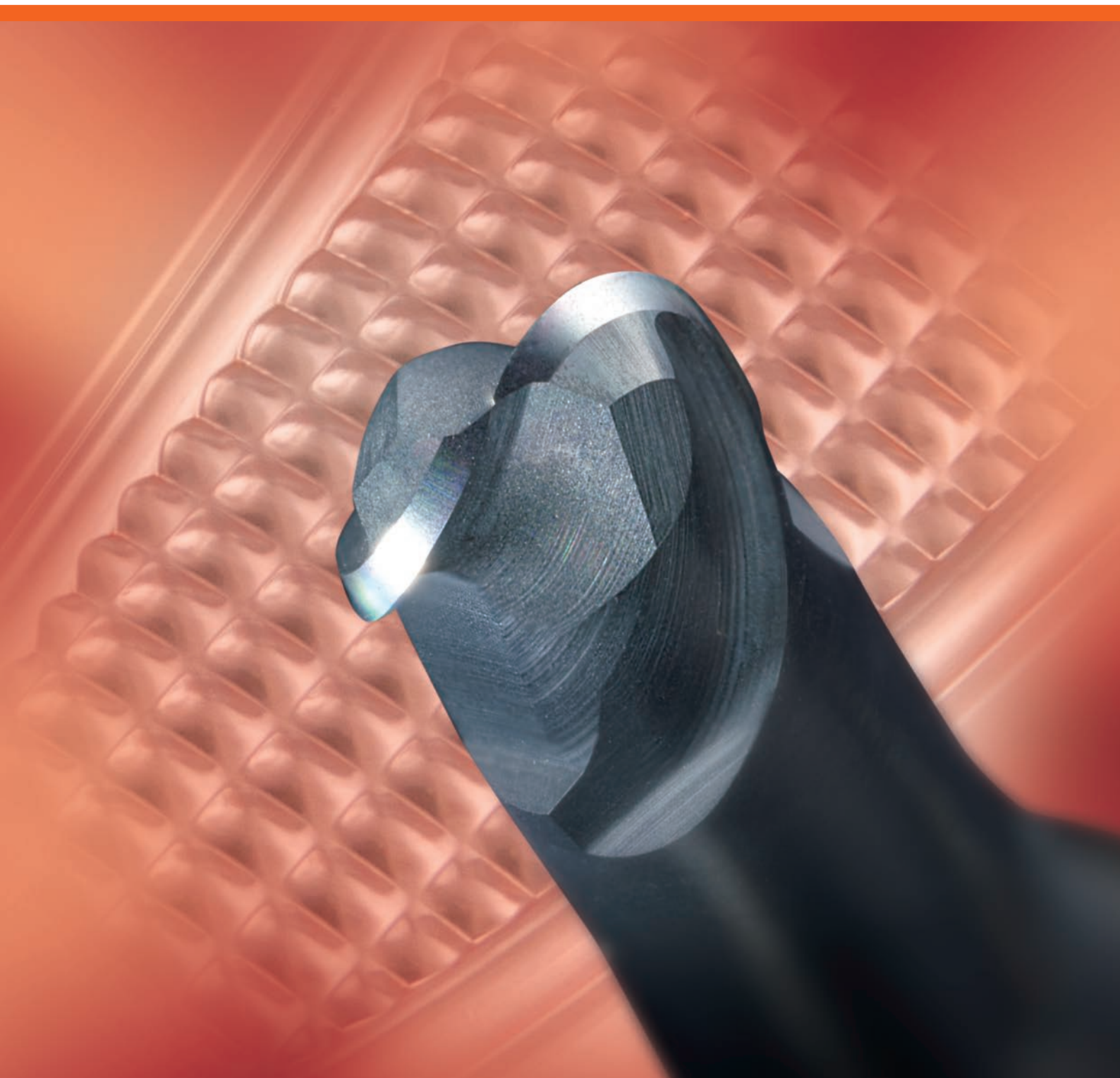


铜电极加工用长颈球头铣刀

Long Neck Ball End Mill for Copper Electrode

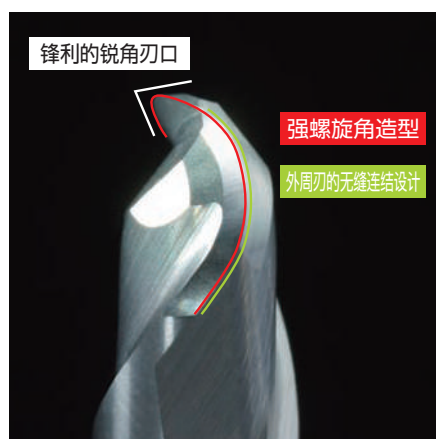
DRB230



在铜电极加工上 DRB230 实现了前所未有的长时间加工寿命与高品质的加工面

Realize long life and high quality in machining copper electrode. Long Neck Ball End Mill for Copper Electrode - DRB230.

同时具备切削性能与高精度的刃口设计 High accuracy edge profile with sharpness shearing ability.



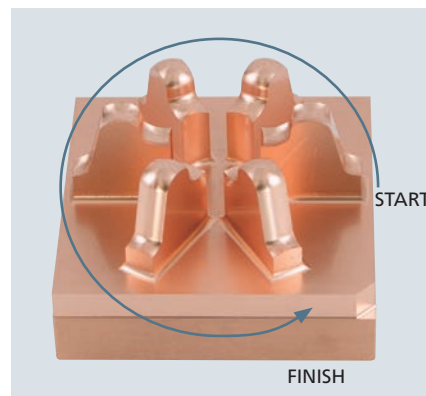
- 针对粘性较高的铜合金加工, 采用锋利的刃口形状可实现「抑制毛刺」与「高精度加工」的效果!
- Comparing to highly viscous copper alloy, edge profile with sharpness shearing ability realized burr suppression and high precision.
- R角刃与外周刃的无缝连接设计实现高精度加工!
- Seamless on peripheral cutting edge and R realized high-quality machining by edge profile.

- 锋利的锐角刃口
Sharp cutting edge
- 强螺旋角造型
Strong spiral shape
- 外周刃的无缝连接设计
