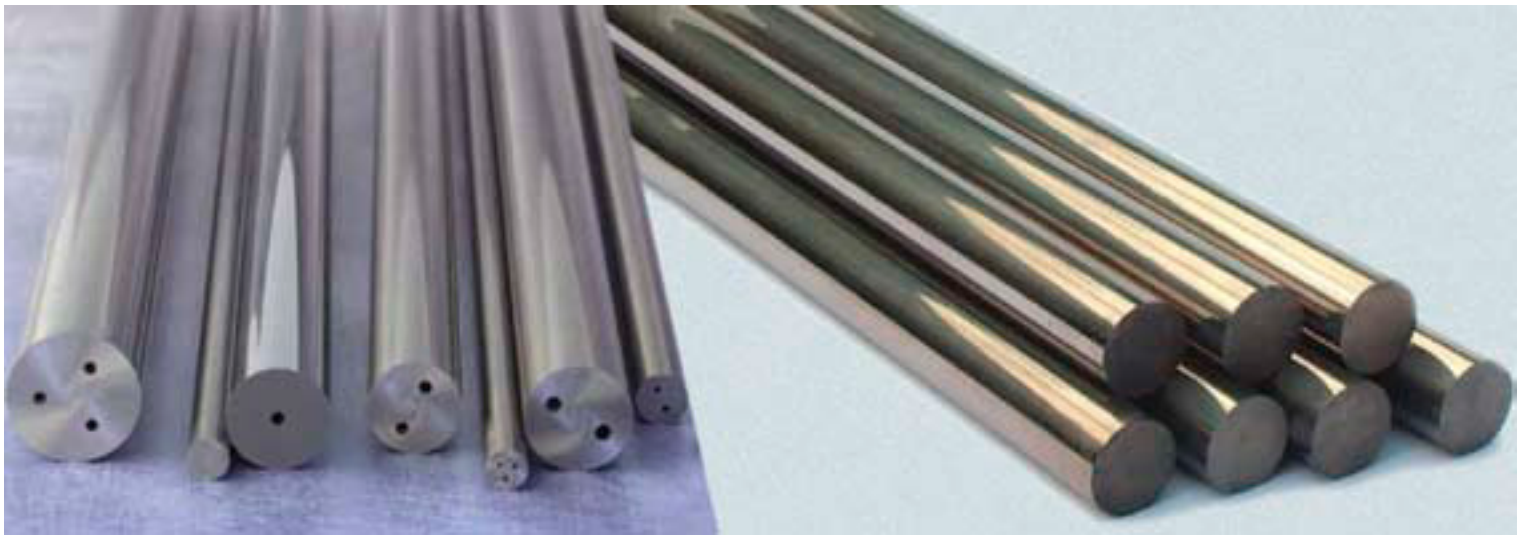
钻石牌
DIAMOND BRAND
Выдающийся бренд Китая.

ТВЕРДОСПЛАВНЫЕ ПРУТЬЯ

Каталог 2008



ZCC Zhuzhou cemented carbide group corp. LTD

Закрытое акционерное общество "ABTEX"

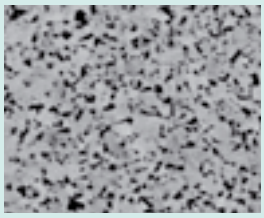
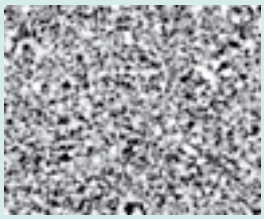
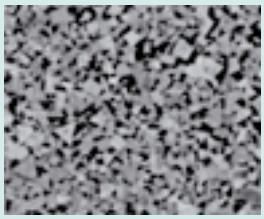
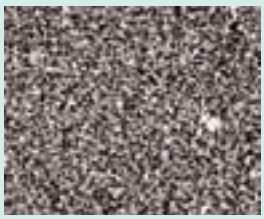
目　　录
Contents

牌号成分及性能
Grades, composition and properties

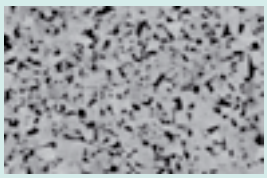
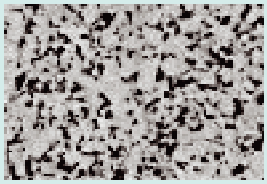
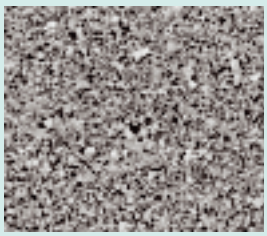
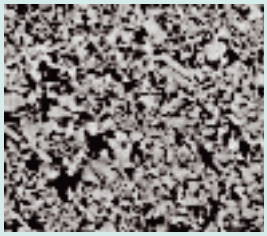
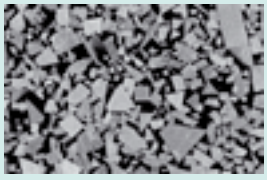
牌 号 Grade	国际分类号 ISO code	晶粒度 Grain size μm	钴含量 Cobalt content (wt.-%)	密 度 Density g/cm³	硬 度 Hardness		抗弯强度 TRS(ISO3327) C试样 Sample C	
					HV30	HRA	N/mm²	K PSI
YU06	K05–K10	0.4	6.0	14.75	2050	94.3	3000	437.3
YU12	K30–K40	0.4	12.0	14.05	1700	92.5	4000	583.1
YF06	K05–K10	0.5	6.0	14.90	1850	93.5	3800	553.9
YH6F	K05–K10	0.5	6.0	14.80	1900	93.8	4000	583.1
YL10.2	K20–K30	0.8	10.0	14.42	1600	91.8	4000	583.1
YC40T	P30–P40	0.8	13.0	13.60	1470	91.0	3500	510.2
YL15	P20–P30	1.0	8.5	12.80	1600	91.5	3000	437.3
YL50	K30–K40	1.3	15.0	14.00	1110	87.6	4000	583.1

