENGTH L2	NECK DIA. D3	SHANK DIA. D2	OVERALL LENGTH L3
F3B0200504	R0.25	0.5	0.4	4	0.46	4	45
F3B02005045				4.5			
F3B0200505				5			
F3B02005055				5.5			
F3B0200506				6			
F3B0200508				8			
F3B0200510				10			
F3B0200601	R0.3	0.6	0.5	1	0.56		
F3B02006015				1.5			
F3B0200602				2			
F3B02006025				2.5			
F3B0200603				3			
F3B02006035				3.5			
F3B0200604				4			
F3B02006045				4.5			
F3B0200605				5			
F3B02006055				5.5			
F3B0200606				6			
F3B0200607				7			
F3B0200608				8			
F3B0200609				9			
F3B0200610				10			
F3B0200612	12						
F3B0200702	R0.35	0.7	0.5	2	0.66		
F3B0200704				4			
F3B0200706				6			
F3B0200708				8			
F3B0200802	R0.4	0.8	0.6	2	0.76		
F3B0200803				3			
F3B0200804				4			
F3B0200805				5			
F3B0200806				6			
F3B0200807				7			
F3B0200808				8			
F3B0200810				10			
F3B0200812				12			
F3B0201002	R0.5	1	0.8	2	0.95		
F3B02010025				2.5			
F3B0201003				3			
F3B0201004				4			
F3B0201005				5			
F3B0201006				6			
F3B0201007				7			
F3B0201008				8			
F3B0201010				10			
F3B0201012				12			
F3B0201014				14			
F3B0201016				16			
F3B0201018				18			
F3B0201020	20						
F3B0201022	22						

⚠ Tips: We recommend 4-flute if you use Φ1mm end mill. It will better extend tool life time and ensure surface clearance.

ITEM CODE	RADIUS R	OUTSIDE DIA. D1	FLUTE LENGTH L1	EFFECTIVE LENGTH L2	NECK DIA. D3	SHANK DIA. D2	OVERALL LENGTH L3	ITEM CODE	RADIUS R	OUTSIDE DIA. D1	FLUTE LENGTH L1	EFFECTIVE LENGTH L2	NECK DIA. D3	SHANK DIA. D2	OVERALL LENGTH L3
F3B02012024	R0.6	1.2	1	2.4	1.15	4	45	F3B0203006	R1.5	3	2.4	6	2.85	6	60
F3B0201204				4				F3B0203008				8			
F3B0201206				6				F3B0203010				10			
F3B0201208				8				F3B0203012				12			
F3B0201210				10				F3B0203014				14			
F3B0201212				12				F3B0203016				16			
F3B0201214				14				F3B0203020				20			
F3B0201216				16			F3B0203025	25				65			
F3B0201503	R0.75	1.5	1.2	3	1.45		45	F3B0203030	R1.75	3.5	2.8	30	3.35	6	70
F3B0201504				4				F3B0203035				35			80
F3B0201506				6				F3B0203040				40			90
F3B0201508				8				F3B0203515				15			60
F3B0201510				10			F3B0203520	20				60			
F3B0201512				12			F3B0203525	25				70			
F3B0201514				14			F3B0203530	30				70			
F3B0201516				16			F3B0203535	35				80			
F3B0201518				18		F3B0203540	40	90							
F3B0201520				20		F3B0203545	45	90							
F3B0201522				22		F3B0204008	8	4				50			
F3B0201530				30		F3B02040086	8					50			
F3B0202003	3	F3B0204010	10	50											
F3B0202004	4	F3B0204012	12	60											
F3B02020046	4	6	50	R2	4	3.2	3.8	6	60						
F3B0202006	6	4	45						F3B0204016	16	60				
F3B02020066	6	6	50						F3B0204020	20	60				
F3B0202008	8	4	45						F3B0204025	25	70				
F3B02020086	8	6	50						F3B0204030	30	70				
F3B0202010	10	4	45						F3B0204035	35	80				
F3B02020106	10	6	50						F3B0204040	40	85				
F3B0202012	12	4	45						F3B0204045	45	90				
F3B0202014	14		50						F3B0204050	50	100				
F3B0202016	16								F3B0205010	10	60				
F3B02020166	16		6						60	F3B0205015	15	60			
F3B0202018	18	4	55						F3B0205020	20	60				
F3B0202020	20			F3B0205025	25	70									
F3B0202022	22			F3B0205030	30	80									
F3B0202025	25		65	F3B0205040	40	90									
F3B02020256	25	6	80	F3B0206010	R3	6	6	5.7	60						
F3B0202030	30	4	70	F3B0206015					15	60					
F3B0202035	35			F3B0206020					20	60					
F3B0202040	40		90	F3B0206025					25	70					
F3B0202506	6		2.4	4					F3B0206030	30	80				
F3B0202508	8	F3B0206035							35	85					
F3B0202510	10	F3B0206040							40	90					
F3B0202515	15	50							F3B0206050	50	120				
F3B0202520	20	55			F3B0206060	60	120								
F3B0202525	25	65			⚠️ Tips: We recommend 4-flute if you use Φ1mm end mill. It will better extend tool life time and ensure surface clearance.										
F3B0202530	30	70													
F3B0202535	35	70													

⚠️ **Tips:** We recommend 4-flute if you use Φ1mm end mill.
It will better extend tool life time and ensure surface clearance.

F3S02 2-FLUTE LONG NECK END MILL

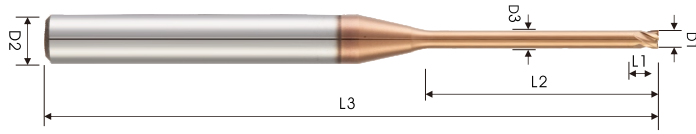


ITEM CODE	OUTSIDE DIA. D1	FLUTE LENGTH L1	EFFECTIVE LENGTH L2	NECK DIA. D3	SHANK DIA. D2	OVERALL LENGTH L3
F3S02001003	0.1	0.15	0.3	0.085	4	45
F3S02001005			0.5			
F3S02002005	0.2	0.3	0.5	0.18		
F3S0200201			1			
F3S02002015			1.5			
F3S0200301	0.3	0.4	1	0.28		
F3S02003015			1.5			
F3S0200302			2			
F3S0200303			3			
F3S0200304			4			
F3S0200401	0.4	0.6	1	0.37		
F3S0200402			2			
F3S0200403			3			
F3S0200404			4			
F3S0200405			5			
F3S0200502	0.5	0.7	2	0.46		
F3S0200504			4			
F3S0200506			6			
F3S0200508			8			
F3S0200602	0.6	1	2	0.56		
F3S0200603			3			
F3S0200604			4			
F3S0200606			6			
F3S0200608			8			
F3S0200610			10			
F3S0200802	0.8	1.2	2	0.76		
F3S0200804			4			
F3S0200806			6			
F3S0200808			8			
F3S0200810			10			
F3S0200812			12			
F3S0201004	1	1.5	4	0.95		
F3S0201006			6			
F3S0201008			8			
F3S0201010			10			
F3S0201012			12			
F3S0201016			16			
F3S0201020	1.2	1.8	20	1.15		50
F3S0201206			6			45
F3S0201208			8			
F3S0201210			10			
F3S0201212			12			
F3S0201216			16			50

ITEM CODE	OUTSIDE DIA. D1	FLUTE LENGTH L1	EFFECTIVE LENGTH L2	NECK DIA. D3	SHANK DIA. D2	OVERALL LENGTH L3
F3S0201506	1.5	2.3	6	1.43	4	45
F3S0201508			8			
F3S0201510			10			
F3S0201512			12			
F3S0201514			14			50
F3S0201516			16			
F3S0201518			18			
F3S0201520			20			
F3S0202006	2	3	6	1.91		
F3S0202008			8			
F3S0202010			10			
F3S0202012			12			
F3S0202014			14			50
F3S0202016			16			
F3S0202018			18			
F3S0202020			20			55
F3S0202025			25			60
F3S0202030			30			70
F3S0202510	2.5	3.7	10	2.4		45
F3S0202512			12			
F3S0202514			14			
F3S0202516			16			45
F3S0202518			18			
F3S0202525			20			
F3S0202520			25			70
F3S0202530			30			80
F3S0202535			35			
F3S0202540			40			
F3S0203010	3	4.5	10	2.85		45
F3S0203012			12			
F3S0203014			14			
F3S0203016			16			55
F3S0203018			18			
F3S0203020			20			
F3S0203025			25			65
F3S0203030			30			70
F3S0203035			35			80
F3S0203040			40			90
F3S0204012	4	6	12	3.8		60
F3S0204014			14			
F3S0204016			16			
F3S0204020			20			70
F3S0204025			25			
F3S0204030			30			
F3S0204035			35			80
F3S0204040			40			90
F3S0204045			45			
F3S0204050			50			

⚠ Tips: We recommend 4-flute if you use Φ1mm end mill. It will better extend tool life time and ensure surface clearance.

F3S04 4-FLUTE LONG NECK END MILL



ITEM CODE	OUTSIDE DIA. D1	FLUTE LENGTH L1	EFFECTIVE LENGTH L2	NECK DIA. D3	SHANK DIA. D2	OVERALL LENGTH L3
F3S0401004	1	4	0.8	0.95		50
F3S0401006		6				50
F3S0401008		8				50
F3S0401010		10				50
F3S0401506	1.5	6	1.2	1.45	4	50
F3S0401508		8				50
F3S0401510		10				50
F3S0401512		12				50
F3S0401514		14				60
F3S0401516		16				60
F3S0402006	2	6	1.6	1.91	4	50
F3S0402008		8				50
F3S0402010		10				50
F3S0402012		12				50
F3S0402014		14				60
F3S0402016		16				60
F3S0402018	2.5	18	2	2.4	6	60
F3S0402020		20				60
F3S0402508		8				50
F3S0402512		12				50
F3S0402516	3	16	4.5	2.85	6	60
F3S0402520		20				70
F3S0402525		25				70
F3S0403008		8				50
F3S0403012	4	12	6	3.8	6	50
F3S0403016		16				60
F3S0403020		20				70
F3S0403025		25				70
F3S0403030	5	30	7.5	4.75	6	70
F3S0404012		12				50
F3S0404016		16				60
F3S0404020		20				60
F3S0404030	6	30	9	5.7	6	70
F3S0404040		40				90
F3S0405016	5	16	7.5	4.75	6	60
F3S0405025		25				70
F3S0405035		35				80
F3S0406020	6	20	9	5.7	6	80
F3S0406030		30				90
F3S0406040		40				100

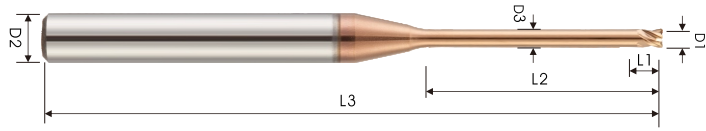
⚠ Tips: We recommend 4-flute if you use $\Phi 1$ mm end mill.
It will better extend tool life time and ensure surface clearance.