Peripheral edge seamless shape

与过往产品的耐久性能比较 Compared to conventional products

- 加工材料: 紫铜 (TPC) Material: Tough-Pitch Copper
- 冷却方式: 油冷 Coolant: Water-insoluble fluid
- 总加工时间: 75 小时 25 分钟 (全 5 个) Cutting time: 75hr 25min (total)
- 工件尺寸: 50×50mm Work size: 50×50mm
- 加工深度: 16.0mm Cutting depth: 16.0mm

加工工序 Cutting process	粗加工 Roughing	中加工 Semi-finishing	精加工 Finishing
使用工具 Tool	DRB230 R1×16 (从粗加工到精加工只用同一把工具) (Machined by one end mill from roughing to finishing.)		
主轴转速[min^{-1}] Spindle speed	10,000	10,000	12,000
进给速度[mm/min] Feed	1,200	1,000	500
切深量[mm]ap×ae Depth of cut	0.25×0.5	0.05×0.05	0.03×0.03
加工余量[mm] Stock	0.1	0.03	—
加工时间 Cutting time	4小时30分钟 4hr 30min	2小时48分钟 2hr 48min	形状部 5小时47分钟 5hr 47min (Profile) 底部 2小时 2hr (Bottom)



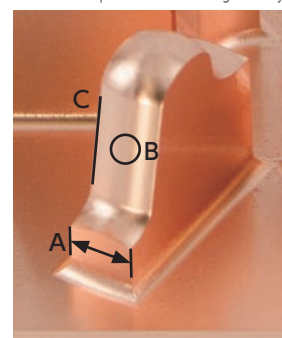
●与过往产品的加工精度比较 Accuracy measurement result