牌号用途推荐
Recommended applications for the grades

PCB工具用牌号
Grades for PCB tools

牌 号 Grade	金 相 Microstructure	推 荐 用 途 Applications recommended
YF06		适用于加工铝镁合金、塑料、塑料王以及碳纤维、铁基合金等复合材料。 推荐用于制作ϕ3.2~6.3mmPCB大直径钻头、ϕ0.8~3.2mmPCB微钻、微铣刀和铰刀等硬质合金工具。 Suitable for machining composite materials, such as aluminum-magnesium alloys, plastics, reinforced plastics and carbon fiber, iron-based alloys, etc. It is recommended for making big PCB drills of ϕ3.2-6.3mm, micro drills of ϕ0.8-3.2mm, micro milling tools and reamers, etc.
YU06		适用于玻璃纤维、木材、塑料、铝镁合金等材料的加工。 推荐用于制作各种硬质合金整体工具和PCB微钻、微铣刀，是制作加工PCB微铣刀的首选。 Suitable for machining glass fiber, wood, plastics,aluminum-magnesium alloys, etc. It is recommended for making various solid carbide tools and PCB micro drills ,micro milling tools & it is an optimal grade for PCB micro drills & micro milling tools.
（新）YH6F		采用纳米复合粉研制，具有更为均匀的晶粒度，更高的强度、硬度和韧性等综合性能。特别适合于制作ϕ0.30~0.50mmPCB微钻。 It is developed with Nomi composite powder with comprehensive properties of more even grain size, higher strength, hardness and toughness etc. It is especially suitable for making PCB micro drills of ϕ0.3-0.5mm.
（新） YU08E		适用于加工玻璃纤维制品、木材、塑料、纸、黄铜等材料。 推荐用于制作ϕ0.3~0.5mmPCB用微钻。 It is suitable for making glass fiber,wood,plastics,paper,brass,etc.it is recommended for making PCB drills of ϕ0.3-0.5mm.

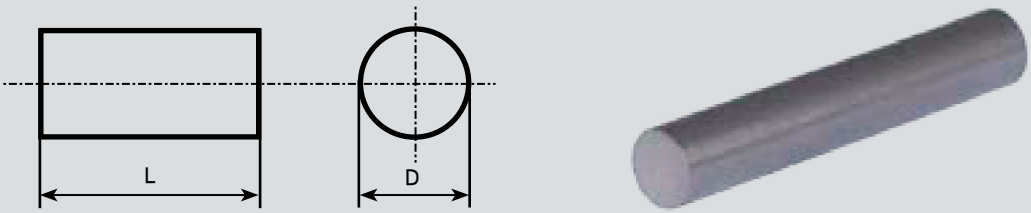
整体刀具用牌号
Grades for solid tools

牌号 Grade	金 相 Microstructure	推 荐 用 途 Applications recommended
YF06		适用于加工铝镁合金、塑料、塑料王以及碳纤维、铁基合金等复合材料。推荐用于制作加工铝镁合金的钻头。 Suitable for machining composite materials, such as aluminum-magnesium alloys, reinforced plastics, and carbon fiber, iron-based alloys,etc. It is recommended for making drills for machining aluminum-magnesium alloys.
YL15		适合制作螺旋铣刀片等硬质合金工具，具有高的红硬性、冲击韧性。 推荐用于普通碳钢的粗加工。 Suitable for making carbide tools,such as helical milling tools with high hot hardness and impact toughness. It is recommended for the roughing of common carbon steel.
YL10.2		适用于普钢、铸铁、不锈钢、耐热钢、镍基及钛合金等材料的加工。 推荐用于麻花钻头、立铣刀、丝锥、枪钻等通用工具材料。 Suitable for machining common steel, cast iron, stainless steel, heat-resistant steel, nickel based alloys and titanium alloys, etc. It is recommended for making conventional tools, such as twist drills, end mills, screw taps, gun drills, etc.
（新）YU12		适用于钛合金，耐热合金，不锈钢，淬硬钢，灰口铸铁，玻璃纤维增强塑料等材料的加工。 推荐用于制作各种规格的立铣刀、球头铣刀等硬质合金工具，具有比YL10.2更高的硬度和强度。 Suitable for machining titanium alloys, heat-resistant alloys, stainless steel, hardened steel, grey cast iron, glass fiber reinforced plastics, etc. It is recommended for making end mills and ball nose mills of various specifications with a higher hardness and strength than YL10.2.
（新）YC40T		具有较好的耐磨性、高的抗弯强度及良好韧性和抗冲击能力。 适用于不锈钢尤其是奥氏体不锈钢的粗加工和半精加工， 适用于低速条件下切削耐热合金钢。 It possesses better wear resistance, high transverse rupture strength, good toughness and impact resistance. Suitable for machining stainless steel, especially for the roughing and semi-finishing operations of austenitic stainless steel. It is suitable for machining heat-resistant alloy steel at low speeds.
YL50		适合制作冲压用整体模具和工具。 Suitable for making solid dies and moulds and tools for punching operations.