F3R02 2-FLUTE LONG NECK CORNER RADIUS



ITEM CODE	OUTSIDE DIA. D1	RADIUS R	EFFECTIVE LENGTH L2	FLUTE LENGTH L1	NECK DIA. D3	SHANK DIA. D2	OVERALL LENGTH L3
F3R02002005005	0.2	R0.05	0.5	0.15	0.18		
F3R0200200501			1				
F3R02002005015			1.5				
F3R0200200502			2				
F3R0200300501	0.3	R0.05	1	0.25	0.28		
F3R02003005015			1.5				
F3R0200300502			2				
F3R02003005025			2.5				
F3R0200300503	0.4	R0.05	3	0.3	0.37		
F3R0200400501			1				
F3R0200400502			2				
F3R0200400503			3				
F3R0200400504	0.5	R0.05	4	0.4	0.46	4	45
F3R020040101			1				
F3R020040102			2				
F3R020040103			3				
F3R020040104	0.6	R0.1	4	0.5	0.56		
F3R0200500501			1				
F3R0200500502			2				
F3R0200500503			3				
F3R0200500504	0.8	R0.05	4	0.65	0.76		
F3R0200500505			5				
F3R020050101			1				
F3R020050102			2				
F3R020050103	0.6	R0.1	3	0.5	0.56		
F3R020050104			4				
F3R020050105			5				
F3R0200600502			6				
F3R0200600504	0.8	R0.1	4	0.65	0.76		
F3R0200600506			6				
F3R020060102			2				
F3R020060104			4				
F3R020060106	0.8	R0.2	6	0.65	0.76		
F3R0200800504			4				
F3R0200800506			6				
F3R0200800508			8				
F3R020080104	0.8	R0.2	4	0.65	0.76		
F3R020080106			6				
F3R020080108			8				
F3R020080204			4				
F3R020080206	0.8	R0.2	6	0.65	0.76		
F3R020080208			8				

F3R04 4-FLUTE LONG NECK CORNER RADIUS



ITEM CODE	OUTSIDE DIA. D1	RADIUS R	EFFECTIVE LENGTH L2	FLUTE LENGTH L1	NECK DIA. D3	SHANK DIA. D2	OVERALL LENGTH L3
F3R0401000503	1	R0.05	3	0.8	0.95	4	50
F3R0401000504			4				
F3R0401000505			5				
F3R0401000506			6				
F3R0401000508			8				
F3R0401000510			10				
F3R0401000512			12				
F3R040100103		R0.1	3				
F3R040100104			4				
F3R040100105			5				
F3R040100106			6				
F3R040100108			8				
F3R040100110			10				
F3R040100112			12				
F3R040100203		R0.2	3				
F3R040100204			4				
F3R040100205			5				
F3R040100206			6				
F3R040100208			8				
F3R040100210			10				
F3R040100212			12				
F3R040100303		R0.3	3				
F3R040100304			4				
F3R040100305			5				
F3R040100306			6				
F3R040100308			8				
F3R040100310			10				
F3R040100312			12				
F3R040120105	1.2	R0.1	5	1	1.14		60
F3R040120110			10				
F3R040120115			15				
F3R040120205		R0.2	5				50
F3R040120210			10				
F3R040120215			15				
F3R040120305		R0.3	5				50
F3R040120310			10				
F3R040120315			15				

ITEM CODE	OUTSIDE DIA. D1	RADIUS R	EFFECTIVE LENGTH L2	FLUTE LENGTH L1	NECK DIA. D3	SHANK DIA. D2	OVERALL LENGTH L3
F3R040150106	1.5	R0.1	6	1.2	1.45		50
F3R040150112			12				60
F3R040150118			18				50
F3R040150206		R0.2	6				60
F3R040150212			12				50
F3R040150218			18				60
F3R040150306		R0.3	6				50
F3R040150312			12				60
F3R040150318			18				50
F3R040150506		R0.5	6				60
F3R040150512			12				50
F3R040150518			18				60
F3R040200108	2	R0.1	8	1.6	1.94	4	50
F3R040200112			12				60
F3R040200116			16				70
F3R040200120			20				50
F3R040200124		R0.2	24				60
F3R040200208			8				70
F3R040200212			12				50
F3R040200216			16				60
F3R040200220			20				70
F3R040200224		R0.3	24				50
F3R040200308			8				60
F3R040200312			12				70
F3R040200316			16				50
F3R040200320			20				60
F3R040200324		R0.5	24				70
F3R040200508			8				50
F3R040200512			12				60
F3R040200516			16				70
F3R040200520			20				50
F3R040200524			24				60
F3R040250110	2.5	R0.1	10	2	2.4		50
F3R040250120			20				60
F3R040250130			30				70
F3R040250210		R0.2	10				50
F3R040250220			20				60
F3R040250230			30				70
F3R040250310		R0.3	10				50
F3R040250320			20				60
F3R040250330			30				70

⚠ Tips: We recommend 4-flute if you use Φ1mm end mill. It will better extend tool life time and ensure surface clearance.

ITEM CODE	OUTSIDE DIA. D1	RADIUS R	EFFECTIVE LENGTH L2	FLUTE LENGTH L1	NECK DIA. D3	SHANK DIA. D2	OVERALL LENGTH L3
F3R040250510	2.5	R0.5	10	2	2.4	4	50
F3R040250520			20				60
F3R040250530			30				70
F3R040300112	3	R0.1	12	2.5	2.85	6	50
F3R040300118			18				60
F3R040300124			24				70
F3R040300130			30				70
F3R040300136			36				80
F3R040300212		R0.2	12				50
F3R040300218			18				60
F3R040300224			24				70
F3R040300230			30				70
F3R040300236			36				80
F3R040300312		R0.3	12				50
F3R040300318			18				60
F3R040300324			24				70
F3R040300330			30				70
F3R040300336			36				80
F3R040300512		R0.5	12				50
F3R040300518			18				60
F3R040300524			24				70
F3R040300530			30				70
F3R040300536			36				80
F3R040301012		R1	12				50
F3R040301018			18				60
F3R040301024			24				70
F3R040301030			30				70
F3R040301036			36				80
F3R040400116	4	R0.1	16	3.2	3.8		60
F3R040400124			24				70
F3R040400132			32				70
F3R040400148			48				100
F3R040400216		R0.2	16				60
F3R040400224			24				70
F3R040400232			32				70
F3R040400248			48				100
F3R040400316		R0.3	16				60
F3R040400324			24				70
F3R040400332			32				70
F3R040400348			48				100
F3R040400516		R0.5	16				60
F3R040400524			24				70
F3R040400532			32				70
F3R040400548			48				100
F3R040401016		R1	16				60
F3R040401024			24				70
F3R040401032			32				70
F3R040401048			48				100

Key points	 Instructions and Advices
Rigidity of Machine	① Use a rigid machine for the machining. ② Adjust cutting depth and parameters when lack of rigidity.
Collet Chuck and Run out of End Mill	① Use a rigid and precise collet chuck. ② Minimize the deflection of tool when processing.
Work Clamp	① Work piece must be firmly clamped. ② In case of failure, adjust cutting depth and parameters.
Cutting fluid and dispose of chips	① Give sufficient concentrated cutting fluid. ② Recommend water-base cutting fluid for heavy cutting. ③ Part of the end mills are applied to dry cutting only. ④ Use air blow for cooling when apply dry cutting. ⑤ Remove chips from working area to smoothen the supply of cutting fluid or the machining.
Selection of End Mill	① Select most suitable end mills according to work material and dimension. ② Refer to the index table in the front page.
Cutting parameter	① Refer to recommended milling condition table. ② Adjust process conditions according to the machine rigidity and clamping condition of the work piece.
Overhang of End Mill from Tool Holder	① Overhang of end mill must be as short as possible from tool holder. ② In case of overhang, adjust the cutting condition and parameters.