比较内容 Comparative content	测量工件	从目标值5.000mm开始计算的公差误差(mm) Dimension error from the target value 5.000 (mm)		面粗度(Ra: μm) Surface roughness		毛刺量(mm) Burr amount	
		测量位置A Measurement position A	测量位置B Measurement position B	测量位置C Measurement position C	测量位置A Measurement position A	测量位置B Measurement position B	测量位置C Measurement position C
过往产品 (钢材用涂层品) Conventional products (Coated end mill for steel)	第一个 1st	0.002	0.008	0.129	0.135	0.040	0.049
	第五个 5th	0.003	0.003	0.094	0.095	0.023	0.026
DRB230	第一个 1st	0.001	0.001	0.076	0.078	0.014	0.018
	第五个 5th	0.003	0.003	0.094	0.095	0.023	0.026

- 在加工 1 个工作后, 钢材用涂层的过往产品会产生较大的公差和误差, 以及面粗度底下目明显的状态。
- DRB230 可以做到仅用 1 支刀具加工 5 个工作, 并且对公差和加工面品质方面影响很小, 达到安定高品质的加工效果。
- In the conventional coated end mill for steel product, the dimensional error was large when processing one workpiece, and the surface quality was also noticeable.
- DRB230 was able to process five workpieces with one tool, with little change in dimensions and surface quality, and it gave a stable and it ensured an outstanding surface quality.

面粗度测量仪: 三鹰光器制 NH-3SP
公差: 光学显微镜 x 100
Measuring Instrument:
Mitaka Kohki NH-3SP (Ra)
Optical microscope x 100 (Dimension)

加工精度测量位置
Measurement position of machining accuracy.

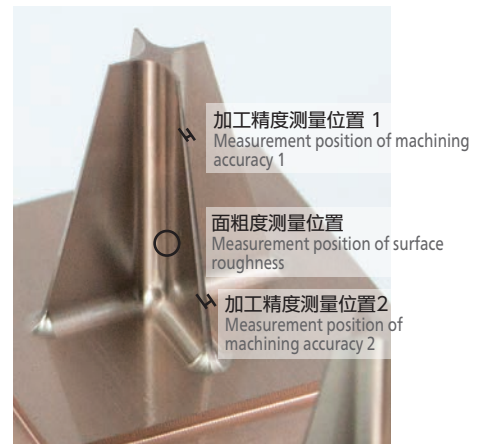
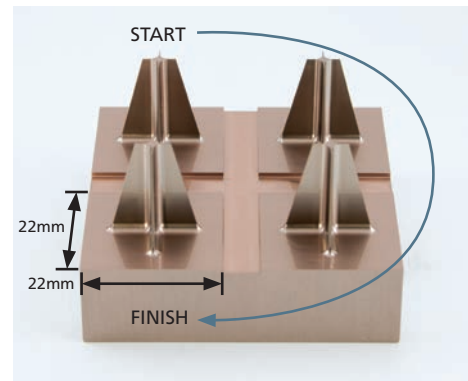


- ◆能最大限度抑制毛刺的发生，实现高精密加工的锋利刃口造型。
- ◆采用全新 DLC 镀膜技术，提供稳定的刀具加工寿命。
- ◆在铜电极加工领域达到前所未有的加工品质和耐久性能。
- ◆即使针对加工困难的钨铜也能实现长时间的加工寿命。
- ◆Edge profile that enables highly accurate processing with minimal burrs.
- ◆DLC coating contributes to stable life.
- ◆Innovation of copper electrode processing with unprecedented shearing ability and durability.
- ◆Realize long life milling on tough material of Copper Tungsten!

钨铜电极加工案例 Cutting example of Copper tungsten

- 加工材料：钨铜 Material : Copper Tungsten (W70% - Cu30%)
- 冷却方式：油冷 Coolant : Water-insoluble fluid
- 总加工时间：51 小时 28 分钟 (全 4 处) Cutting time : 51hr 28min (total 4 places)
- 加工尺寸(1处)：22×22mm Work size : 22 × 22mm
- 加工深度：16.0mm Cutting depth : 16.0mm