PCB工具用硬质合金棒材
Cemented carbide rods for PCB tools

型号表示：BϕD×L

Type specifications: BϕD xL

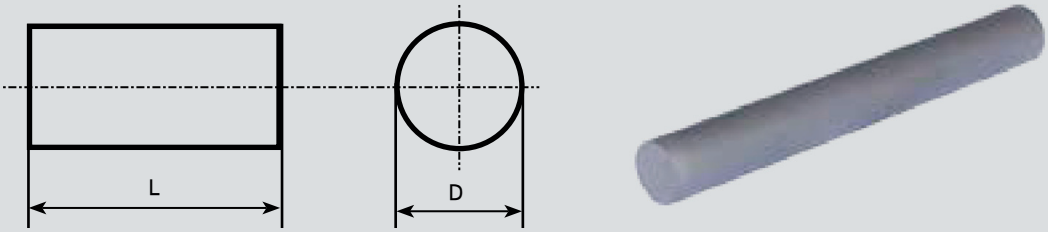


型 号 Type	直径公差 Tolerance of diameter(mm)	长度公差 Tolerance of length(mm)
BΦ3.25×38.5	−0/+0.05	−0.20/+0.20
BΦ3.5×38.5	−0/+0.05	−0.20/+0.20
BΦ4.0×38.5	−0/+0.05	−0.20/+0.20
BΦ4.5×38.5	−0/+0.05	−0.20/+0.20
BΦ5.0×38.5	−0/+0.05	−0.20/+0.20
BΦ5.5×38.5	−0/+0.05	−0.20/+0.20
BΦ6.0×38.5	−0/+0.05	−0.20/+0.20
BΦ6.5×38.5	−0/+0.05	−0.20/+0.20
BΦ3.25×38.7	−0/+0.05	−0.20/+0.30
BΦ3.5×12.8	+0.20/+0.50	−0.10/+0.10
BΦ4.0×12.8	+0.20/+0.50	−0.10/+0.10
BΦ4.5×12.8	+0.20/+0.50	−0.10/+0.10
BΦ5.0×12.8	+0.20/+0.40	−0.10/+0.10
BΦ5.5×12.8	+0.20/+0.40	−0.10/+0.10
BΦ6.0×12.8	+0.20/+0.40	−0.10/+0.10
BΦ6.5×12.8	+0.20/+0.40	−0.10/+0.10
BΦ6.85×12.8	+0.20/+0.40	−0.10/+0.10

实心硬质合金棒材毛坯
Solid cemented carbide rod blanks

型号表示：ϕD×L

Type specifications: ϕD x L



（公制） the metric system

型 号 Type	外径公差 Tolerance of diameter(mm)	长度公差 Tolerance of length(mm)
ϕ0.5×330	+0.20/+0.45	−0/+5.0
ϕ1.0×330	+0.20/+0.45	−0/+5.0
ϕ1.2×330	+0.20/+0.45	−0/+5.0
ϕ1.6×330	+0.20/+0.45	−0/+5.0
ϕ1.8×330	+0.20/+0.45	−0/+5.0
ϕ2.3×330	+0.20/+0.45	−0/+5.0
ϕ2.5×330	+0.20/+0.45	−0/+5.0
ϕ3.0×330	+0.20/+0.45	−0/+5.0
ϕ3.5×330	+0.20/+0.45	−0/+5.0
ϕ4.0×330	+0.20/+0.45	−0/+5.0
ϕ4.5×330	+0.20/+0.45	−0/+5.0
ϕ5.0×330	+0.20/+0.45	−0/+5.0

续表1

型 号 Type	外径公差 Tolerance of diameter(mm)	长度公差 Tolerance of length(mm)
ϕ5.5×330	+0.20/+0.45	−0/+5.0
ϕ6.0×330	+0.20/+0.45	−0/+5.0
ϕ6.5×330	+0.20/+0.45	−0/+5.0
ϕ7.0×330	+0.20/+0.45	−0/+5.0
ϕ7.5×330	+0.20/+0.45	−0/+5.0
ϕ8.0×330	+0.20/+0.45	−0/+5.0
ϕ8.5×330	+0.20/+0.45	−0/+5.0
ϕ9.0×330	+0.20/+0.45	−0/+5.0
ϕ9.5×330	+0.20/+0.45	−0/+5.0
ϕ10.0×330	+0.20/+0.45	−0/+5.0
ϕ10.5×330	+0.20/+0.45	−0/+5.0
ϕ11.0×330	+0.20/+0.45	−0/+5.0
ϕ11.5×330	+0.20/+0.45	−0/+5.0
ϕ12.0×330	+0.20/+0.45	−0/+5.0
ϕ12.5×330	+0.20/+0.60	−0/+5.0
ϕ13.0×330	+0.20/+0.60	−0/+5.0
ϕ13.5×330	+0.20/+0.60	−0/+5.0
ϕ14.0×330	+0.20/+0.60	−0/+5.0
ϕ14.5×330	+0.20/+0.60	−0/+5.0
ϕ15.0×330	+0.20/+0.60	−0/+5.0
ϕ15.5×330	+0.20/+0.60	−0/+5.0
ϕ16.0×330	+0.20/+0.60	−0/+5.0

续表2

型 号 Type	外径公差 Tolerance of diameter(mm)	长度公差 Tolerance of length(mm)
ϕ16.5×330	+0.20/+0.60	−0/+5.0
ϕ17.0×330	+0.20/+0.60	−0/+5.0
ϕ17.5×330	+0.20/+0.60	−0/+5.0
ϕ18.0×330	+0.20/+0.60	−0/+5.0
ϕ18.5×330	+0.20/+0.60	−0/+5.0
ϕ19.0×330	+0.20/+0.60	−0/+5.0
ϕ19.5×330	+0.20/+0.60	−0/+5.0
ϕ20.0×330	+0.20/+0.60	−0/+5.0
ϕ21.0×330	+0.20/+0.80	−0/+5.0
ϕ22.0×330	+0.20/+0.80	−0/+5.0
ϕ23.0×330	+0.20/+0.80	−0/+5.0
ϕ24.0×330	+0.20/+0.80	−0/+5.0
ϕ25.0×330	+0.20/+0.80	−0/+5.0
ϕ26.0×330	+0.20/+0.80	−0/+5.0
ϕ27.0×330	+0.20/+0.80	−0/+5.0
ϕ28.0×330	+0.20/+0.80	−0/+5.0
ϕ29.0×330	+0.20/+0.80	−0/+5.0
ϕ30.0×330	+0.20/+0.80	−0/+5.0

