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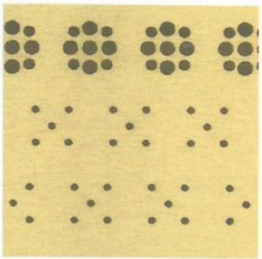
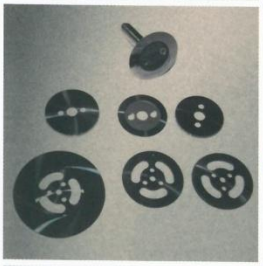
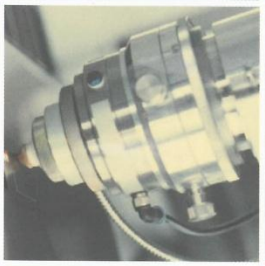
21C

21CENTURY CO., LTD.

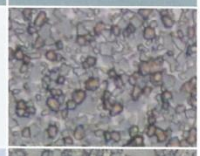
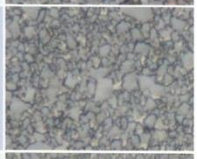






• Materials for Cutting Tool

››› Properties & Micro Structure of Main Grades

Grade	Properties	Micro Structure
P40	• Medium grain tungsten carbide. • Good abrasive wear resistance combined with excellent toughness. • Good resistance to cratering & thermo-mechanical shock.	
K10	• Fine grain tungsten carbide. • Excellent abrasive wear resistance combined with medium toughness. • Low resistance to cratering.	
K20	• Fine grain tungsten carbide. • Good abrasive wear resistance and toughness. • Low resistance to cratering.	
MA2	• Ultra-fine grain tungsten carbide. • Excellent toughness combined with good abrasive wear resistance. • Low resistance to thermal deformation.	

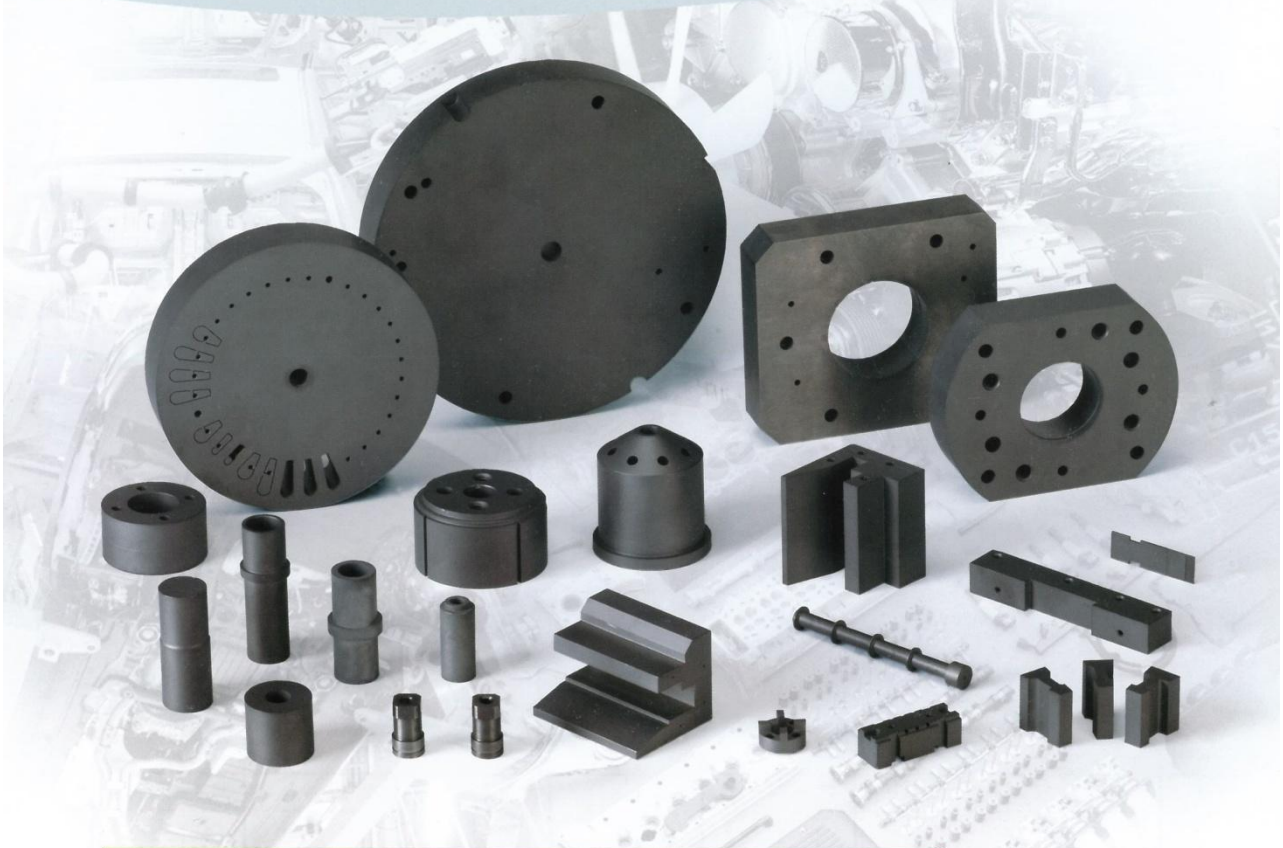
- Multi Drill, Burnishing Drill&Gun Drill
- Reamer
- End Mill
- Slitting Saw