加工工序 Cutting process	粗加工 Roughing	精加工 Finishing
使用工具 Tool	DRB230 R1×16	DRB230 R1×16
主轴转速[min^{-1}] Spindle speed	7,000	7,000
进给速度[mm/min] Feed	800	上面 500 Top 侧面 100 Side 底面 500 Bottom
切深量[mm] $a_p \times a_e$ Depth of cut	0.15×0.25	上面 a_e 0.03 Top 侧面 a_p 0.015 Side 底面 a_e 0.03 Bottom
加工余量[mm] Stock	0.05	—
加工时间 Cutting time	4小时37分钟 4hr 37min	上面 6分钟 Top 6min 侧面 7小时 Side 7hr 底面 1小时9分钟 Bottom 1hr 9min



●加工精度测定结果 Results of machining accuracy measurement

加工精度误差 Accuracy error with respect to target value.

单位 [mm] Unit [mm]

	测量位置 1 Measurement position 1	测量位置 2 Measurement position 2
目标值 Target	0.2	0.444
START	0.002	0.004
FINISH	0.003	0.006

测量仪：光学显微镜×100
Measuring Instrument : Optical microscope x 100

面粗度测定值 Surface roughness measurement value

单位 [mm] Unit [μm]

START	Ra:0.082 Rz:0.783
FINISH	Ra:0.089 Rz:0.854

测量仪：三鹰光器制 NH-3SP
Measuring Instrument : Mitaka Kohki NH-3SP

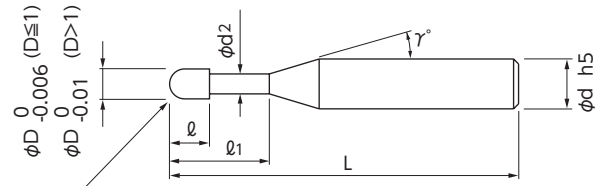
在粗加工和精加工各使用一支工具完成 4 处加工
即使是在加工难切削材料钨铜时也能实现高精度与高品质的长时间加工。

Processing all four places with total two tools that one for roughing, the other for finishing.
High-precision, high-quality processing is possible even in the long processing of difficult-to-cut material, copper tungsten.

DRB230

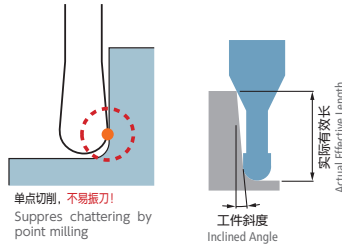


- 针对铜合金加工用的长颈球头铣刀。
- 锋利的刀口形状和 DLC 涂层实现了长时间安定的高品质加工。
- 也可以对应钨铜电极的加工。
- Long neck ball end mill specialized for processing copper alloy.
- Sharp edge shearing ability and DLC coating realized high quality and stable a long life processing.
- Processing copper tungsten electrodes is also effective.



※R±0.002 (R≤0.2)
 ※R±0.003 (0.2<R≤0.5)
 ※R±0.004 (R>0.5)

※DRB230 的 R 角精度以实际刀径的 1/2 为基准值。
 R accuracy of DRB230 is based on a half value.



加工材料 Work Material

碳素钢 Carbon Steels	合金钢·工具钢 Alloy Steels · Tool Steels	预硬钢·调质 Prehardened Steels	淬硬钢 Hardened Steels		不锈钢 Stainless Steels	钛合金 Titanium Alloy	铜合金 Copper	钨铜 Copper Tungsten
			~ 55HRC	55HRC ~				
							◎	◎

单位 [公差: mm / 定价: 円] Unit (Size: mm / Retail Price: JPY)