（英制） the British system

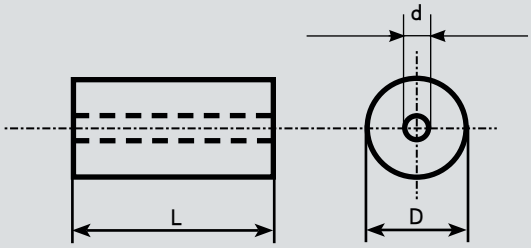
型 号 Type	外径公差 Tolerance of diameter(mm)	长度公差 Tolerance of length(mm)
ϕ1/8×13	+0.006/+0.018	−0/+0.197
ϕ5/32×13	+0.006/+0.018	−0/+0.197
ϕ3/16×13	+0.006/+0.018	−0/+0.197
ϕ1/4×13	+0.006/+0.018	−0/+0.197
ϕ3/8×13	+0.006/+0.018	−0/+0.197
ϕ1/2×13	+0.006/+0.018	−0/+0.197
ϕ5/16×13	+0.006/+0.018	−0/+0.197

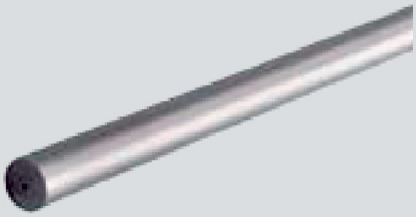
可按客户要求提供长度L≤700mm的毛坯棒材。

Rod blanks of L≤700mm can be supplied at customers' requests.

单直孔硬质合金棒材
Cemented carbide rods with one straight coolant hole

型号表示：φD×φd×L
Type specifications: φD xφd x L





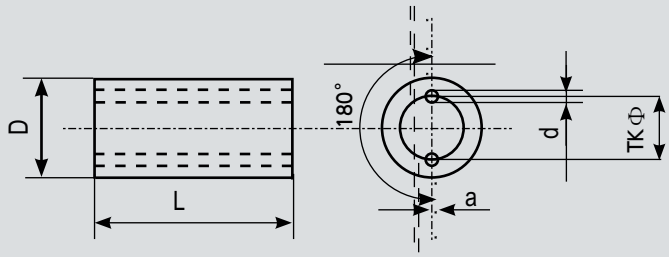
外 径 D (mm)	外径公差 Tolerance of diameter (mm)	孔尺寸 d (mm)	孔公差 Tol. of d (mm)	同心度 max. Concentricity	长 度 L (mm)	公 差 Tolerance of length (mm)
φ2.5	+0.20～+0.50	0.3	±0.10	0.20	330	−0/+5.0
φ4.0		1.0	±0.15		330	−0/+5.0
φ6.0					330	−0/+5.0
φ8.0		1.5			330	−0/+5.0
φ10.0	+0.30～+0.60	2.0	±0.20	0.25	330	−0/+5.0
φ12.0					330	−0/+5.0
φ14.0					330	−0/+5.0
φ16.0					330	−0/+5.0
φ18.0	+0.40～+0.80	3.0	±0.25	0.30	330	−0/+5.0
φ20.0					330	−0/+5.0
φ22.0					330	−0/+5.0
φ24.0		4.0	±0.30		330	−0/+5.0
φ26.0		5.0	±0.35		330	−0/+5.0
φ28.0					330	−0/+5.0
φ30.0					330	−0/+5.0

可根据用户需求提供不同规格的直径和孔径的配合。
Rods of various diameter and hole size combinations can be supplied at customers' requests.

双直孔硬质合金棒材
Cemented carbide rods with two straight coolant holes

型号表示：ϕD×2ϕd×TKϕ ×LZ （ L表示长度；Z表示双直孔）

Type specifications: ϕDx2ϕdxTKϕxLZ (L indicates the length; Z indicates two straight coolant holes)



外 径 D(mm)	外径公差 Tol of D(mm)	孔尺寸 d(mm)	孔公差 Tol of d(mm)	孔间距 TKϕ(mm)	孔间距公差 Tol.of TKϕ(mm)	孔偏离 a(mm)
Φ4.2	+0.3 −0	0.8	±0.1	1.8	−0.2	0.1
Φ5.2		0.8	±0.1	2.0	−0.2	0.13
Φ6.3		1.0	±0.1	3.0	−0.2	0.15
Φ7.3		1.0	±0.15	3.5	−0.3	0.15
Φ8.3		1.0	±0.15	4.0	−0.3	0.15
Φ9.3		1.4	±0.15	4.0	−0.3	0.2
Φ10.3		1.4	±0.15	5.0	−0.3	0.2
Φ11.3	+0.4 −0	1.4	±0.15	5.0	−0.5	0.28
Φ12.3		1.75	±0.15	6.0	−0.5	0.3
Φ13.3		1.75	±0.15	6.0	−0.5	0.34
Φ14.3		1.75	±0.15	7.0	−0.5	0.37
Φ15.3		2.0	±0.2	7.0	−0.5	0.4
Φ16.3		2.0	±0.2	8.0	−0.5	0.4