››› Grades & Application for Cutting Tool

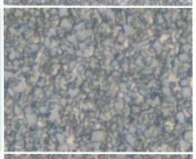
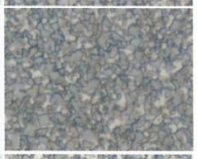
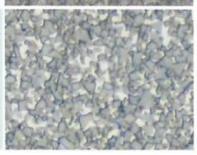
I.S.O CLASS.		Grade	Hardness (HRa)	T.R.S (kg/㎟)	Workmaterials	Application
P	10	P10	92.5~93.2	200	Steel Cast steel & Malleable cast iron	High speed cutting, Finish turning, Threading
	20	P20	92.0~92.7	220		High speed cutting, Turning, Milling
	30	P30	91.5~92.2	240		Medium speed cutting, Milling, Roughing
	40	P40	90.5~91.3	260		Low speed cutting, Heavy duty cutting
K	05	K05	92.5~93.2	240	Cast iron Malleable cast iron Copper, Aluminum Glass, Wood	High speed cutting, Finish turning, Reaming
	10	K10	92.0~92.6	250		High speed cutting, Turning, Milling, Reaming
	20	K20	91.7~92.3	270		Semiroughing, Turning, Milling
	30	K30	90.7~91.3	300		Roughing, Heavy duty cutting
Micro Alloy		MA2	91.7~92.5	310	Steel, Cast iron Copper, Aluminum	End milling, Drilling
		MA3	91.0~91.7	330		
		UR10	91.0~91.7	300		
		UR12	90.2~91.0	320		

All products can be made to order.

• Materials for Mold & Preform



››› Properties & Micro Structure of Main Grades

Grade	Properties	Micro Structure
MA2	• Ultra-fine grain tungsten carbide. • Excellent wear resistance and toughness. • Easy grinding and good edge stability.	
K30	• Fine grain tungsten carbide. • Good wear resistance and toughness. • Good mechanical shock resistance.	
D20	• Fine grain tungsten carbide. • Good wear resistance and toughness • Medium impact resistance.	
DX3	• Fine grain tungsten carbide. • Excellent toughness and good wear resistance. • High impact resistance.	

- **Dies** (Drawing Dies, Header Dies & Nut Forming Dies)
- **Nozzle**
- **Punch**
- **Semiconductor Parts**

>>> Grades & Application for Mold & Preform

I.S.O CLASS.		Grade	Hardness (HRa)	T.R.S (kg/㎟)	Application
K	05	K05	92.5~93.2	240	Nozzle, Drawing dies, Bush
	10	K10	92.0~92.6	250	
	20	K20	91.7~92.3	270	Drawing dies, Guide bush, Tube sizing mandrels
	30	K30	90.7~91.3	300	
D	10	D10	91.7~92.3	270	Drawing dies, Plug, Nozzle
	20~30	D20	89.8~90.5	320	Die & Punch for motor core mold, Forming dies
	40	DX3	88.8~89.5	340	Dies, Punch, Blanking dies
	50	DX5	87.7~88.6	360	Dies, Punch, Wire flattening roll
	60	D53	86.6~87.6	350	Header dies
	70	D70	82.5~83.5	300	Impact dies, Nut forming dies
Micro Alloy		MA2	91.7~92.5	310	Die & Punch for semiconductor mold
		MA3	91.0~91.7	330	
		UR10	91.0~91.7	300	Pot & plunger
		UR12	90.2~91.0	320	
Non-Magnetic Alloy		NM50	87.5~88.3	300	Nonmagnetic die & punch, Mechanical seal, etc.