F3B02 2-FLUTE LONG NECK BALL



Recommended Milling Conditions

Work Material		Carbon Steels · Prehardened Steels S50C · NAK55 · NAK80 · HPM-1 ~43HRC				Hardened Steels HPM-38 · STAVAX · SKD61 ~55HRC				Hardened Steels SKD11 · PD613 ~62HRC				Copper			
Radius	Effective Length	Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut	
		min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm
0.05	0.3	40000	80	0.005	0.005	30000~50000	60	0.003	0.003	30000~50000	50	0.003	0.003	30000~50000	80	0.005	0.005
	0.5	40000	70	0.003	0.003	30000~50000	40	0.003	0.003	30000~50000	40	0.003	0.003	30000~50000	70	0.005	0.005
0.075	0.3	40000	150	0.005	0.015	30000~50000	120	0.003	0.005	30000~50000	90	0.002	0.005	30000~50000	150	0.008	0.01
	0.5	40000	150	0.004	0.007	30000~50000	120	0.003	0.005	30000~50000	90	0.002	0.005	30000~50000	150	0.007	0.008
0.1	1	39000	100	0.003	0.005	30000~50000	70	0.002	0.003	30000~50000	60	0.001	0.003	30000~50000	100	0.005	0.007
	0.5	39000	250	0.01	0.02	30000~50000	210	0.01	0.01	30000~50000	170	0.007	0.007	30000~50000	250	0.01	0.02
	0.75	39000	250	0.007	0.01	30000~50000	210	0.005	0.01	30000~50000	170	0.004	0.007	30000~50000	250	0.01	0.015
	1	39000	250	0.005	0.01	30000~50000	210	0.003	0.005	30000~50000	170	0.002	0.004	30000~50000	250	0.008	0.015
	1.25	39000	150	0.003	0.01	30000~50000	120	0.003	0.005	30000~50000	100	0.002	0.004	30000~50000	150	0.005	0.015
	1.5	38000	150	0.003	0.01	30000~50000	120	0.003	0.005	30000~50000	100	0.002	0.004	30000~50000	150	0.005	0.015
	1.75	38000	150	0.003	0.007	30000~50000	120	0.002	0.005	30000~50000	100	0.002	0.003	30000~50000	150	0.005	0.01
	2	38000	100	0.003	0.005	30000~50000	80	0.002	0.003	30000~50000	70	0.002	0.003	30000~50000	100	0.005	0.007
	2.5	37000	100	0.003	0.005	30000~50000	80	0.002	0.003	30000~50000	70	0.002	0.003	30000~50000	100	0.005	0.007
	3	37000	80	0.002	0.003	30000~50000	60	0.002	0.002	30000~50000	50	0.002	0.002	30000~50000	80	0.003	0.004
	0.5	36000	250	0.01	0.02	20000~50000	210	0.01	0.015	20000~50000	170	0.007	0.01	20000~50000	250	0.012	0.025
	0.6	36000	250	0.01	0.02	20000~50000	210	0.01	0.015	20000~50000	170	0.007	0.01	20000~50000	250	0.012	0.025
0.15	0.75	36000	250	0.008	0.015	20000~50000	210	0.007	0.01	20000~50000	170	0.005	0.007	20000~50000	250	0.01	0.02
	1	35000	250	0.007	0.01	20000~50000	210	0.005	0.01	20000~50000	170	0.004	0.007	20000~50000	250	0.01	0.02
	1.25	35000	250	0.005	0.01	20000~50000	210	0.005	0.005	20000~50000	170	0.004	0.004	20000~50000	250	0.008	0.015
	1.5	35000	200	0.005	0.01	20000~50000	170	0.005	0.005	20000~50000	140	0.004	0.004	20000~50000	200	0.008	0.015
	1.75	35000	200	0.005	0.01	20000~50000	170	0.005	0.005	20000~50000	140	0.004	0.004	20000~50000	200	0.008	0.015
	2	34000	150	0.003	0.01	20000~50000	120	0.003	0.005	20000~50000	100	0.002	0.003	20000~50000	150	0.005	0.012
	2.25	34000	150	0.003	0.01	20000~50000	120	0.003	0.005	20000~50000	100	0.002	0.003	20000~50000	150	0.005	0.012
	2.5	34000	150	0.003	0.007	20000~50000	120	0.003	0.003	20000~50000	100	0.002	0.002	20000~50000	150	0.005	0.01
	3	33000	150	0.003	0.005	20000~50000	120	0.003	0.003	20000~50000	100	0.002	0.002	20000~50000	150	0.005	0.007
	3.5	33000	100	0.003	0.005	20000~50000	80	0.003	0.003	20000~50000	70	0.002	0.002	20000~50000	100	0.005	0.007
	4	33000	100	0.003	0.005	20000~50000	80	0.003	0.003	20000~50000	70	0.002	0.002	20000~50000	100	0.005	0.007
	0.5	35000	800	0.02	0.05	20000~50000	650	0.02	0.03	20000~50000	560	0.015	0.02	20000~50000	800	0.03	0.07
0.2	0.75	35000	800	0.02	0.05	20000~50000	650	0.02	0.03	20000~50000	560	0.015	0.02	20000~50000	800	0.03	0.07
	1	35000	800	0.02	0.05	20000~50000	650	0.02	0.03	20000~50000	560	0.015	0.02	20000~50000	800	0.03	0.07
	1.5	33000	700	0.02	0.03	20000~50000	600	0.01	0.02	20000~50000	490	0.007	0.015	20000~50000	700	0.03	0.05
	2	33000	600	0.015	0.02	20000~50000	500	0.01	0.015	20000~50000	420	0.007	0.01	20000~50000	600	0.02	0.03
	2.5	33000	450	0.015	0.02	20000~50000	380	0.01	0.015	20000~50000	310	0.007	0.01	20000~50000	450	0.02	0.03
	3	33000	400	0.01	0.02	20000~30000	340	0.01	0.01	20000~30000	280	0.007	0.007	20000~30000	400	0.015	0.03
	3.5	31000	350	0.01	0.015	20000~30000	300	0.01	0.01	20000~30000	240	0.007	0.007	20000~30000	350	0.015	0.02
	4	31000	250	0.005	0.01	20000~30000	210	0.005	0.007	20000~30000	170	0.004	0.004	20000~30000	250	0.008	0.015
	4.5	30000	200	0.005	0.007	20000~30000	170	0.005	0.005	20000~30000	140	0.004	0.004	20000~30000	200	0.008	0.01
	5	30000	150	0.003	0.005	20000~30000	120	0.003	0.005	20000~30000	100	0.002	0.003	20000~30000	150	0.005	0.007
	6	30000	80	0.003	0.003	20000~30000	60	0.003	0.003	20000~30000	50	0.002	0.002	20000~30000	80	0.005	0.005
	1	34000	800	0.03	0.05	20000~50000	680	0.02	0.05	20000~50000	560	0.015	0.035	20000~50000	800	0.045	0.07
0.25	1.5	34000	700	0.03	0.05	20000~50000	600	0.02	0.04	20000~50000	490	0.015	0.03	20000~50000	700	0.04	0.07
	2	34000	600	0.02	0.04	20000~50000	510	0.02	0.03	20000~50000	420	0.015	0.02	20000~50000	600	0.03	0.06
	2.5	34000	600	0.015	0.04	20000~50000	510	0.01	0.03	20000~50000	420	0.007	0.02	20000~50000	600	0.02	0.06
	3	32000	500	0.015	0.035	20000~50000	420	0.01	0.025	20000~50000	350	0.007	0.015	20000~50000	500	0.02	0.05
	3.5	32000	400	0.015	0.03	20000~50000	340	0.01	0.02	20000~50000	280	0.007	0.015	20000~50000	400	0.02	0.045

▶ F3B02 2-FLUTE LONG NECK BALL



Recommended Milling Conditions

Work Material		Carbon Steels · Prehardened Steels S50C · NAK55 · NAK80 · HPM-1 ~43HRC				Hardened Steels HPM-38 · STAVAX · SKD61 ~55HRC				Hardened Steels SKD11 · PD613 ~62HRC				Copper			
Radius	Effective Length	Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut	
		min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm
0.25	4	30000	400	0.012	0.02	20000~50000	340	0.005	0.01	20000~50000	280	0.004	0.007	20000~50000	400	0.018	0.03
	4.5	30000	320	0.008	0.01	20000~50000	270	0.005	0.005	20000~50000	220	0.004	0.004	20000~50000	320	0.012	0.015
	5	30000	250	0.005	0.01	20000~30000	210	0.005	0.005	20000~30000	170	0.003	0.003	20000~30000	250	0.008	0.015
	5.5	30000	200	0.005	0.007	20000~30000	170	0.003	0.003	20000~30000	140	0.002	0.002	20000~30000	200	0.008	0.01
	6	30000	150	0.005	0.005	20000~30000	120	0.003	0.003	20000~30000	100	0.002	0.002	20000~30000	150	0.008	0.008
	8	28000	120	0.003	0.003	20000~30000	100	0.002	0.002	20000~30000	80	0.002	0.002	20000~30000	120	0.005	0.005
	10	27000	80	0.002	0.002	18000~24000	60	0.002	0.002	18000~24000	50	0.002	0.002	18000~24000	80	0.003	0.003
0.3	1	33000	1200	0.05	0.1	20000~50000	1000	0.05	0.07	20000~50000	840	0.035	0.05	20000~50000	1200	0.07	0.12
	1.5	33000	1200	0.05	0.1	20000~50000	1000	0.05	0.07	20000~50000	840	0.035	0.05	20000~50000	1200	0.07	0.12
	2	33000	1200	0.05	0.1	20000~50000	1000	0.04	0.07	20000~50000	840	0.028	0.05	20000~50000	1200	0.07	0.12
	2.5	33000	1200	0.035	0.1	20000~50000	1000	0.03	0.06	20000~50000	840	0.02	0.04	20000~50000	1200	0.05	0.12
	3	31000	1000	0.025	0.1	20000~50000	850	0.03	0.05	20000~50000	700	0.02	0.035	20000~50000	1000	0.04	0.1
	3.5	31000	1000	0.025	0.08	20000~50000	850	0.02	0.05	20000~50000	700	0.015	0.035	20000~50000	1000	0.04	0.1
	4	31000	800	0.025	0.05	20000~50000	680	0.02	0.04	20000~50000	560	0.015	0.03	20000~50000	800	0.035	0.08
	4.5	31000	750	0.025	0.05	20000~50000	630	0.01	0.03	20000~50000	520	0.007	0.02	20000~50000	750	0.035	0.08
	5	30000	500	0.02	0.04	20000~30000	420	0.01	0.02	20000~30000	350	0.007	0.015	20000~30000	500	0.03	0.06
	5.5	30000	500	0.013	0.02	20000~30000	420	0.01	0.01	20000~30000	350	0.007	0.007	20000~30000	500	0.02	0.03
	6	28000	450	0.01	0.02	20000~30000	380	0.005	0.01	20000~30000	310	0.004	0.007	20000~30000	450	0.015	0.03
	7	28000	400	0.008	0.02	20000~30000	340	0.005	0.005	20000~30000	280	0.004	0.004	20000~30000	400	0.012	0.03
	8	26000	300	0.005	0.01	18000~24000	250	0.003	0.005	18000~24000	210	0.002	0.004	18000~24000	300	0.008	0.015
	9	25000	250	0.005	0.01	18000~24000	210	0.003	0.003	18000~24000	170	0.002	0.002	18000~24000	250	0.007	0.015
0.35	10	23000	150	0.003	0.005	18000~24000	120	0.002	0.003	18000~24000	100	0.002	0.002	18000~24000	150	0.005	0.008
	12	20000	80	0.003	0.003	16000~20000	60	0.002	0.002	16000~20000	50	0.002	0.002	16000~20000	80	0.005	0.005
	2	33000	1800	0.08	0.12	20000~50000	1300	0.07	0.08	20000~30000	1000	0.04	0.06	20000~30000	1500	0.1	0.15
	4	33000	1300	0.05	0.11	20000~50000	1100	0.03	0.06	20000~30000	700	0.02	0.04	20000~30000	1200	0.06	0.12
	6	30000	700	0.03	0.05	20000~30000	600	0.01	0.02	20000~30000	450	0.008	0.015	20000~30000	600	0.04	0.07
0.4	8	28000	400	0.005	0.01	18000~24000	330	0.003	0.005	14000~21000	250	0.002	0.003	18000~24000	400	0.008	0.01
	2	33000	2000	0.1	0.15	20000~50000	1700	0.1	0.12	14000~35000	1400	0.07	0.085	20000~50000	2000	0.15	0.2
	3	33000	1800	0.07	0.15	20000~50000	1500	0.07	0.1	14000~35000	1200	0.05	0.07	20000~50000	1800	0.12	0.2
	4	33000	1500	0.05	0.12	20000~50000	1300	0.05	0.08	14000~35000	1000	0.035	0.055	20000~50000	1500	0.1	0.2
	5	30000	1200	0.05	0.1	20000~50000	1000	0.04	0.07	14000~35000	840	0.03	0.05	20000~50000	1200	0.08	0.15
	6	29000	900	0.05	0.08	20000~30000	750	0.03	0.05	14000~21000	630	0.02	0.035	20000~30000	900	0.07	0.12
	7	29000	700	0.03	0.05	20000~30000	600	0.02	0.03	14000~21000	490	0.015	0.02	20000~30000	700	0.05	0.08
	8	27000	500	0.015	0.03	18000~24000	420	0.01	0.01	12600~16800	350	0.007	0.007	18000~24000	500	0.02	0.05
	10	24000	350	0.005	0.01	18000~24000	300	0.003	0.005	12600~16800	240	0.002	0.003	18000~24000	350	0.008	0.008
	12	22000	250	0.005	0.005	16000~20000	210	0.003	0.003	11200~14000	170	0.002	0.002	16000~20000	250	0.008	0.008
0.5	2	32000	3200	0.25	0.35	20000~50000	2500	0.12	0.3	14000~35000	2300	0.085	0.2	20000~50000	3500	0.25	0.4
	2.5	32000	3000	0.25	0.3	20000~50000	2500	0.12	0.3	14000~35000	2000	0.08	0.2	20000~50000	3200	0.25	0.4
	3	32000	3000	0.2	0.3	20000~50000	2500	0.12	0.3	14000~35000	2100	0.08	0.2	20000~50000	3000	0.25	0.4
	4	32000	2500	0.15	0.25	20000~50000	2100	0.1	0.2	14000~35000	1700	0.07	0.14	20000~50000	2500	0.2	0.4
	5	32000	2000	0.1	0.25	20000~50000	1700	0.08	0.17	14000~35000	1400	0.055	0.12	20000~50000	2000	0.15	0.35
	6	30000	1500	0.1	0.2	20000~50000	1200	0.07	0.12	14000~35000	1000	0.05	0.085	20000~50000	1500	0.15	0.3
	7	30000	1300	0.08	0.2	20000~30000	1100	0.06	0.1	14000~21000	910	0.04	0.07	20000~30000	1300	0.12	0.3
	8	28000	1200	0.05	0.1	20000~30000	1000	0.05	0.08	14000~21000	840	0.035	0.055	20000~30000	1200	0.08	0.15
	10	26000	1000	0.04	0.06	20000~30000	850	0.05	0.05	14000~21000	700	0.035	0.035	20000~30000	1000	0.06	0.1
	12	20000	600	0.015	0.025	16000~20000	510	0.01	0.03	11200~14000	420	0.007	0.02	16000~20000	600	0.02	0.04