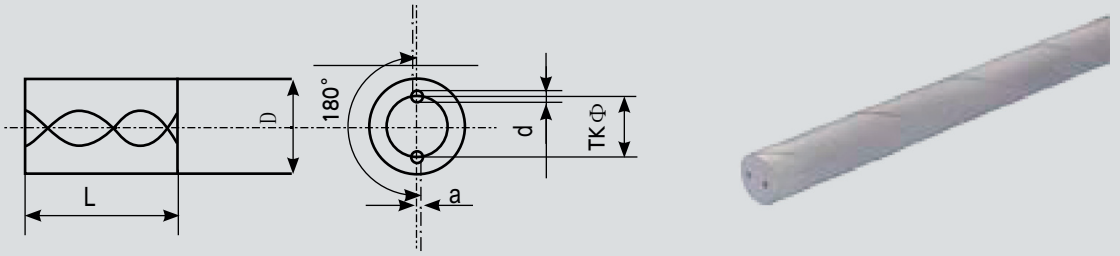
续 表

外　径 D(mm)	外径公差 Tol of D(mm)	孔尺寸 d(mm)	孔公差 Tol of d(mm)	孔间距 TKφ(mm)	孔间距公差 Tol.of TKφ(mm)	孔偏离 a(mm)
Φ17.3	+0.5−0	2.0	±0.2	8.0	−0.8	0.47
Φ18.3		2.0	±0.2	9.0	−0.8	0.5
Φ19.3		2.0	±0.2	9.0	−0.8	0.5
Φ20.4		2.5	±0.25	10.0	−0.8	0.5
Φ21.4		2.5	±0.25	10.0	−0.8	0.5
Φ22.4		2.5	±0.25	11.0	−0.8	0.5
Φ23.4		2.5	±0.25	11.0	−0.8	0.5
Φ24.4	+0.5−0	3.0	±0.25	12.0	−1.0	0.5
Φ25.4		3.0	±0.25	12.0	−1.0	0.5
Φ26.4		3.0	±0.25	13.0	−1.0	0.5
Φ28.4		3.0	±0.25	14.0	−1.0	0.5
Φ30.4		3.0	±0.25	14.0	−1.0	0.5
Φ32.4		3.0	±0.25	14.0	−1.0	0.5
Φ34.4		3.0	±0.25	14.0	−1.0	0.5

双螺旋孔棒材可供产品规格
Specification of rods available with two helical holes

型号表示：ϕD×2ϕd×TKϕ×LB（L表示长度；B表示螺旋角为30°，也可取 A、C、D：分别为15° 40° 45°）

Type specifications: ϕDx2ϕdxTKϕxLB (L indicates the length, B indicates a helical angle of 30º and A, C, D are optional with helical angels of 15º, 40º and 45º respectively.)



外 径 D(mm)	外径公差 Tol of D	孔间距 TKϕ(mm)	孔间距公差 Tol of TKϕ	孔尺寸 d(mm)	孔公差 Tol of d	孔偏离 a(mm)	螺 距 Pitch (mm) (B: 30°±0.5°)	
Φ6.3	+0.3	2.60	−0.40	0.70	±0.10	0.15	32.65	−3.0/+3.0
Φ6.8	+0.3	3.5	−0.40	1.00	±0.15	0.15	35.37	−3.0/+3.0
Φ7.3	+0.3	3.70	−0.40	1.00	±0.15	0.15	38.09	−3.0/+3.0
Φ7.8	+0.3	4.00	−0.40	1.00	±0.15	0.15	40.81	−3.0/+3.0
Φ8.3	+0.3	4.00	−0.40	1.00	±0.15	0.15	43.53	−4.5/+4.5
Φ8.8	+0.3	4.50	−0.60	1.00	±0.15	0.20	46.25	−4.5/+4.5
Φ9.3	+0.3	4.80	−0.60	1.40	±0.15	0.20	48.97	−4.5/+4.5
Φ9.8	+0.3	4.80	−0.60	1.40	±0.15	0.20	51.69	−4.5/+4.5
Φ10.3	+0.3	4.80	−0.60	1.40	±0.15	0.20	54.41	−4.5/+4.5
Φ10.8	+0.4	4.80	−0.80	1.40	±0.15	0.28	57.13	−4.5/+4.5
Φ11.3	+0.4	5.30	−0.80	1.40	±0.15	0.28	59.86	−4.5/+4.5
Φ11.8	+0.4	5.90	−0.80	1.40	±0.20	0.30	62.58	−7.0/+7.0
Φ12.3	+0.4	6.25	−0.80	1.40	±0.20	0.30	65.30	−7.0/+7.0