产品代码 Code No.	(R) 球头半径 Radius	(L1) 有效长 Effective Length	(L) 刃长 Length of Cut	(D) 刃径 Dia.	(d2) 颈径 Neck Dia.	(γ) 颈角 Neck Taper Angle	(d) 柄径 Shank Dia.	(L) 全长 Overall Length	定价 Retail Price	相对于工件斜度的有效长 Actual effective length depending on inclined angle of workpiece.				
										30°	1°	1° 30'	2°	3°
07-00530-00503	R0.05	0.3	0.07	0.1	0.085	12°	4	45	13,900	0.34	0.36	0.37	0.39	0.42
07-00530-00505		0.5	0.07	0.1	0.085	12°	4	45	14,500	0.55	0.57	0.60	0.63	0.69
07-00530-01005	R0.1	0.5	0.15	0.2	0.18	12°	4	45	11,100	0.56	0.58	0.61	0.63	0.69
07-00530-01010		1	0.15	0.2	0.18	12°	4	45	11,600	1.08	1.13	1.18	1.23	1.35
07-00530-01015		1.5	0.15	0.2	0.18	12°	4	45	12,100	1.60	1.67	1.75	1.83	2.02
07-00530-01510	R0.15	1	0.2	0.3	0.28	12°	4	45	11,600	1.08	1.12	1.17	1.22	1.34
07-00530-01515		1.5	0.2	0.3	0.28	12°	4	45	12,100	1.60	1.67	1.74	1.82	2.00
07-00530-01520		2	0.2	0.3	0.28	12°	4	45	12,600	2.12	2.21	2.31	2.42	2.66
07-00530-02010	R0.2	1	0.3	0.4	0.37	12°	4	45	10,100	1.10	1.14	1.19	1.24	1.35
07-00530-02020		2	0.3	0.4	0.37	12°	4	45	10,300	2.15	2.23	2.33	2.43	2.68
07-00530-02030		3	0.3	0.4	0.37	12°	4	45	10,500	3.19	3.32	3.47	3.63	4.01
07-00530-02040		4	0.3	0.4	0.37	12°	4	45	10,700	4.23	4.41	4.61	4.83	5.33
07-00530-02520	R0.25	2	0.35	0.5	0.46	12°	4	45	9,900	2.17	2.25	2.35	2.45	2.69
07-00530-02530		3	0.35	0.5	0.46	12°	4	45	10,100	3.21	3.34	3.49	3.65	4.02
07-00530-02540		4	0.35	0.5	0.46	12°	4	45	10,300	4.25	4.43	4.63	4.85	5.35
07-00530-02550		5	0.35	0.5	0.46	12°	4	45	10,500	5.30	5.52	5.77	6.04	6.68
07-00530-03020	R0.3	2	0.45	0.6	0.56	12°	4	45	7,700	2.17	2.25	2.34	2.44	2.68
07-00530-03030		3	0.45	0.6	0.56	12°	4	45	7,900	3.21	3.34	3.48	3.64	4.01
07-00530-03040		4	0.45	0.6	0.56	12°	4	45	8,100	4.25	4.43	4.62	4.84	5.33
07-00530-03050		5	0.45	0.6	0.56	12°	4	45	8,300	5.29	5.52	5.76	6.03	6.66
07-00530-03060		6	0.45	0.6	0.56	12°	4	45	8,500	6.34	6.61	6.90	7.23	7.99
07-00530-04030	R0.4	3	0.6	0.8	0.76	12°	4	45	7,900	3.20	3.33	3.47	3.62	3.97
07-00530-04040		4	0.6	0.8	0.76	12°	4	45	8,100	4.25	4.42	4.61	4.82	5.30
07-00530-04060		6	0.6	0.8	0.76	12°	4	45	8,300	6.33	6.60	6.89	7.21	7.96
07-00530-04080		8	0.6	0.8	0.76	12°	4	45	8,500	8.42	8.78	9.17	9.60	10.61

订购方法

请指定 DRB230 的球头半径 (R) × 有效长 (L1) ※ (γ) 为参考值。
 When you order, indicate DRB230 (R) × (L1). ※ (γ) is reference value.