F3B02 2-FLUTE LONG NECK BALL



Recommended Milling Conditions

Work Material		Carbon Steels · Prehardened Steels S50C · NAK55 · NAK80 · HPM-1 ~43HRC				Hardened Steels HPM-38 · STAVAX · SKD61 ~55HRC				Hardened Steels SKD11 · PD613 ~62HRC				Copper			
Radius	Effective Length	Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut	
		min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm
0.5	14	20000	500	0.01	0.02	16000~20000	420	0.005	0.01	11200~14000	350	0.004	0.007	16000~20000	500	0.015	0.03
	16	15000	250	0.005	0.01	12000~16000	210	0.005	0.01	8400~11200	170	0.004	0.007	12000~16000	250	0.01	0.015
	18	15000	150	0.005	0.005	12000~16000	120	0.003	0.003	8400~11200	100	0.002	0.002	12000~16000	150	0.008	0.01
	20	13000	100	0.005	0.005	12000~16000	80	0.003	0.003	8400~11200	70	0.002	0.002	12000~16000	100	0.008	0.008
	22	10000	80	0.003	0.005	12000~16000	60	0.002	0.003	8400~11200	50	0.002	0.002	12000~16000	80	0.005	0.008
0.6	2.4	30000	3400	0.25	0.35	20000~30000	2500	0.12	0.3	14000~21000	2500	0.09	0.21	20000~30000	3400	0.3	0.45
	4	30000	3000	0.2	0.3	20000~30000	2500	0.12	0.3	14000~21000	2100	0.085	0.21	20000~30000	3000	0.28	0.45
	6	30000	2000	0.1	0.25	20000~30000	1700	0.08	0.17	14000~21000	1400	0.055	0.12	20000~30000	2000	0.15	0.4
	8	30000	1300	0.08	0.2	20000~30000	1100	0.06	0.15	14000~21000	910	0.04	0.1	20000~30000	1300	0.12	0.3
	10	25000	1200	0.05	0.1	14000~20000	1000	0.03	0.08	9800~14000	840	0.02	0.055	14000~20000	1200	0.08	0.15
	12	24000	800	0.03	0.05	14000~20000	680	0.02	0.04	9800~14000	560	0.015	0.03	14000~20000	800	0.05	0.08
	14	21000	600	0.015	0.025	14000~20000	510	0.01	0.02	9800~14000	420	0.007	0.015	14000~20000	600	0.02	0.04
	16	20000	400	0.01	0.02	14000~20000	340	0.01	0.01	9800~14000	280	0.007	0.007	14000~20000	400	0.015	0.03
0.75	3	30000	4000	0.2	0.35	20000~30000	3400	0.15	0.3	14000~21000	2800	0.1	0.18	20000~30000	4000	0.3	0.5
	4	30000	4000	0.2	0.3	20000~30000	3400	0.15	0.25	14000~21000	2800	0.09	0.15	20000~30000	4000	0.3	0.45
	6	30000	3000	0.15	0.3	20000~30000	2500	0.12	0.2	14000~21000	2100	0.07	0.12	20000~30000	3000	0.2	0.45
	8	30000	2400	0.1	0.25	20000~30000	2000	0.08	0.18	14000~21000	1700	0.05	0.11	20000~30000	2400	0.15	0.4
	10	28000	1800	0.08	0.2	20000~30000	1500	0.06	0.12	14000~21000	1200	0.035	0.07	20000~30000	1800	0.12	0.3
	12	26000	1200	0.07	0.13	18000~24000	1000	0.05	0.09	12600~16800	840	0.03	0.055	18000~24000	1200	0.1	0.2
	14	24000	1200	0.06	0.1	18000~24000	1000	0.04	0.07	12600~16800	840	0.025	0.04	18000~24000	1200	0.1	0.15
	16	20000	800	0.05	0.08	12000~18000	680	0.035	0.06	8400~12600	560	0.02	0.035	12000~18000	800	0.07	0.12
	18	17000	500	0.03	0.05	12000~18000	420	0.02	0.04	8400~12600	350	0.012	0.025	12000~18000	500	0.05	0.08
	20	15000	400	0.02	0.04	12000~18000	340	0.015	0.03	8400~12600	280	0.01	0.02	12000~18000	400	0.03	0.06
	22	12000	250	0.01	0.02	10000~14000	210	0.005	0.005	7000~9800	170	0.003	0.003	10000~14000	250	0.02	0.03
	30	10000	100	0.005	0.005	10000~14000	80	0.003	0.005	7000~9800	70	0.002	0.003	10000~14000	100	0.01	0.008
1	3	25000	4000	0.3	0.5	20000~30000	3400	0.2	0.5	14000~21000	2800	0.12	0.3	20000~30000	4000	0.45	0.7
	4	25000	4000	0.3	0.5	20000~30000	3400	0.2	0.45	14000~21000	2800	0.12	0.27	20000~30000	4000	0.45	0.7
	6	25000	3000	0.25	0.5	20000~30000	2500	0.2	0.4	14000~21000	2100	0.12	0.24	20000~30000	3000	0.38	0.7
	8	22000	2500	0.2	0.3	16000~20000	2100	0.15	0.3	11200~14000	1700	0.09	0.18	16000~20000	2500	0.3	0.45
	10	20000	2500	0.15	0.3	16000~20000	2100	0.1	0.2	11200~14000	1700	0.06	0.12	16000~20000	2500	0.23	0.45
	12	15000	1,800	0.13	0.2	12000~16000	1,500	0.1	0.15	8400~11200	1,300	0.06	0.09	12000~16000	1,800	0.2	0.3
	14	15000	1,800	0.1	0.2	12000~16000	1,500	0.07	0.13	8400~11200	1,300	0.04	0.08	12000~16000	1,800	0.15	0.3
	16	12000	1,600	0.1	0.15	10000~14000	1,400	0.06	0.11	7000~9800	1,100	0.035	0.065	10000~14000	1,600	0.15	0.25
	18	12000	1,600	0.07	0.12	10000~14000	1,400	0.05	0.1	7000~9800	1,100	0.03	0.06	10000~14000	1,600	0.1	0.2
	20	10000	1,000	0.06	0.1	8000~12000	850	0.05	0.07	5600~8400	700	0.03	0.04	8000~12000	1,000	0.1	0.15
	22	8000	1,000	0.05	0.1	8000~12000	850	0.04	0.06	5600~8400	700	0.025	0.035	8000~12000	1,000	0.08	0.15
	25	8000	800	0.03	0.05	8000~12000	680	0.03	0.04	5600~8400	560	0.02	0.025	8000~12000	800	0.05	0.08
	30	7000	420	0.02	0.04	6000~10000	360	0.02	0.04	4200~7000	300	0.01	0.025	6000~10000	420	0.03	0.06
	35	6000	140	0.02	0.03	6000~10000	120	0.015	0.02	4200~7000	100	0.01	0.01	6000~10000	140	0.03	0.04
	40	5000	100	0.007	0.01	6000~10000	80	0.004	0.007	4200~7000	70	0.002	0.004	6000~10000	100	0.01	0.015
1.25	6	25000	4,000	0.35	0.5	16000~20000	3,400	0.3	0.4	11200~14000	2,800	0.18	0.24	16000~20000	4,000	0.5	0.8
	8	25000	3,000	0.2	0.5	16000~20000	2,500	0.25	0.35	11200~14000	2,100	0.15	0.21	16000~20000	3,000	0.3	0.8
	10	22000	3,000	0.2	0.5	16000~20000	2,500	0.25	0.35	11200~14000	2,100	0.15	0.21	16000~20000	3,000	0.3	0.8
	15	18000	2,500	0.15	0.3	16000~20000	2,100	0.1	0.2	11200~14000	1,700	0.06	0.12	16000~20000	2,500	0.25	0.45
	20	14000	1,800	0.1	0.2	12000~16000	1,500	0.08	0.15	8400~11200	1,300	0.05	0.09	12000~16000	1,800	0.15	0.3
	25	8000	1,100	0.075	0.14	10000~14000	930	0.05	0.1	7000~9800	770	0.03	0.06	10000~14000	1,100	0.1	0.2