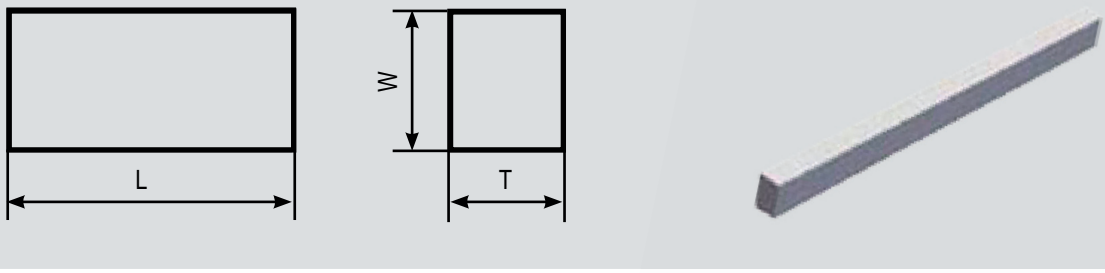
续 表

外 径 D(mm)	外径公差 Tol of D	孔间距 TKφ(mm)	孔间距公差 Tol of TKφ	孔尺寸 d(mm)	孔公差 Tol of d	孔偏离 a(mm)	螺 距 Pitch (mm) (B: 30°±0.5°)	
Φ12.8	+0.4	6.25	−1.0	1.75	±0.20	0.33	68.02	−7.0/+7.0
Φ13.3	+0.4	6.50	−1.0	1.75	±0.20	0.34	70.74	−7.0/+7.0
Φ13.8	+0.4	6.80	−1.0	1.75	±0.20	0.35	73.43	−7.0/+7.0
Φ14.3	+0.4	7.10	−1.0	1.75	±0.20	0.37	76.18	−7.0/+7.0
Φ14.8	+0.4	7.40	−1.0	1.75	±0.20	0.39	78.90	−7.0/+7.0
Φ15.3	+0.4	7.70	−1.0	1.75	±0.20	0.40	81.62	−7.0/+7.0
Φ15.8	+0.4	8.00	−1.0	1.75	±0.20	0.40	84.34	−7.0/+7.0
Φ16.3	+0.4	8.30	−1.0	1.75	±0.20	0.40	87.06	−7.0/+7.0
Φ16.8	+0.5	8.60	−1.0	1.75	±0.20	0.45	89.78	−7.5/+7.5
Φ17.3	+0.5	8.90	−1.0	1.75	±0.20	0.47	92.50	−7.5/+7.5
Φ17.8	+0.5	9.20	−1.0	1.75	±0.20	0.48	95.22	−7.5/+7.5
Φ18.3	+0.5	9.55	−1.0	2.00	±0.25	0.50	97.95	−7.5/+7.5
Φ18.8	+0.5	9.75	−1.0	2.00	±0.25	0.50	100.67	−7.5/+7.5
Φ19.3	+0.5	10.10	−1.0	2.00	±0.25	0.50	103.39	−7.5/+7.5
Φ19.8	+0.5	10.25	−1.0	2.00	±0.25	0.50	106.10	−7.5/+7.5
Φ20.3	+0.5	10.40	−1.0	2.00	±0.25	0.50	108.83	−7.5/+7.5

硬质合金片材
Cemented carbide strips

型号表示：T×W×L

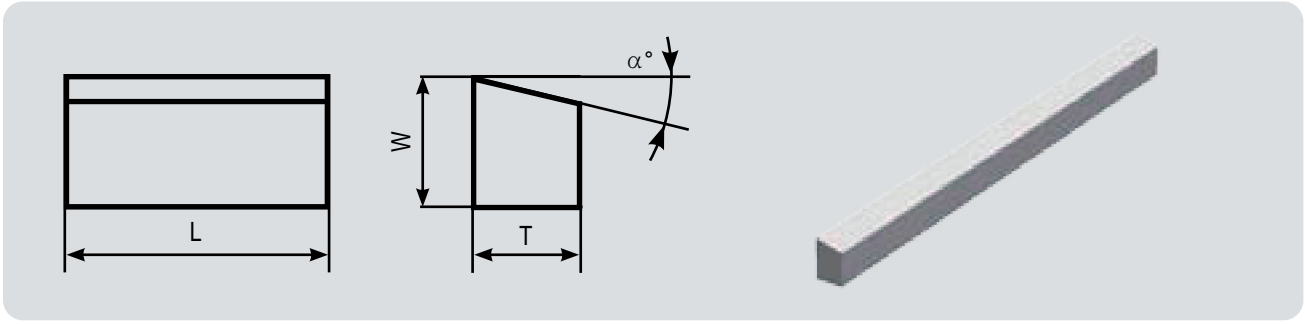
Type specifications: T x W x L--α



型号（T×W×L） Type (mm)	厚度公差 Tol. of T (mm)	宽度公差 Tol. of W (mm)	长度公差 Tol. of L (mm)
1×（2~5）×L	T≤7.0 $T^{+0.5}_{+0.2}$； T>7.0 $T^{+0.6}_{+0.2}$	W≤30 $W^{+0.6}_{+0.2}$； W>30 $W^{+0.8}_{+0.2}$	L<100 $L^{+1.0}_{0}$； L≥100 （330mm excl.）$L^{+2.0}_{0}$； L=330 $L^{+5.0}_{0}$
1.5×（2~10）×L			
2.0×（3.5~15）×L			
2.5×（2.5~20）×L			
3.0×（3.0~20）×L			
3.5×（3.5~25）×L			
4.0×（4.0~30）×L			
5.0×（4.0~40）×L			
6.0×（5.0~40）×L			
（7~20）×（7~40）×L			

硬质合金带角度片材
Cemented carbide strips with angles

型号表示：T×W×L－α
Type specifications: T x W x L



型号（T×W×L） Type (mm)	厚度公差 Tol. of T (mm)	宽度公差 Tol. of W (mm)	角度公差 Tol.of α° (mm)	长度公差 Tol. of L (mm)
(1～2)×(2.5～6.0)～(0～35°)	T $^{+0.5}_{+0.2}$	W $^{+0.6}_{+0.2}$	± 1°	L＜100 L $^{+1.0}_{0}$； L≥100 (330mm excl.) ,L $^{+2.0}_{0}$； L=330 L $^{+5.0}_{0}$ It is +1.0/0 when L is <100mm; It is +2.0/0 when L is ≥100mm(330mm excluded); When L is equal to 330mm, it is +5.0/0 then.
(2～3)×(3.0～8.0)～(0～35°)				
(3～4)×(3.0～20.0)～(0～35°)				
(4～5)×(4.0～30.0)～(0～35°)				

硬质合金的质量控制
Quality control for cemented carbide

硬质合金
Cemented carbide

硬质合金是指至少含有一种金属碳化物组成的烧结复合材料。碳化钨（WC），碳化钛（TiC），碳化钽（TaC）是常见组份。碳化物组份（或相）的晶粒尺寸通常在0.2–10微米之间。碳化物晶粒使用金属粘结剂结合在一起。粘结剂通常是钴金属（Co），但对一些特别的用途，镍（Ni），铁（Fe），或其它金属及合金也可使用。对于一个特定的碳化物和粘结相的成份组合称之为“牌号”。

碳化物，或称“硬质相”，在工程应用中通常是利用其耐磨性。

粘结相成份主要是利用其强度和耐蚀性。

Cemented carbide refers to a sintered composite material with at least one metallic carbide. Tungsten carbide (WC), titanium carbide (TiC) and TaC are the most common constituents. The grain size of the carbide constituents (or phase) is normally between 0.2-10 microns. The grains of the carbides are cemented together via metal binder. Binder is usually cobalt and nickel (Ni), iron (Fe) or other metals & alloys can also be used for some special applications. The combination of a specific carbide and binder component is called “grade”.