产品代码 Code No.	(R)球头半径 Radius	(L)有效长 Effective Length	(L)刃长 Length of Cut	(D)刃径 Dia.	(d2)颈径 Neck Dia.	(γ)颈角 Neck Taper Angle	(d)柄径 Shank Dia.	(L)全长 Overall Length	定价 Retail Price	相对于工件斜度的有效长 Actual effective length depending on inclined angle of workpiece.				
										30°	1°	1° 30'	2°	3°
										07-00530-05030	R0.5	3	0.75	1
07-00530-05040	4	0.75	1	0.95	12°	4	45	7,500	4.27	4.44		4.62	4.83	5.30
07-00530-05050	5	0.75	1	0.95	12°	4	45	7,700	5.31	5.53		5.76	6.02	6.63
07-00530-05060	6	0.75	1	0.95	12°	4	45	7,700	6.35	6.62		6.90	7.22	7.96
07-00530-05080	8	0.75	1	0.95	12°	4	45	8,100	8.44	8.79		9.18	9.61	10.61
07-00530-05100	10	0.75	1	0.95	12°	4	45	8,100	10.52	10.97		11.46	12.01	13.26
07-00530-05120	12	0.75	1	0.95	12°	4	45	8,100	12.61	13.15		13.75	14.40	15.92
07-00530-07506	R0.75	6	1.1	1.5	1.45	12°	4	50	7,700	6.34		6.59	6.87	7.17
07-00530-07512		12	1.1	1.5	1.45	12°	4	50	8,700	12.60	13.13	13.71	14.35	15.84
07-00530-07518		18	1.1	1.5	1.45	12°	4	50	9,700	18.86	19.67	20.55	21.53	23.80
07-00530-10040	R1	4	1.5	2	1.94	12°	4	50	7,900	4.27	4.42	4.58	4.76	5.17
07-00530-10060		6	1.5	2	1.94	12°	4	50	7,900	6.36	6.60	6.86	7.15	7.83
07-00530-10080		8	1.5	2	1.94	12°	4	50	8,100	8.44	8.78	9.14	9.54	10.48
07-00530-10100		10	1.5	2	1.94	12°	4	50	8,100	10.53	10.95	11.42	11.94	13.14
07-00530-10120		12	1.5	2	1.94	12°	4	50	8,100	12.61	13.13	13.70	14.33	15.79
07-00530-10160		16	1.5	2	1.94	12°	4	50	8,100	16.78	17.49	18.27	19.12	Free
07-00530-10200		20	1.5	2	1.94	12°	4	60	9,000	20.96	21.85	22.83	23.90	Free
07-00530-10250		25	1.5	2	1.94	12°	4	60	10,000	26.17	27.30	28.53	29.89	Free
07-00530-15100		R1.5	10	2.5	3	2.85	12°	6	60	10,300	10.73	11.14	11.59	12.09
07-00530-15150	15		2.5	3	2.85	12°	6	70	10,500	15.94	16.59	17.30	18.08	19.89
07-00530-15200	20		2.5	3	2.85	12°	6	70	11,000	21.16	22.04	23.00	24.06	26.53
07-00530-15250	25		2.5	3	2.85	12°	6	70	11,000	26.37	27.48	28.70	30.04	Free
07-00530-15300	30		2.5	3	2.85	12°	6	70	12,000	31.58	32.93	34.40	36.03	Free
07-00530-20100	R2	10	3	4	3.8	12°	6	60	9,500	10.83	11.22	11.66	12.14	13.25
07-00530-20150		15	3	4	3.8	12°	6	60	9,500	16.04	16.67	17.36	18.12	19.89
07-00530-20200		20	3	4	3.8	12°	6	60	11,300	21.26	22.12	23.06	24.10	Free
07-00530-20250		25	3	4	3.8	12°	6	70	12,000	26.47	27.57	28.77	30.09	Free
07-00530-20300		30	3	4	3.8	12°	6	70	12,500	31.68	33.01	34.47	Free	Free
07-00530-20400		40	3	4	3.8	12°	6	80	13,500	42.11	43.91	Free	Free	Free
07-00530-30200	R3	20	6	6	5.7	—	6	70	12,500	Free	Free	Free	Free	Free
07-00530-30300		30	6	6	5.7	—	6	80	13,100	Free	Free	Free	Free	Free
07-00530-30500		50	6	6	5.7	—	6	100	15,200	Free	Free	Free	Free	Free