▶ F3B02 2-FLUTE LONG NECK BALL



Recommended Milling Conditions

Work Material		Carbon Steels · Prehardened Steels S50C · NAK55 · NAK80 · HPM-1 ~43HRC				Hardened Steels HPM-38 · STAVAX · SKD61 ~55HRC				Hardened Steels SKD11 · PD613 ~62HRC				Copper			
Radius	Effective Length	Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut	
		min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm
1.25	30	6000	800	0.04	0.08	8000~12000	680	0.02	0.06	5600~8400	560	0.012	0.035	8000~12000	800	0.06	0.15
	35	5000	450	0.03	0.07	6000~10000	380	0.01	0.03	4200~7000	310	0.006	0.018	6000~10000	450	0.05	0.1
1.5	6	20000	4,000	0.35	0.6	16000~20000	3,400	0.25	0.5	11200~14000	2,800	0.15	0.3	16000~20000	4,000	0.5	1
	8	20000	4,000	0.3	0.5	16000~20000	3,400	0.2	0.5	11200~14000	2,800	0.12	0.3	16000~20000	4,000	0.45	0.8
	10	19000	4,000	0.3	0.5	16000~20000	3,400	0.2	0.45	11200~14000	2,800	0.12	0.27	16000~20000	4,000	0.45	0.8
	12	18000	3,000	0.2	0.4	16000~20000	2,500	0.2	0.4	11200~14000	2,100	0.12	0.24	16000~20000	3,000	0.3	0.6
	14	15000	3,000	0.2	0.4	16000~20000	2,500	0.15	0.35	11200~14000	2,100	0.09	0.21	16000~20000	3,000	0.3	0.6
	16	13000	3,000	0.15	0.35	16000~20000	2,500	0.13	0.35	11200~14000	2,100	0.07	0.21	16000~20000	3,000	0.23	0.5
	20	11000	1,800	0.15	0.3	12000~16000	1,500	0.1	0.2	8400~11200	1,300	0.06	0.12	12000~16000	1,800	0.23	0.45
	25	9000	1,200	0.13	0.27	12000~16000	1,000	0.1	0.16	8400~11200	840	0.06	0.09	12000~16000	1,200	0.2	0.4
	30	7000	800	0.1	0.2	8000~12000	680	0.07	0.12	5600~8400	560	0.04	0.07	8000~12000	800	0.15	0.3
	35	6000	600	0.07	0.15	8000~12000	510	0.05	0.1	5600~8400	420	0.03	0.06	8000~12000	600	0.1	0.2
1.75	40	5000	460	0.05	0.1	6000~10000	390	0.05	0.07	4200~7000	320	0.03	0.04	6000~10000	460	0.08	0.15
	15	18000	4,000	0.3	0.4	16000~20000	3,400	0.2	0.45	11200~14000	2,800	0.12	0.27	16000~20000	4,000	0.45	0.6
	20	16000	2,400	0.2	0.3	14000~18000	2,000	0.13	0.35	9800~12600	1,680	0.08	0.21	14000~18000	2,400	0.3	0.45
	25	12000	2,000	0.17	0.3	14000~18000	1,800	0.1	0.3	8400~9800	1,400	0.08	0.15	14000~18000	2,000	0.25	0.42
	30	9000	1,600	0.15	0.27	8000~12000	1,400	0.1	0.2	5600~8400	1,120	0.06	0.12	8000~12000	1,600	0.23	0.4
	35	7000	1,200	0.1	0.2	8000~12000	1,000	0.07	0.15	5600~8400	800	0.05	0.08	8000~12000	1,200	0.15	0.3
	40	6000	800	0.07	0.13	6000~10000	680	0.05	0.1	4200~7000	560	0.03	0.06	6000~10000	800	0.1	0.2
2	45	5000	800	0.05	0.1	6000~10000	680	0.05	0.05	4200~7000	560	0.03	0.03	6000~10000	800	0.08	0.15
	8	20000	4000	0.35	0.8	16000~20000	3400	0.25	0.7	11200~14000	2800	0.15	0.42	16000~20000	4000	0.55	1.2
	10	20000	4000	0.35	0.8	16000~20000	3400	0.25	0.7	11200~14000	2800	0.15	0.42	16000~20000	4000	0.55	1.2
	12	20000	4000	0.35	0.7	16000~20000	3400	0.25	0.7	11200~14000	2800	0.15	0.42	16000~20000	4000	0.53	1
	14	20000	4000	0.3	0.6	16000~20000	3400	0.2	0.5	11200~14000	2800	0.12	0.3	16000~20000	4000	0.45	1
	16	20000	3500	0.2	0.5	16000~20000	3000	0.2	0.3	11200~14000	2500	0.12	0.18	16000~20000	3500	0.3	0.8
	20	20000	3300	0.2	0.35	16000~20000	2800	0.15	0.3	11200~14000	2300	0.09	0.18	16000~20000	3300	0.3	0.5
	25	17000	2600	0.15	0.3	12000~16000	2200	0.12	0.25	8400~11200	1800	0.07	0.15	12000~16000	2600	0.23	0.45
	30	16000	2600	0.12	0.25	12000~16000	2200	0.1	0.2	8400~11200	1800	0.06	0.12	12000~16000	2600	0.2	0.4
	35	14000	1800	0.12	0.2	10000~14000	1500	0.07	0.15	7000~9800	1300	0.04	0.09	10000~14000	1800	0.18	0.3
	40	11000	1200	0.1	0.15	10000~14000	1000	0.07	0.12	7000~9800	840	0.04	0.07	10000~14000	1200	0.15	0.2
	45	9000	800	0.07	0.12	10000~14000	700	0.05	0.1	4200~7000	600	0.03	0.05	10000~14000	800	0.1	0.17
	50	7000	600	0.07	0.1	6000~10000	500	0.05	0.07	4200~7000	420	0.03	0.04	6000~10000	600	0.1	0.15
2.5	10	18000	4000	0.4	1.2	16000~20000	3400	0.3	1	11200~14000	2800	0.18	0.6	16000~20000	4000	0.6	1.8
	15	18000	4000	0.35	1	16000~20000	3400	0.3	0.9	11200~14000	2800	0.18	0.54	16000~20000	4000	0.55	1.5
	20	18000	4000	0.3	0.7	16000~20000	3400	0.25	0.7	11200~14000	2800	0.15	0.42	16000~20000	4000	0.45	1
	25	18000	3000	0.25	0.6	14000~16000	2500	0.2	0.5	9800~11200	2100	0.12	0.3	14000~16000	3000	0.38	0.9
	30	15000	2400	0.2	0.5	14000~16000	2000	0.15	0.4	9800~11200	1700	0.09	0.24	14000~16000	2400	0.3	0.8
	40	10000	1200	0.15	0.3	8000~12000	1000	0.12	0.2	5600~8400	840	0.07	0.12	8000~12000	1200	0.23	0.45
3	10	16000	4000	0.5	1.5	14000~18000	3400	0.35	1.2	9800~12600	2800	0.21	0.72	14000~18000	4000	0.75	2.3
	15	16000	4000	0.5	1.3	14000~18000	3400	0.35	1.2	9800~12600	2800	0.21	0.68	14000~18000	4000	0.75	2
	20	16000	4000	0.5	1.2	14000~18000	3400	0.35	1.1	9800~12600	2800	0.21	0.66	14000~18000	4000	0.75	1.8
	25	16000	4000	0.4	1	14000~18000	3400	0.3	0.8	9800~12600	2800	0.18	0.48	14000~18000	4000	0.6	1.5
	30	16000	3000	0.35	0.7	8000~12000	2500	0.25	0.6	5600~8400	2100	0.15	0.36	8000~12000	3000	0.53	1
	35	14000	2500	0.35	0.5	8000~12000	2100	0.2	0.5	5600~8400	1700	0.12	0.3	8000~12000	2500	0.53	0.8
	40	12000	2300	0.25	0.4	8000~12000	1900	0.2	0.4	5600~8400	1600	0.12	0.24	8000~12000	2300	0.38	0.6
	50	10000	1500	0.25	0.4	6000~8000	1200	0.2	0.35	4200~5600	1000	0.12	0.21	6000~8000	1500	0.38	0.6
	60	8000	1500	0.2	0.4	6000~8000	1200	0.2	0.3	4200~5600	1000	0.12	0.18	6000~8000	1500	0.3	0.6