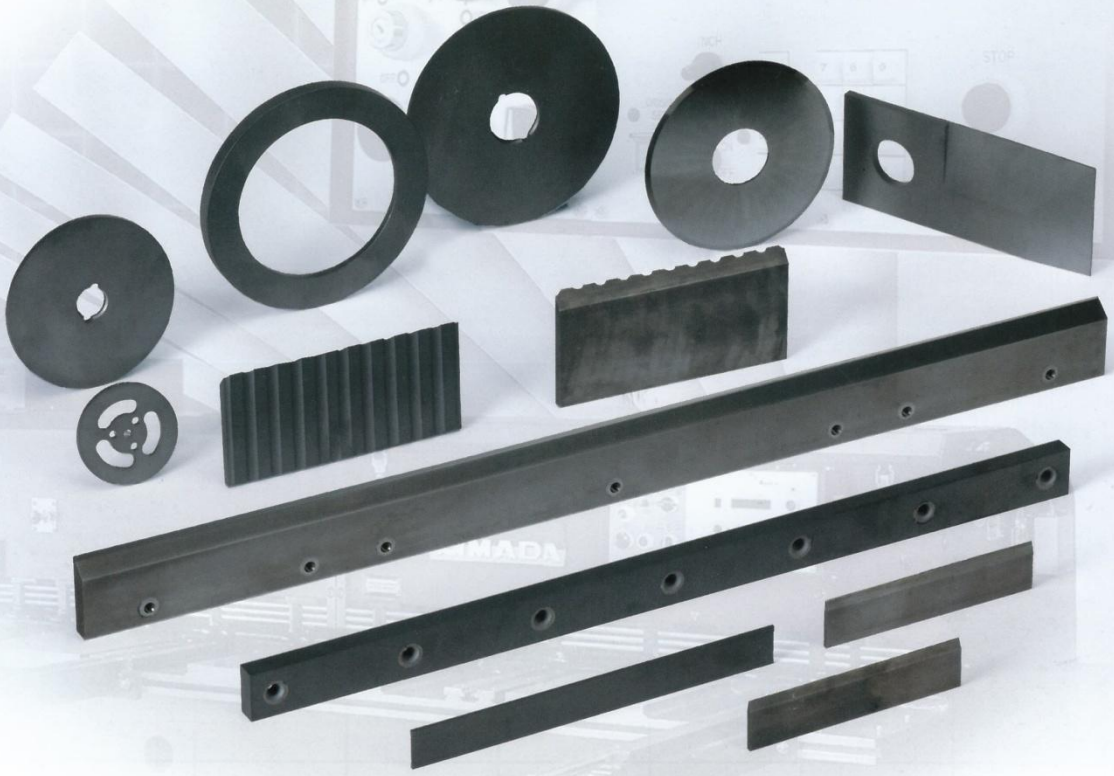
All products can be made to order.

• Plate

››› Properties & Application of Main Grades

Grade	Hardness (HRa)	T.R.S (kg/㎟)	Properties & Application	
MA2	91.7~92.5	310	Properties	• Ultra-fine grain tungsten carbide. • Excellent wear resistance and toughness. • Good edge stability.
			Application	• Die & Punch for semiconductor mold. • Punch for lead frame & connector mold. • High Pitch Damber Punch, Tape Lamination Punch.
MA3	91.0~91.7	330	Properties	• Ultra-fine grain tungsten carbide. • Excellent toughness combined with good wear resistance. • Excellent edge stability.
			Application	• Pot & Plunger • High Pitch Damber Die, Tape Lamination Die.
UR12	90.2~91.0	320	Properties	• Very fine grain tungsten carbide. • Good wear resistance and toughness combined with easy grinding.
			Application	• Notching/Blanking/Bending Die & Punch. • Die Bush, Blade.
D20	89.8~90.5	320	Properties	• Fine grain tungsten carbide. • Good wear resistance and toughness.
			Application	• Die for lead frame & connector mold. • Moter Core Die, Die Insert, Center Block

• Materials for Knife



››› Properties & Application of Main Grades

Grade	Hardness (HRa)	T.R.S (kg/㎟)	Properties & Application	
D10	91.7~92.3	270	Properties	• Fine grain tungsten carbide. • Excellent wear resistance and Medium toughness.
			Application	• Rotary slitting knives for paper, rubber, coppper & aluminum foil. • String knife
UR12	90.2~91.0	320	Properties	• Very fine grain tungsten carbide. • Good wear resistance and toughness.
			Application	• Slitting knives for thin steel & silicon steel plate.
DX5	87.7~88.6	360	Properties	• Fine grain tungsten carbide. • Excellent toughness and high impact resistance.
			Application	• Slitting knives for medium thickness of steel plate.