In engineering applications the wear resistance of carbide or “hard phase”

is taken advantage of and mainly the strength and corrosion resistance of the binder phase is taken advantage of.

密 度
Density

ISO 3369

一种材料的密度（比重）是其质量与其体积之比。 它是采用排水技术（阿基米德法）来测量的。

密度在硬质合金工业中通常用于确定一个牌号成分的正确性。与通常的理解不同的是，现代硬质合金的孔隙度水平不能用测量密度的方法来确定。碳化钨（WC）的密度是15.7g／cm3,钴的密度是8.9g／cm3。因此对于WC–Co牌号来说，随钴含量增加，密度线性减少。碳化钛的增加导致密度降低，因为纯碳化钛的密度只有4.9 g／cm3。

ISO3369

The density (specific gravity) of a material is the relation mass to volume. It is determined by the water displacement technology (Archimedean Principle).

Density is usually used to determine whether the composition of a grade is correct or not. What differs from common understanding is that the porosity of modern cemented carbide can not be determined by the measurement of the density. The density of tungsten carbide (WC) is 15.7g/cm3 and that of cobalt is 8.9g/cm3. As far as grades which contain WC-Co are concerned, the density will have a linear decrease with the increase of cobalt content. The increase of titanium carbide will result in the decrease of density, since the density of pure titanium carbide is onoy 4.9g/cm3.

矫顽磁力
Coercive force

ISO 3326

矫顽磁力是硬质合金中的钴粘结相磁化和去磁后在一个磁滞回线中的剩磁。

由于在碳化物相平均晶粒尺寸和矫顽力之间有一个直接的关系，因此它在工业上是一种重要的无损试验方法。碳化物相晶粒越细，矫顽力值越高。

ISO3327
Coercive force refers to the residual magnet in a magnetic retardation cycle after the cobalt binder phase is magnetized and demagnetized. It is a very important harmless test method in industries due to the fact that there is a direction relation between the average grain size of the carbide phase and the coercive force. The finer that grain size of the carbide phase, the high value the coercive force.

磁饱和
Magnetic saturation

硬质合金工业中钴粘结相的磁饱和测量被用于评价其成份。
钴是磁性的。碳化钨（WC）晶体，立方碳化物晶体（TiC，TaC，NbC，VC，等等）是非磁性的。因此如果一个牌号中的钴的磁饱和值被测定，然后与含纯钴的试样的对应值相比较，钴粘结相的合金化水平就可获得，这是因为与钴形成合金的元素影响磁饱和值。因此对于理想粘结相成份的任何变化都可以被测量。这个试验被用于确定对最佳碳含量的任何偏差，这是因为碳在成份控制中扮演了一个主要角色。
低的磁饱和值表明碳含量低和/或碳化物η相的存在。
高的磁饱和值表明游离碳或石墨相的存在。
这两种情况对机械性能都是有害的。

The measurement of magnetic saturation of the cobalt binder phase in cemented carbide is used for the evaluation of its composition.
Cobalt is magnetic. WC crystals and cubic carbide crystals (TiC, TaC, NbC, VC, etc.) are non-magnetic. As a result, if the magnetic saturation value of the cobalt in a grade is determined and then compared with the corresponding value of a sample containing pure cobalt, the alloying level of the cobalt binder phase can be obtained, as the elements that form the alloy together with cobalt affect the value of magnetic saturation. Thus any change in the optimal binder phase composition can be measured. This test is applied to determine any deviation of the optimal carbon content, since carbon plays an important role in the control of the composition.
A low magnetic saturation value indicates a low carbon content and/or the existence of η phase it the carbides.
A high magnetic saturation value indicates the existence of free carbon and graphite phase .
Both will have adverse effects on the mechanical properties.

硬 度
Hardness

ISO 3738 及ISO 3878
一种材料的硬度是这样定义的：即材料抵抗金刚石压头产生压痕的能力。
维氏硬度（HV）测量方法使用一个标准的有方形基座的金字塔形金刚石在一定的负荷条件下穿透试样表面。测量压痕的对角线即可得到硬度值，硬质合金常用的预载压力为3公斤（HV30）。这种方法在国际上广泛使用。
洛氏硬度（H R A）是另一种常用的硬度测量方法。这种系统测量以一个标准的金刚石锥头的穿透深度来获得硬度值。
由于维氏和洛氏硬度测量的原理不同，当从一种硬度转换成另一种硬度时必须注意。

ISO3738 and ISO3878
The hardness of a material is defined as this: the capability of the material resisting the indent made by a diamond indenter.
The method for determining Vickers hardness (HV) is to use a standard pyramid diamond sitting on a square base for penetrating the surface of a sample at a certain load. The hardness value can be obtained by measuring the diagonal line of the indent. The preload used for cemented carbide is normally 3 kilograms (HV30). This method is widely used in the world.
Rockwell hardness (HRA) is another common method for measuring hardness. This system is to obtain the hardness value via measuring the depth penetrated by a standard conic diamond head.
Attention should be paid to the conversion of one hardness to another in view of the difference in the principle for measuring Vickers hardness and Rockwell hardness.