F3S02 2-FLUTE LONG NECK END MILLS



Recommended Milling Conditions

Work Material		Carbon Steels · Alloy Steels · Stainless Steels S50C · SCM · SKD · SUS			Prehardened Steels HPM-1 · NAK50 · NAK80 ~43HRC			Copper		
Dia.	Effective Length	Spindle Speed	Feed	Depth of Cut	Spindle Speed	Feed	Depth of Cut	Spindle Speed	Feed	Depth of Cut
		min ⁻¹	mm/min	ap mm	min ⁻¹	mm/min	ap mm	min ⁻¹	mm/min	ap mm
0.1	0.3	40000	150	0.005	40000	120	0.004	40000	150	0.006
	0.5	40000	100	0.004	40000	75	0.003	40000	100	0.005
0.2	0.5	40000	330	0.01	40000	250	0.007	40000	330	0.012
	1	40000	250	0.007	40000	180	0.005	40000	250	0.008
	1.5	40000	180	0.005	35000	120	0.004	40000	180	0.006
0.3	1	40000	400	0.02	35000	260	0.015	40000	400	0.024
	1.5	40000	350	0.015	35000	230	0.01	40000	350	0.018
	2	35000	300	0.01	30000	180	0.007	40000	320	0.012
	3	30000	200	0.005	25000	130	0.004	35000	250	0.006
	4	25000	120	0.004	22000	80	0.003	30000	150	0.004
0.4	1	35000	500	0.025	30000	330	0.018	40000	600	0.03
	2	35000	400	0.02	30000	260	0.014	40000	450	0.024
	3	30000	300	0.015	25000	190	0.01	35000	350	0.018
	4	25000	200	0.01	22000	140	0.007	30000	240	0.012
	5	22000	160	0.008	20000	110	0.005	25000	180	0.01
0.5	2	30000	500	0.025	25000	320	0.018	35000	600	0.03
	4	25000	350	0.015	22000	230	0.01	30000	420	0.018
	6	20000	200	0.008	18000	140	0.005	25000	250	0.01
	8	18000	150	0.003	14000	90	0.002	20000	160	0.003
0.6	2	30000	600	0.035	25000	380	0.025	35000	700	0.04
	3	30000	550	0.03	25000	350	0.02	35000	650	0.035
	4	25000	450	0.025	22000	300	0.018	30000	550	0.03
	6	20000	300	0.015	18000	200	0.01	25000	380	0.018
	8	18000	200	0.01	15000	130	0.007	20000	230	0.012
	10	16000	150	0.005	14000	100	0.003	18000	170	0.006
0.8	2	25000	650	0.045	22000	400	0.03	30000	780	0.055
	4	25000	600	0.045	22000	400	0.03	30000	720	0.055
	6	20000	450	0.03	18000	300	0.02	25000	560	0.04
	8	18000	350	0.02	15000	240	0.015	22000	430	0.025
	10	16000	300	0.01	14000	200	0.007	20000	380	0.012
	12	14000	250	0.008	12000	170	0.005	16000	290	0.01
1.0	4	25000	1,100	0.055	22000	700	0.045	30000	1300	0.065
	6	20000	800	0.045	18000	500	0.035	25000	1000	0.055
	8	18000	700	0.035	15000	400	0.025	22000	850	0.045
	10	16000	600	0.025	14000	350	0.018	20000	750	0.03
	12	14000	500	0.02	12000	300	0.014	18000	650	0.025
	16	12000	300	0.01	10000	200	0.007	14000	350	0.012
	20	11000	200	0.005	9000	120	0.003	13000	230	0.006
1.2	6	20000	900	0.05	18000	600	0.04	25000	1200	0.06
	8	18000	800	0.04	15000	500	0.03	22000	1000	0.05
	10	16000	700	0.03	14000	450	0.02	20000	850	0.04
	12	14000	600	0.025	12000	350	0.018	17000	700	0.03
	16	12000	400	0.015	10000	250	0.01	14000	450	0.02

▶ F3S02 2-FLUTE LONG NECK END MILLS



Recommended Milling Conditions

Work Material		Carbon Steels · Alloy Steels · Stainless Steels S50C · SCM · SKD · SUS			Prehardened Steels HPM-1 · NAK50 · NAK80 ~43HRC			Copper		
Dia.	Effective Length	Spindle Speed	Feed	Depth of Cut	Spindle Speed	Feed	Depth of Cut	Spindle Speed	Feed	Depth of Cut
		min ⁻¹	mm/min	ap mm	min ⁻¹	mm/min	ap mm	min ⁻¹	mm/min	ap mm
1.5	6	20000	1,200	0.08	16000	720	0.07	24000	1500	0.09
	8	18000	1,000	0.07	14000	580	0.06	22000	1300	0.08
	10	16000	850	0.06	13000	520	0.05	20000	1100	0.07
	12	14000	700	0.05	12000	450	0.04	17000	850	0.06
	14	13000	600	0.04	11000	380	0.03	16000	750	0.05
	16	12000	500	0.035	10000	320	0.025	15000	650	0.04
	18	11000	450	0.03	9000	280	0.02	13000	530	0.035
	20	10000	400	0.02	8000	240	0.014	12000	480	0.025
2	6	16000	1400	0.12	13000	850	0.1	20000	1750	0.14
	8	16000	1300	0.11	13000	800	0.09	20000	1650	0.13
	10	16000	1200	0.1	13000	750	0.08	20000	1500	0.12
	12	14000	1000	0.09	12000	650	0.07	17000	1200	0.11
	14	13000	900	0.08	11000	570	0.06	16000	1100	0.1
	16	12000	800	0.07	10000	500	0.05	15000	1000	0.085
	18	11000	700	0.06	9000	430	0.04	13000	800	0.07
	20	10000	600	0.05	8000	360	0.035	12000	720	0.06
	25	9000	500	0.03	7000	300	0.02	11000	600	0.035
2.5	30	8000	400	0.02	6000	220	0.014	9000	450	0.025
	10	13000	1300	0.14	11000	800	0.11	16000	1600	0.17
	12	13000	1200	0.13	11000	750	0.1	16000	1500	0.16
	14	12000	1000	0.12	10000	650	0.09	14000	1200	0.15
	16	11000	900	0.1	9000	550	0.07	13000	1100	0.12
	18	10000	800	0.09	8000	480	0.06	12000	950	0.11
	20	9000	700	0.08	7000	400	0.05	11000	850	0.1
	25	8000	600	0.05	6000	330	0.035	10000	750	0.06
	30	7000	500	0.03	5500	280	0.02	8500	600	0.035
	35	6000	300	0.015	4500	180	0.01	6000	300	0.018
3	40	5000	200	0.01	4000	120	0.007	5000	200	0.012
	10	11000	1400	0.18	9000	900	0.14	13000	1700	0.22
	12	11000	1300	0.16	9000	800	0.12	13000	1600	0.2
	14	11000	1200	0.14	9000	700	0.1	13000	1400	0.17
	16	10000	1000	0.12	8000	600	0.09	12000	1200	0.15
	18	10000	900	0.11	8000	550	0.08	12000	1100	0.13
	20	9000	800	0.1	7000	450	0.07	11000	1000	0.12
	25	8000	700	0.08	6000	380	0.06	10000	900	0.1
	30	7000	600	0.06	5000	300	0.045	8500	730	0.07
	35	6000	500	0.03	4500	260	0.02	7200	600	0.035
4	40	5000	400	0.025	4000	220	0.018	6000	480	0.03
	12	8000	1500	0.3	6000	850	0.25	10000	1900	0.36
	14	8000	1400	0.25	6000	800	0.2	10000	1800	0.3
	16	8000	1400	0.25	6000	800	0.2	10000	1800	0.3
	20	8000	1300	0.2	6000	730	0.15	10000	1600	0.24
	25	7000	1100	0.15	5000	600	0.1	8500	1300	0.18
	30	7000	1000	0.12	5000	540	0.08	8500	1200	0.15
	35	6000	800	0.1	4500	450	0.07	7200	1000	0.12
	40	5000	600	0.08	4000	360	0.06	6000	720	0.1
	45	4500	500	0.06	3500	300	0.04	5400	600	0.07
5	50	4000	400	0.04	3000	220	0.03	4800	480	0.05

▶ F3S04 4-FLUTE LONG NECK END MILLS



Recommended Milling Conditions

Work Material		Carbon Steels · Prehardened Steels S50C · NAK55 · NAK80 · HPM-1 ~43HRC				Hardened Steels HPM-38 · STAVAX · SKD61 ~55HRC				Hardened Steels SKD11 · PD613 ~62HRC				High Speed Tool Steels SKH ~65HRC			
Dia.	Effective Length	Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut	
		min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm
1	4	25000	2000	0.05	0.6	23000	1800	0.04	0.5	18000	1600	0.03	0.4	14000	1000	0.02	0.3
	6	20000	1800	0.03	0.6	18000	1400	0.02	0.5	14000	1200	0.01	0.4	10000	800	0.007	0.3
	8	18000	1600	0.03	0.6	16000	1200	0.02	0.5	12000	1000	0.01	0.4	8000	680	0.005	0.3
	10	16000	1200	0.02	0.6	14000	1000	0.01	0.5	10000	800	0.007	0.4	6000	500	0.005	0.3
1.5	6	23000	2000	0.06	0.9	20000	1600	0.04	0.75	18000	1400	0.03	0.6	14000	1000	0.02	0.45
	8	20000	1800	0.06	0.9	18000	1200	0.03	0.75	14000	1200	0.03	0.6	10000	750	0.01	0.45
	10	20000	1600	0.04	0.9	16000	1000	0.03	0.75	14000	1000	0.02	0.6	10000	700	0.01	0.45
	12	16000	1400	0.04	0.9	14000	1000	0.02	0.75	12000	850	0.02	0.6	8000	620	0.007	0.45
	14	14000	1200	0.03	0.9	12000	800	0.02	0.75	10000	750	0.01	0.6	7500	500	0.007	0.45
	16	12000	1000	0.02	0.9	10000	720	0.01	0.75	9000	600	0.007	0.6	6800	400	0.005	0.45
2	6	20000	2000	0.08	1.2	18000	1800	0.06	1	15000	1500	0.05	0.8	12000	1200	0.03	0.6
	8	18000	1800	0.07	1.2	16000	1600	0.05	1	12000	1200	0.04	0.8	9500	1000	0.02	0.6
	10	16000	1600	0.06	1.2	14000	1400	0.05	1	12000	1000	0.04	0.8	9500	900	0.02	0.6
	12	14000	1400	0.05	1.2	12000	1200	0.04	1	10000	1000	0.03	0.8	8200	800	0.01	0.6
	14	14000	1400	0.04	1.2	12000	1200	0.03	1	10000	860	0.02	0.8	8200	720	0.007	0.6
	16	12000	1200	0.04	1.2	10000	1000	0.03	1	9200	800	0.02	0.8	7500	680	0.007	0.6
	18	10000	1000	0.03	1.2	9200	820	0.02	1	8500	740	0.01	0.8	6000	640	0.005	0.6
	20	10000	800	0.03	1.2	9200	760	0.02	1	8500	680	0.01	0.8	6000	520	0.005	0.6
2.5	8	16000	2000	0.08	1.5	14000	1600	0.07	1.25	10000	1400	0.05	1	8000	1000	0.03	0.75
	12	14000	1600	0.07	1.5	12000	1400	0.06	1.25	9600	1200	0.04	1	7500	960	0.02	0.75
	16	12000	1400	0.06	1.5	10000	1200	0.05	1.25	8500	1000	0.02	1	7000	800	0.01	0.75
	20	10000	1200	0.06	1.5	8200	1000	0.05	1.25	7500	1000	0.02	1	5000	800	0.01	0.75
	25	8000	1000	0.05	1.5	7000	800	0.03	1.25	6500	680	0.01	1	4500	550	0.005	0.75
3	8	16000	2000	0.15	1.8	14000	1800	0.1	1.5	10000	1600	0.07	1.2	8000	1	0.05	0.9
	12	14000	1800	0.1	1.8	12000	1600	0.08	1.5	9200	1400	0.06	1.2	7200	1000	0.04	0.9
	16	12000	1600	0.08	1.8	10000	1400	0.07	1.5	8500	1200	0.05	1.2	6500	800	0.03	0.9
	20	10000	1600	0.08	1.8	9000	1400	0.07	1.5	7800	1200	0.04	1.2	5800	800	0.02	0.9
	25	9000	1400	0.07	1.8	8200	1200	0.06	1.5	7000	1000	0.03	1.2	5000	720	0.01	0.9
	30	8000	1400	0.05	1.8	7000	1200	0.03	1.5	6500	1000	0.02	1.2	4500	650	0.007	0.9
4	12	12000	2000	0.2	2.5	9500	2000	0.15	2	8000	1600	0.08	1.6	7000	1000	0.06	1.2
	16	10000	2000	0.15	2.5	8000	1800	0.1	2	7000	1400	0.06	1.6	6000	1200	0.05	1.2
	20	8500	1800	0.12	2.5	7000	1600	0.08	2	6500	1200	0.05	1.6	5500	1000	0.04	1.2
	30	6800	1400	0.08	2.5	4800	1000	0.05	2	4200	850	0.03	1.6	3500	620	0.02	1.2
	40	4000	860	0.05	2.5	3600	720	0.03	2	3000	600	0.01	1.6	2500	400	0.007	1.2
5	16	10000	2000	0.2	3	7000	1800	0.12	2.5	5500	1600	0.08	2	4500	1000	0.06	1.5
	25	8000	1600	0.15	3	5800	1400	0.07	2.5	4200	1200	0.05	2	3000	800	0.03	1.5
	35	6000	1200	0.1	3	4200	900	0.05	2.5	3500	800	0.03	2	2500	600	0.02	1.5
6	20	8000	2000	0.25	4	6500	1600	0.18	3	4500	1400	0.08	2.4	3500	920	0.06	1.8
	30	7000	1600	0.2	4	4500	1200	0.12	3	3500	1000	0.06	2.4	2500	660	0.04	1.8
	40	4500	1200	0.15	4	3000	1000	0.08	3	2500	800	0.03	2.4	2000	550	0.02	1.8