All products can be made to order.

Physical properties of Orion Alloy Grade

››› Micro Alloy Grade

Grade	Hardness (HRa)	T.R.S (kg/mm²)	Density (g/cm³)	Compressive Strength (kgf/mm²)	Modulus of elasticity (kgf/mm²)	[Charpy] ImpactResis-tance(in·lbs)	Thermal Exp.Coeff (×10⁻⁶/℃)	Thermal Conductivity (cal/cm·s·℃)
MA2	92.2	310	14.2	600	58000	15	5.7	0.17
MA3	91.4	330	13.9	570	56000	19	5.8	0.17
UR10	91.5	300	14.5	580	58000	15	5.6	0.17
UR12	90.7	320	14.3	530	58000	16	5.7	0.17

››› Cutting Tool Grade

Grade	Hardness (HRa)	T.R.S (kg/mm²)	Density (g/cm³)	Compressive Strength (kgf/mm²)	Modulus of elasticity (kgf/mm²)	[Charpy] ImpactResis-tance(in·lbs)	Thermal Exp.Coeff (×10⁻⁶/℃)	Thermal Conductivity (cal/cm·s·℃)
P10	92.9	200	10.2	570	58000	6	5.2	0.10
P20	92.4	220	12.0	520	56000	9	5.4	0.10
P30	91.8	240	12.5	510	56000	10	5.5	0.10
P40	90.9	260	14.9	490	54000	12	5.7	0.10
K05	92.9	240	14.9	610	64000	11	4.7	0.20
K10	92.4	250	15.1	580	64000	11	4.8	0.20
K20	92.1	270	15.0	560	63000	13	4.8	0.20
K30	91.0	300	14.7	510	62000	15	5.3	0.19

››› Wear-Resistant Grade

Grade	Hardness (HRa)	T.R.S (kg/mm²)	Density (g/cm³)	Compressive Strength (kgf/mm²)	Modulus of elasticity (kgf/mm²)	[Charpy] ImpactResis-tance(in·lbs)	Thermal Exp.Coeff (×10⁻⁶/℃)	Thermal Conductivity (cal/cm·s·℃)
D10	92.1	270	15.0	560	63000	13	4.8	0.20
D20	90.4	320	14.3	470	58000	17	5.7	0.17
DX3	89.4	340	14.1	450	57000	22	5.8	0.15
DX5	88.5	360	13.9	420	55000	25	5.9	0.12
D53	87.5	350	13.8	400	53000	27	6.1	0.12
D70	83.0	300	13.2	340	49000	29	6.7	0.12

››› Non magnetic Grade

Grade	Hardness (HRa)	T.R.S (kg/mm²)	Density (g/cm³)	Compressive Strength (kgf/mm²)	Modulus of elasticity (kgf/mm²)	[Charpy] ImpactResis-tance(in·lbs)	Thermal Exp.Coeff (×10⁻⁶/℃)	Thermal Conductivity (cal/cm·s·℃)
NM50	88.0	300	13.9	410	56000	21	5.8	0.15

Hardness Conversion Chart

Vickers	Brinell 10mm Ball Load 3,000 kgf		Rockwell Hardness				Shore's	Tensile Strength (Approximation)
	Standard Ball	Tungsten Carbide Ball	A Scale 60kgf Diamond brale	B Scale 100kgf 1/161N Ball	C Scale 150kgf Diamond brale	D Scale 100kgf Diamond brale		kgf/mm2
HV	HB		HRA	HRB	HRC	HRD	HS	
1900			93.1		80.5		–	
1800			92.6		79.2		–	
1700			91.9		77.9		–	
1600			91.3		76.6		–	
1500			90.5		75.3		–	
1450			90.1		74.6		–	
1400			89.6		74.0		–	
1350			89.1		73.4		–	
1300			88.7		72.7		–	
1250			88.6		72.1		–	
1200			88.1		71.5		–	
1150			87.6		70.9		–	
1100			87.1		70.3		–	
1050			86.6		69.6		–	
1000			86.2		68.9		–	
940			85.6		68.0	76.9	97	
920			85.3		67.5	76.5	96	
900			85.0		67.0	76.1	95	
880		(767)	84.7		66.4	75.7	93	
860		(757)	84.4		65.9	75.3	92	
840		(745)	84.1		65.3	74.8	91	
820		(733)	83.8		64.7	74.3	90	
800		(722)	83.4		64.0	73.8	88	
780		(710)	83.0		63.3	73.3	87	
760		(698)	82.6		62.5	72.6	86	
740		(684)	82.2		61.8	72.1	84	
720		(670)	81.8		61.0	71.5	83	
700		(656)	81.3		60.1	70.8	81	
690		(647)	81.1		59.7	70.5	–	
680		(638)	80.8		59.2	70.1	80	
670		630	80.6		58.8	69.8	–	
660		620	80.3		58.3	69.4	79	
650		611	80.0		57.8	69.0	–	
640		601	79.8		57.3	68.7	77	
630		591	79.5		56.8	68.3	–	
620		582	79.2		56.3	67.9	75	
610		573	78.9		55.7	67.5	–	
600		564	78.6		55.2	67.0	74	
590		554	78.4		54.7	66.7	–	2055(210)
580		545	78.0		54.1	66.2	72	2020(206)
570		535	77.8		53.6	65.8	–	1985(202)
560		525	77.4		53.0	65.4	71	1950(199)
550	(505)	517	77.0		52.3	64.8	–	1905(194)
540	(496)	507	76.7		51.7	64.4	69	1860(190)
530	(488)	497	76.4		51.1	63.9	–	1825(186)
520	(480)	488	76.1		50.5	63.5	67	1795(183)
510	(473)	479	75.7		49.8	62.9	–	1750(179)
500	(465)	471	75.3		49.1	62.2	66	1705(174)
490	(456)	460	74.9		48.4	61.6	–	1660(169)
480	488	452	74.5		47.7	61.3	64	1620(165)