孔隙度
Porosity

ISO 4505

硬质合金是使用粉末冶金方法制造的，其中金属粘结相用于将碳化相烧结在一起。

因此存在这样的可能：由于不完全的烧结，少量的残余孔隙会存在于产品的金相结构中。

材料中存在的孔隙的体积是使用一种标准的比较程序来评价的。后者根据一系列的标准图谱将孔隙尺寸范围和分布分成不同类别。

尺寸10微米以下的孔隙称为“A”型孔隙。

尺寸10–25微米的孔隙称为“B”型孔隙。

更大尺寸的孔隙单独测量和分类。

硬质合金中孔隙的存在对机械性能有负面的影响。

ISO4505

Cemented carbide is manufactured by powder metallurgy and the metal binder phase is used to sinter together the carbide phase. So there exists such a possibility: A small amount of residual pores are present in the microstructure of cemented carbide due to the incomplete sintering. The volume of the pores present in the material is to be evaluated by a standard comparison procedure. The latter divides the scope of dimensions and the distribution of pores into several categories:

A pore under 10 microns is called porosity “A”

A pore of 10-25 microns is called porosity “B”

Pores of bigger dimensions are to be measured and classified separately.

The existence of pores in cemented carbide will have adverse effects on its mechanical properties.

钴 池
Cobalt lake

硬质合金是采用金属粉末冶金方法制造的。其中金属粘结相用于将碳化物相烧结在一起。因此存在这样的机会：烧结后结构中某些地方存在过多的钴。这种情况被称为“钴池”。钴池是烧结时钴的不完全分布的结果。这可能是由于烧结温度过低，钴不能充分流动。原始粉末材料成形密度不够，或是在热等静压处理时孔隙被钴填充结果。

材料中钴池体积的评价是根据其尺寸和分布采用显微照片比较和/或单个测量。硬质合金中钴池的存在会影响耐磨性和强度。

Cemented carbide is manufactured by powder metallurgy and the metal the binder phase is to sinter together the carbide phase. So there exists such an opportunity: Too much cobalt is present in some places of structure after the sintering process and it is called “cobalt lake”. Cobalt lake is caused by the incomplete distribution of cobalt in the sintering process. The reason may be the too low sintering temperature to hinder the sufficient flow of cobalt, the insufficiency of density of the virgin compacted material or the filling of cobalt into the pores in the HIP process.

The evaluation of the volume of cobalt lake in the material is made by the comparison of micrographs and/or measurement of one by one based on the sizes and distribution. The presence of cobalt lake in cemented carbide will affect its wear resistance and strength.

游离碳/石墨
Free carbon/graphite

ISO 4505

高于化学计量值的碳会导致游离碳的形成，即材料中的非化合碳。碳化钨(WC)中理想的碳含量是6.13wt%。碳量可接受的范围是6.05～6.14%,大于6.14%的任意数量将会导致游离碳的形成，即微观结构中的石墨。硬质合金中石墨体积的评价采用同孔隙度一样的程序。石墨的存在会显著降低材料的强度和耐磨性。

ISO4505

Carbon that is higher than the stoichiometric value brings about the formation of free carbon, i.e. the non-combined carbide in materials. The optimal carbon content in WC is 6.13wt%. The acceptable range of carbon content is 6.05-6.14%. Any surplus amount higher than 6.14% will bring about the formation of free carbon, i.e.the graphite in the microstructure. The evaluation of the volume of graphite in cemented carbide follows the same procedure as porosity. The presence of graphite will considerably reduce the strength and wear resistance of materials.

η 相
η phase

ISO 4505

低于化学计量的碳会导致 η 相碳化物的形成。碳化钨(WC)中理想的碳含量是6.13wt%。碳量可接受的范围是6.05～6.14%，低于6.02%的碳量会导致可见的碳缺乏，导致 η 相碳化物的形成(W,Co_2C,W_2C)。

材料中 η 相碳化物体积的评价采用同孔隙度类似的程序。

这些碳化物相的存在会显著降低材料的强度，增加材料的脆性。

ISO4505

Carbon lower than the stoichiometric value will bring about the formation ofη phase carbides. The optimal carbon content in WC is 6.13wt%. The acceptable range of carbon content is 6.05-6.14%. Carbon lower than 6.02% will result in visible deficient carbon and the formation ofη phase carbides (W, Co2C, W2C).

The evaluation of the volume of graphite in cemented carbide follows a similar procedure as for porosity.

The presence of these carbide phases will substantially reduce the strength of the materials and increase their brittleness.

抗弯强度
Transverse rupture strength

ISO 3327

抗弯强度（TRS）是在一个标准的三点弯曲试验中在材料的破断点测得的应力。此试验应用于硬质合金时，使用一个标准的施载夹具及试样（φ3.25mm×38mm）。TRS使用几个测量值的平均值作为测量值。随试样几何形状，表面状态及试验设备的不同，此值可以变化很大。特别要指出的是，此结果对表面光洁度，表面残留应力，表面腐蚀及材料内部的缺陷很敏感。

必须注意，不能只用TRS值作为牌号选择的标准。

ISO3327

Transverse rupture strength (TRS) is the stress measured at the ruptured point of a material in a bending test at 3 standard points. When the test is applied to cemented carbide, a standard loaded fixture and a sample of (φ3.25x 38mm) is used. The average of several measured values is taken as the measured value. The value can vary much with the geometry and surface status of the sample and testing equipment. What is to be especially pointed out is that the test is sensitive to the surface finish, residual surface stress, surface corrosion and the internal defects of the material.

It should be noted that TRS can not be taken as the only standard for the selection of a grade.

Прямое и быстрое обслуживание

Наша философия предоставления сервиса:
Главное – прямота, быстрота и продуманность, создание источника поставок твердосплавного материала, которому доверяют.

Закрытое акционерное общество **"АВТЕХ"**
61072, г. Харьков, пр. Ленина, 56, к. 311
тел. (057) 717-61-61, 717-62-62
тел./факс (057) 717-50-50, 719-49-49
e-mail: office@avteh.com
www.avteh.com.ua