DRB230

切削条件参数参考表 Recommended Milling Conditions

加工材料 Work Material			铜 Copper				钨铜 Copper Tungsten (W70% - Cu30%)			
(R) 球头半径 Radius	有效长 Effective Length	L(有效长)/ D(刀径) L/D	切深量 Depth of Cut		进给速度 Feed	主轴转速 Spindle Speed	切深量 Depth of Cut		进给速度 Feed	主轴转速 Spindle Speed
			ap mm	ae mm	mm/min	min ⁻¹	ap mm	ae mm	mm/min	min ⁻¹
0.05	0.3	3	0.01	0.01	200	40,000	0.008	0.008	150	30,000
	0.5	5	0.007	0.007	150	40,000	0.005	0.005	100	30,000
0.1	0.5	2.5	0.025	0.05	500	40,000	0.02	0.04	350	30,000
	1	5	0.02	0.04	400	40,000	0.015	0.03	250	30,000
0.15	1.5	7.5	0.015	0.03	300	40,000	0.008	0.02	150	30,000
	1	3.3	0.03	0.07	700	40,000	0.03	0.07	500	30,000
0.2	1.5	5	0.025	0.05	500	40,000	0.02	0.05	300	30,000
	2	6.7	0.015	0.03	400	40,000	0.01	0.02	200	30,000
0.25	1	2.5	0.05	0.1	1000	40,000	0.04	0.08	700	30,000
	2	5	0.035	0.06	600	40,000	0.02	0.05	350	30,000
	3	7.5	0.02	0.04	400	30,000	0.01	0.03	200	25,000
	4	10	0.008	0.015	250	25,000	0.005	0.01	100	18,000
0.3	2	4	0.08	0.15	800	40,000	0.08	0.15	500	30,000
	3	6	0.06	0.1	600	35,000	0.06	0.08	400	27,000
	4	8	0.04	0.08	400	30,000	0.025	0.05	200	22,000
	5	10	0.02	0.04	300	25,000	0.01	0.02	150	18,000
0.4	2	3.3	0.12	0.2	1,600	40,000	0.12	0.2	1,200	30,000
	3	5	0.1	0.14	1,000	40,000	0.08	0.1	700	30,000
	4	6.7	0.07	0.1	700	30,000	0.04	0.06	400	25,000
	5	8.3	0.05	0.08	600	27,000	0.02	0.04	300	22,000
0.5	6	10	0.04	0.06	500	25,000	0.01	0.03	200	20,000
	3	3.8	0.15	0.3	2,000	40,000	0.15	0.3	1,400	30,000
	4	5	0.12	0.2	1,600	35,000	0.1	0.16	1,000	27,000
	6	7.5	0.08	0.15	1,000	30,000	0.05	0.1	500	20,000
0.75	8	10	0.05	0.06	700	22,000	0.02	0.025	300	16,000
	3	3	0.25	0.4	2,800	40,000	0.25	0.4	2,000	30,000
	4	4	0.2	0.4	2,400	40,000	0.2	0.4	1,600	30,000
	5	5	0.16	0.3	2,000	35,000	0.12	0.25	1,400	27,000
	6	6	0.14	0.3	1,600	30,000	0.1	0.25	1,000	25,000
	8	8	0.12	0.2	1,000	25,000	0.06	0.1	500	18,000
1	10	10	0.08	0.15	800	20,000	0.03	0.05	300	16,000
	12	12	0.06	0.1	600	16,000	0.015	0.04	200	12,000
	6	4	0.3	0.6	2,400	30,000	0.3	0.6	1,800	25,000
	12	8	0.15	0.3	1,000	16,000	0.1	0.2	500	12,000
	18	12	0.08	0.12	700	10,000	0.02	0.06	200	8,000
	4	2	0.45	0.8	4,000	30,000	0.45	0.8	2,400	22,000
1.5	6	3	0.45	0.8	3,000	27,000	0.45	0.8	1,800	20,000
	8	4	0.4	0.8	2,400	25,000	0.4	0.8	1,600	18,000
	10	5	0.3	0.6	2,000	22,000	0.25	0.5	1,400	16,000
	12	6	0.3	0.6	1,400	16,000	0.25	0.5	900	12,000
	16	8	0.25	0.5	1,000	12,000	0.12	0.25	500	9,000
	20	10	0.15	0.3	800	10,000	0.06	0.1	350	8,000
2	25	12.5	0.08	0.15	600	8,000	0.03	0.05	200	6,000
	10	3.3	0.7	1.5	3,400	20,000	0.6	1.2	2,400	16,000
	15	5	0.6	1	3,000	18,000	0.6	1.2	2,000	14,000
	20	6.7	0.5	0.8	2,400	16,000	0.4	0.6	1,400	12,000
	25	8.3	0.4	0.6	1,800	12,000	0.2	0.3	900	10,000
3	30	10	0.2	0.4	1,200	8,000	0.08	0.15	500	6,000
	10	2.5	1	1.6	4,000	16,000	0.8	1.6	2,800	12,000
	15	3.8	0.8	1.6	3,400	16,000	0.8	1.6	2,400	12,000
	20	5	0.8	1.6	3,000	14,000	0.8	1.6	2,000	10,000
	25	6.3	0.6	1.2	3,000	14,000	0.5	1	2,000	10,000
3	30	7.5	0.5	1	2,400	12,000	0.3	0.5	1,200	7,000
	40	10	0.4	0.8	1,200	8,000	0.15	0.3	500	5,000
	20	3.3	1	2	3,600	12,000	1	2	2,400	9,000
3	30	5	0.8	1.6	3,000	10,000	0.4	0.8	1,800	7,000
	50	8.3	0.5	1	1,800	6,000	0.25	0.5	800	4,000