Vickers	Brinell 10mm Ball Load 3,000 kgf		Rockwell Hardness				Shore's	Tensile Strength (Approximation)
	Standard Ball	Tungsten Carbide Ball	A Scale 60kgf Diamond brale	B Scale 100kgf 1/161N Ball	C Scale 150kgf Diamond brale	D Scale 100kgf Diamond brale		kgf/mm²
HV	HB		HRA	HRB	HRC	HRD	HS	
470	441	442	74.1		46.9	442	–	1570(160)
460	433	433	73.6		46.1	433	62	1530(156)
450	425	425	73.3		45.3	425	–	1495(153)
440	415	415	72.8		44.5	415	59	1460(149)
430	405	405	72.3		43.6	405	–	1410(144)
420	397	397	71.8		42.7	397	57	1370(140)
410	388	388	71.4		41.8	388	–	1330(136)
400	379	379	70.8		40.8	379	55	1290(131)
390	369	369	70.3	(110.0)	39.8	369	–	1240(127)
380	360	360	69.8	–	38.8	360	52	1205(123)
370	350	350	69.2	(109.0)	37.7	350	–	1170(120)
360	341	341	68.7	–	36.6	341	50	1130(115)
350	331	331	68.1	(108.0)	35.5	331	–	1095(112)
340	322	322	67.6	–	34.4	322	47	1070(109)
330	313	313	67.0	(107.0)	33.3	313	–	1035(105)
320	303	303	66.4	–	32.2	303	45	1005(103)
310	294	294	65.8	(105.5)	31.0	294	–	980(100)
300	284	284	65.2	–	29.8	284	42	950(97)
295	280	280	64.8	(104.5)	29.2	280	–	935(96)
290	275	275	64.5	–	28.5	275	41	915(94)
285	270	270	64.2	(103.5)	27.8	270	–	905(92)
280	265	265	63.8	–	27.0	265	40	890(91)
275	261	261	63.5	(102.0)	26.4	261	–	875(89)
270	256	256	63.1	–	25.6	256	38	855(87)
265	252	252	62.7	(101.0)	24.8	252	–	840(86)
260	247	247	62.4	–	24.0	247	37	825(84)
255	243	243	62.0	99.5	23.1	243	–	805(82)
250	238	238	61.6	–	22.2	238	36	795(81)
245	233	233	61.2	98.1	21.3	233	–	780(79)
240	228	228	60.7	96.7	20.3	228	34	765(78)
230	219	219		95.0	(18.0)	219	33	730(75)
220	209	209		93.4	(15.7)	209	32	695(71)
210	200	200		91.5	(13.4)	200	30	670(68)
200	190	190		89.5	(11.0)	190	29	635(65)
190	181	181		87.1	(8.5)	181	28	605(62)
180	171	171		85.0	(6.0)		26	580(59)
170	162	162		81.7	(3.0)		25	545(56)
160	152	152		78.7	(0.0)		24	515(53)
150	143	143		75.0			22	490(50)
140	133	133		71.2			21	455(45)
130	124	124		69.8			20	425(44)
127	121			67.6			19	(42)
122	116			65.7			18	(41)
117	111						15	(39)

21CENTURY CO., LTD.

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