Tips

- ① Use a high speed, rigid and precise machine and chuck holder. (It is recommended to use high-precision shank and collet, and the comprehensive bounce control is best within 0.005mm.)
- ② The recommend milling conditions are just for reference. Adjust milling conditions according to the actual machining status.
- ③ If the spindle speed of a machine is insufficient, adjust both the spindle and feed speed at the same rate.
- ④ Reduce the main spindle and the feed speed at the same rate when chattering occurs.
- ⑤ When L/D exceeds 8 times for stable milling, adjust feed rate to less than 50% and cutting depth(ae) to less than 30%.

▶ F3R02 2-FLUTE LONG NECK CORNER RADIUS



Recommended Milling Conditions

Work Material			Prehardened Steels HPM · NAK 33~41HRC				Hardened Steels HPM-38 · STAVAX · SKD61 ~55HRC				Copper			
Dia.	Corner Radius	Effective Length	Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut	
			min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm
0.2	0.05	0.5	30000	200	0.01	0.05	30000	150	0.003	0.04	30000	250	0.012	0.05
		1	30000	150	0.007	0.05	30000	100	0.003	0.04	30000	200	0.008	0.05
		1.5	30000	100	0.005	0.05	30000	80	0.002	0.04	30000	135	0.006	0.05
		2	30000	50	0.003	0.05	30000	50	0.002	0.04	30000	75	0.004	0.05
0.3	0.05	1	30000	200	0.02	0.1	30000	180	0.003	0.08	30000	300	0.024	0.1
		1.5	30000	180	0.015	0.1	30000	130	0.003	0.08	30000	260	0.018	0.1
		2	30000	150	0.01	0.1	30000	100	0.003	0.08	30000	250	0.012	0.1
		2.5	30000	120	0.007	0.1	25000	80	0.002	0.08	30000	240	0.008	0.1
		3	30000	100	0.005	0.1	25000	50	0.002	0.08	30000	220	0.006	0.1
0.4	0.1	1	30000	350	0.025	0.12	30000	300	0.005	0.1	30000	450	0.03	0.12
		1.5	30000	300	0.022	0.12	30000	270	0.005	0.1	30000	400	0.027	0.12
		2	30000	250	0.02	0.12	25000	180	0.005	0.1	30000	360	0.024	0.12
		3	30000	220	0.015	0.12	25000	150	0.004	0.1	30000	300	0.018	0.12
		4	25000	160	0.01	0.12	20000	100	0.003	0.1	30000	240	0.012	0.12
0.5	0.1	1	30000	500	0.03	0.14	25000	400	0.01	0.12	30000	650	0.036	0.14
		2	30000	400	0.025	0.14	25000	300	0.01	0.12	30000	600	0.03	0.14
		3	30000	340	0.02	0.14	25000	250	0.008	0.12	30000	480	0.024	0.14
		4	25000	280	0.015	0.14	20000	180	0.005	0.12	30000	430	0.018	0.14
		5	25000	230	0.01	0.14	20000	150	0.004	0.12	30000	360	0.012	0.14
0.6	0.05	2	30000	600	0.035	0.16	25000	400	0.02	0.13	30000	800	0.04	0.16
	0.1	4	25000	400	0.025	0.16	20000	250	0.015	0.13	30000	650	0.03	0.16
	0.2	6	20000	250	0.015	0.16	16000	150	0.008	0.13	25000	400	0.018	0.16
0.8	0.05	4	25000	1,000	0.045	0.25	20000	600	0.025	0.2	30000	1,400	0.055	0.25
	0.1	6	20000	700	0.03	0.25	16000	400	0.02	0.2	25000	1,000	0.04	0.25
	0.2	8	18000	400	0.02	0.25	14000	250	0.01	0.2	22000	600	0.025	0.25



Tips

- ① Use a high speed, rigid and precise machine and chuck holder. (It is recommended to use high-precision shank and collet, and the comprehensive bounce control is best within 0.005mm.)
- ② The recommend milling conditions are just for reference. Adjust milling conditions according to the actual machining status.
- ③ If the spindle speed of a machine is insufficient, adjust both the spindle and feed speed at the same rate.
- ④ Reduce the main spindle and the feed speed at the same rate when chattering occurs.
- ⑤ When L/D exceeds 8 times for stable milling, adjust feed rate to less than 50% and cutting depth(ae) to less than 30% .

F3R04 4-FLUTE LONG NECK CORNER RADIUS



Recommended Milling Conditions

Work Material			Prehardened Steels HPM · NAK 33~41HRC				Hardened Steels HPM-38 · STAVAX · SKD61 ~55HRC				Hardened Steels SKD11 · PD613 ~62HRC				Copper			
Dia.	Corner Radius	Effective Length	Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut		Spindle Speed	Feed	Depth of Cut	
			min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm	min ⁻¹	mm/min	ap mm	ae mm
1	0.05 0.1 0.2 0.3	3	16000	1800	0.06	0.35	12800	1,260	0.045	0.3	10800	1000	0.03	0.25	16000	1800	0.2	0.23
		4	16000	1500	0.05	0.35	12800	1,050	0.04	0.3	10800	840	0.03	0.25	16000	1500	0.15	0.23
		5	16000	1410	0.045	0.35	12800	990	0.035	0.25	10800	800	0.02	0.2	16000	1410	0.13	0.23
		6	14500	1200	0.04	0.25	11600	840	0.03	0.25	8900	680	0.015	0.2	14500	1200	0.12	0.2
		8	14500	870	0.03	0.25	11600	620	0.02	0.2	8900	500	0.012	0.16	14500	870	0.09	0.2
		10	11100	660	0.025	0.25	8900	470	0.015	0.1	7100	370	0.01	0.1	11100	660	0.075	0.15
		12	11100	300	0.02	0.2	8900	210	0.01	0.08	7100	160	0.005	0.06	11100	300	0.06	0.15
1.2	0.1 0.2 0.3	5	15500	1740	0.06	0.4	12400	1,220	0.045	0.35	10000	970	0.025	0.25	15500	1740	0.18	0.28
		10	12000	1290	0.04	0.35	9600	900	0.03	0.25	8000	720	0.01	0.15	12000	1290	0.12	0.28
		15	10600	480	0.02	0.25	8500	330	0.01	0.1	6600	270	0.005	0.08	10600	480	0.07	0.23
1.5	0.1 0.2 0.3 0.5	6	14000	1910	0.08	0.53	11200	1,340	0.05	0.4	8500	1070	0.03	0.3	14000	1910	0.24	0.35
		12	11500	1250	0.06	0.42	9000	870	0.04	0.3	6400	700	0.01	0.2	11500	1250	0.18	0.3
		18	8500	560	0.02	0.3	6800	390	0.01	0.15	5400	320	0.005	0.1	8500	560	0.08	0.25
2	0.1 0.2 0.3 0.5	8	11100	2150	0.08	0.6	8800	1,500	0.05	0.5	7000	1200	0.03	0.4	11100	2150	0.24	0.45
		12	11100	1800	0.065	0.6	8800	1,260	0.045	0.5	5600	1000	0.027	0.4	11100	1800	0.2	0.43
		16	9600	1500	0.05	0.5	7700	1,050	0.04	0.35	4800	840	0.01	0.2	9600	1500	0.15	0.39
		20	9600	900	0.03	0.45	7700	630	0.015	0.25	4500	500	0.01	0.1	9600	900	0.12	0.35
		24	6400	740	0.02	0.4	5100	510	0.01	0.2	4100	400	0.005	0.1	6400	740	0.1	0.3
2.5	0.1 0.2 0.3 0.5	10	9200	2280	0.1	0.85	7400	1,590	0.07	0.7	6000	1280	0.04	0.5	9200	2280	0.3	0.5
		20	8300	1580	0.08	0.6	6600	1,110	0.05	0.4	4000	900	0.01	0.2	8300	1580	0.24	0.43
		30	5400	710	0.025	0.45	4300	500	0.01	0.2	3200	400	0.005	0.1	5400	710	0.1	0.33
3	0.1 0.2 0.3 0.5 1	12	8000	2400	0.12	0.9	6400	1,680	0.08	0.8	5200	1350	0.05	0.65	8000	2400	0.36	0.55
		18	7800	2000	0.11	0.8	6200	1,410	0.07	0.7	3700	1100	0.03	0.4	7800	2010	0.33	0.5
		20	7700	1850	0.1	0.8	6200	1,250	0.06	0.6	3600	1000	0.03	0.3	7700	1850	0.3	0.5
		24	7500	1620	0.1	0.7	6000	1,140	0.06	0.5	3400	900	0.02	0.2	7500	1620	0.3	0.45
		30	6000	1050	0.05	0.6	4800	740	0.03	0.4	3000	600	0.005	0.1	6000	1050	0.15	0.4
		36	4200	710	0.03	0.5	3400	500	0.01	0.3	2500	400	0.005	0.1	4200	710	0.1	0.35
4	0.1 0.2 0.3 0.5 1	16	6000	2520	0.15	1.2	4800	1,770	0.1	1	4000	1400	0.06	0.8	6000	2520	0.45	0.75
		24	5400	2030	0.12	1	4300	1,430	0.085	0.8	2800	1140	0.05	0.65	5400	2030	0.39	0.7
		32	4800	1350	0.08	0.9	3800	950	0.04	0.7	2300	750	0.01	0.1	4800	1350	0.25	0.6
		48	3200	570	0.04	0.8	2600	410	0.01	0.35	1500	330	0.005	0.1	3200	570	0.12	0.5
5	0.1,0.2 0.3,0.5 1	20	5100	2300	0.17	1.6	4100	1,610	0.12	1.2	3300	1280	0.07	1	5100	2300	0.52	1
		40	3200	1020	0.07	1.2	2600	720	0.05	0.9	1500	570	0.02	0.1	3200	1020	0.25	0.8
6	0.1,0.2 0.3,0.5 1	24	3700	2100	0.2	2.1	3000	1,470	0.12	1.5	2700	1170	0.07	1.2	3700	2100	0.6	1.2
		48	2600	950	0.09	1.5	2100	660	0.05	1.2	1200	520	0.03	0.2	2600	950	0.32	0.9