备注
Notes

※ 上方切削参数表仅为参考值。请根据实际的加工形状及使用设备调整切削条件。
 ※ 切深量的 ap 表示轴向切入量, ae 表示步距。
 ※ 发生振刀时, 请以相同的比率降低主轴转速和进给速度。
 此外, 主轴转速过低时, 也以相同的比率降低。
 ※ 建议使用油冷冷却方式。
 ※ These recommended cutting conditions indicate just reference. It should be adjusted according to milling shape and machine type.
 ※ Depth of Cut : ap=Axial Depth of Cut / ae=Radial Depth of Cut.
 ※ Reduce both spindle speed and feed at same rate for chattering and also for insufficient spindle speed of a machine.
 ※ Water-insoluble cutting fluid is recommended.

警告 CAUTION 使用上的安全注意事项 Attention on Safety

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| <ol style="list-style-type: none">1) 拿取刀具使用时，请特别小心以免损坏刀刃。2) 请勿空手触摸刀刃。3) 为了安全，使用刀具时请带防护眼镜。4) 选用适合刀具和实际加工内容的刀柄。刀柄装夹后将刀柄的偏摆量控制最低。5) 加工工件必须固定好。6) 请预先测量刀具及被削材的尺寸。7) 请根据工件形状和使用设备情况来调节切削参数。8) 根据实际用途请选择适合的冷却方式。使用切削油时，请采取防火措施以免发生火灾而引火等火灾的发生。9) 加工过程中如发生异常现象（异常声音或烟雾）时，请立即停止加工。10) 请勿改造刀具。 | <ol style="list-style-type: none">1) When removing tools from cases, be careful of getting-out of tools and don't touch directly the cutting edges.2) Never touch the cutting edges directly with bare hand.3) Use safety covers and eye protection, as tools may be broken.4) Use holders, etc. that match the tools and nature of the processing operations. The tool should be firmly attached to the holder to prevent shaking.5) The work materials clamp firmly.6) Make sure of dimensions of tools and work pieces before starting operation.7) It is necessary to adjust conditions according to the dimensions of work materials and the machine.8) Select a cutting fluid appropriate to the particular usage. Using a water insoluble cutting fluid could lead to fires due to sparks generated during processing or heat caused by breakage. Ensure that you take proper fire-prevention measures.9) If abnormal sound, etc. occurs during processing, stop the machine immediately.10) Don't modify tools. |
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