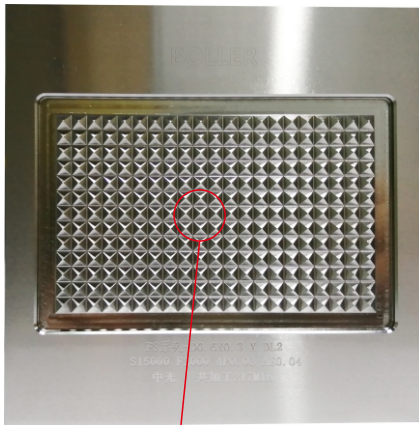


Tips

- ① Use a high speed, rigid and precise machine and chuck holder. (It is recommended to use high-precision shank and collet, and the comprehensive bounce control is best within 0.005mm.)
- ② The recommend milling conditions are just for reference. Adjust milling conditions according to the actual machining status.
- ③ If the spindle speed of a machine is insufficient, adjust both the spindle and feed speed at the same rate.
- ④ Reduce the main spindle and the feed speed at the same rate when chattering occurs.
- ⑤ When L/D exceeds 8 times for stable milling, adjust feed rate to less than 50% and cutting depth(ae) to less than 30%.

▶ Processing case

CASE 1: F3B02 Ball end mill processing case



Location: BOLLER R&D Center

Equipment: RODERS RXP500

Work material: S136 HRC52

Test tool: F3B0200602 R0.3*DL2

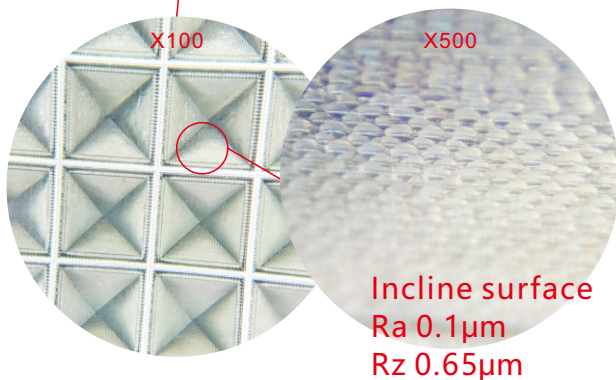
Coolant: Dry(oil)

Cutting oil: Oelheld

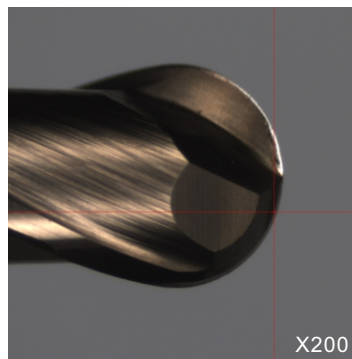
Testing condition: Temperature (23°C)
Humidity (65%)

Runout accuracy : 0.001mm

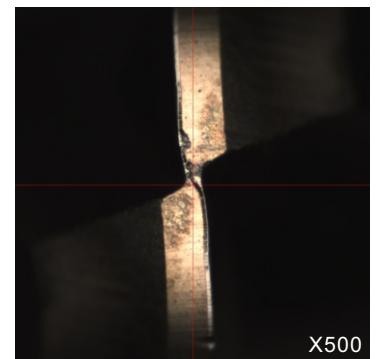
Process	Speed (min ⁻¹)	Feed rate (mm/min)	ap (mm)	ae (mm)	Cutting time (min)
Contour semi finishing	25000	2000	0.03	0.04	217



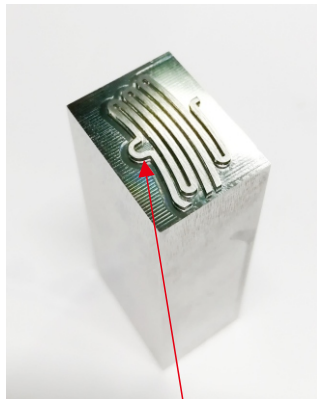
Tool wear W=0.008mm [Front]



Tool wear W=0.01mm [Back]



CASE 2: F3S02 Square end mill processing case



Location: BOLLER R&D Center

Equipment: RODERS RXP500

Work material: S136 HRC52

Test tool: F3S0200402 0.4*DL2

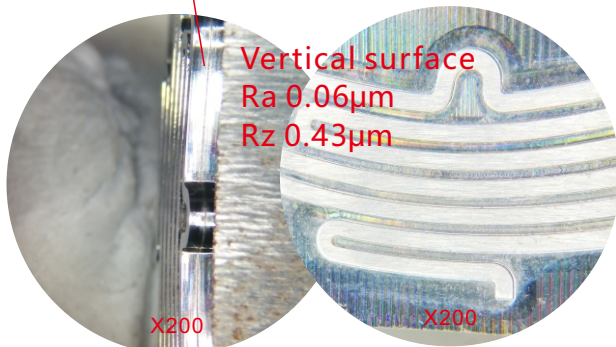
Coolant: Dry(oil)

Cutting oil: Oelheld

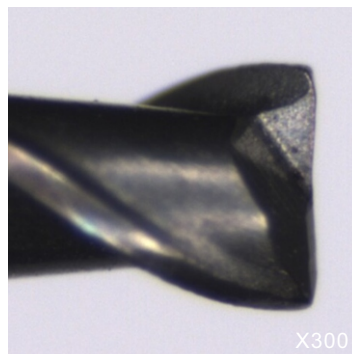
Testing condition: Temperature (23°C)
Humidity (65%)

Runout accuracy : 0.001mm

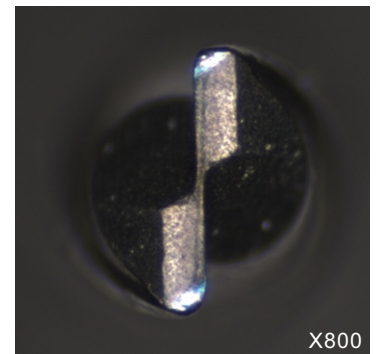
Process	Speed (min ⁻¹)	Feed rate (mm/min)	ap (mm)	ae (mm)	Cutting time (min)
Contour finishing	33000	800	0.015	0.015	106



Tool wear W=0.004mm [Front]



Tool wear W=0.013mm [Back]



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► Safety notices

1. Cautions regarding handling

- (1) When removing the tool from its case (packaging), be careful that the tool does not fly off or drop out. Particularly be careful in contact with the tool flutes.
- (2) When handling tools with sharp cutting flutes, be careful not to touch the cutting flutes directly with your bare hands.

2. Cautions regarding mounting

- (1) Before use, check the outside appearance of the tool for scratches, cracks, etc. and then firmly mounted it in the collet chuck.
- (2) If abnormal chattering occurs during process, stop the machine immediately and remove the cause of the chattering.

3. Cautions during process

- (1) Check the dimension, direction of rotation of the tool and the milling material before use.
- (2) Please use the standard cutting conditions table as criteria for process. The cutting conditions should be adjusted appropriately according to the cutting depth, the rigidity of the machine or conditions of the work material.
- (3) Cutting tools are made of hard material. They may break and fly off during process. In addition, cutting chips may fly off as well. Since there is a risk of injury to workers, fire, or eye damage from those flying pieces, a safety cover should be putted when work is performed. Safety equipment such as safety goggles should be worn for a safe working environment.
- (4) There is a risk of fire or inflammation due to sparks, heat due to breakage, and cutting chips. Do not use the tool in case of fire or explosion. Please be caution of fire while using oil base coolant, fire prevention measures are necessary.
- (5) Do not use the tool for any other purposes.

4. Cautions regarding regrinding

- (1) If regrinding is not performed at the proper time, there is a risk of damage to the tool. Replace the tool with another one in good condition, then perform the regrinding.
- (2) Dust will be produced when regrinding a tool. Put a safety cover in the work area and wear safety clothes such as safety goggles, etc.
- (3) This product contains the specified chemical substance cobalt and its inorganic compounds. When performing regrinding or similar processing, be sure to handle the processing in accordance with laws and regulations regarding prevention of hazards due to specified chemical substances.

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