EVERLOY
CEMENTED CARBIDE TOOLS

General Catalog

KYORITSU GOKIN CO., LTD.

https://www.everloy.co.jp

Introduction

Everloy has been engaged in the manufacturing of cemented carbide tools and spray nozzles since its foundation in 1938, and they have been enjoying the patronage of customers under trade name “EVERLOY”. We hereby express our deepest thanks for your support and patronage.

In the midst of such drastic changes in technical innovation, all company members will actively deal with new demands by our customers by exploiting our originality. We sincerely hope that you will continue, more than ever, to give your valuable instruction and advice to us.

REQUESTS TO OUR CUSTOMERS

⚠ Caution	
!	1. Hard tool materials, when very hard, have brittle characteristics and may break or scatter when subjected to excessive tightening or impact.
!	2. Hard tool materials with density of 10 or greater should be handled as heavy materials for large products or large quantities, and should be handled with care with respect to their weight.
!	3. Engraving on hard tool materials with lasers, electric pens, electroplated grinding wheels, etc. may cause cracks. Do not perform engraving on areas to be applied with work or stress.
!	4. Hard tool materials may have a different thermal expansion coefficient than general steel materials such as cases and holders. Design and work should be done in consideration of the possibility of cracking or shattering in the event of shrink fit, expansion fit, or in applications where temperature is high.
!	5. Hard tool materials may crack when subjected to temperature changes greater than the thermal shock resistance temperature during brazing. Also, if brazing is not performed at the proper temperature, the material may fall off or be damaged. Braze under appropriate conditions.
⊘	6. In repairing hard tool materials that is once used, it is necessary to fully remove cracks and other worn areas caused by use. Do not make repairs on your own.
!	7. Grinding hard tool materials will generate dust and particles. If these are swallowed or inhaled, they are harmful to the body, so use protective equipment such as local exhaust ventilation and protective masks.
!	8. Grinding hard tool materials will generate dust and particles. Contact or adhesion of these to the eyes or skin is dangerous, so use appropriate protective equipment such as protective goggles appropriately.
!	9. If dusts or particles from grinding adhere to skin or eyes, rinse with water. If a large amount is swallowed or enters into the eyes, seek medical attention immediately.
!	10. Regarding details on first aid measures, fire measures, spillage measures, disposal precautions, etc., refer to the SDS of the material and take appropriate measures.
⚠ Attention	
⊘	11.Hard tool materials that are not given corrosion resistance may corrode by contact with grinding fluid, lubricating oil or other liquids, which will lead to material strength deterioration.
!	12.The strength of hard tool material may significantly reduce depending on the surface condition after grinding. Finish the material under appropriate machining conditions.
!	13.Microcracks or affected layers formed on the hard tool material surface during EDM will cause deterioration in material strength. Grind and remove them to obtain the material's original characteristics.
!	14.Among hard tool materials, the heat-treated tool steel or high speed tool steel may soften if applied higher heat than their tempering temperature, which may lead to deterioration in material strength. Pay particular attention to heat generated by grinding, and thermal effects of processes such as brazing, surface treatment, and surface modification.

The notes under “Attention” are excerpts from “Safety Pamphlet for Products Using Cemented Carbide Tool Materials: Wear-Resistant Tools”[Translated from Japanese].

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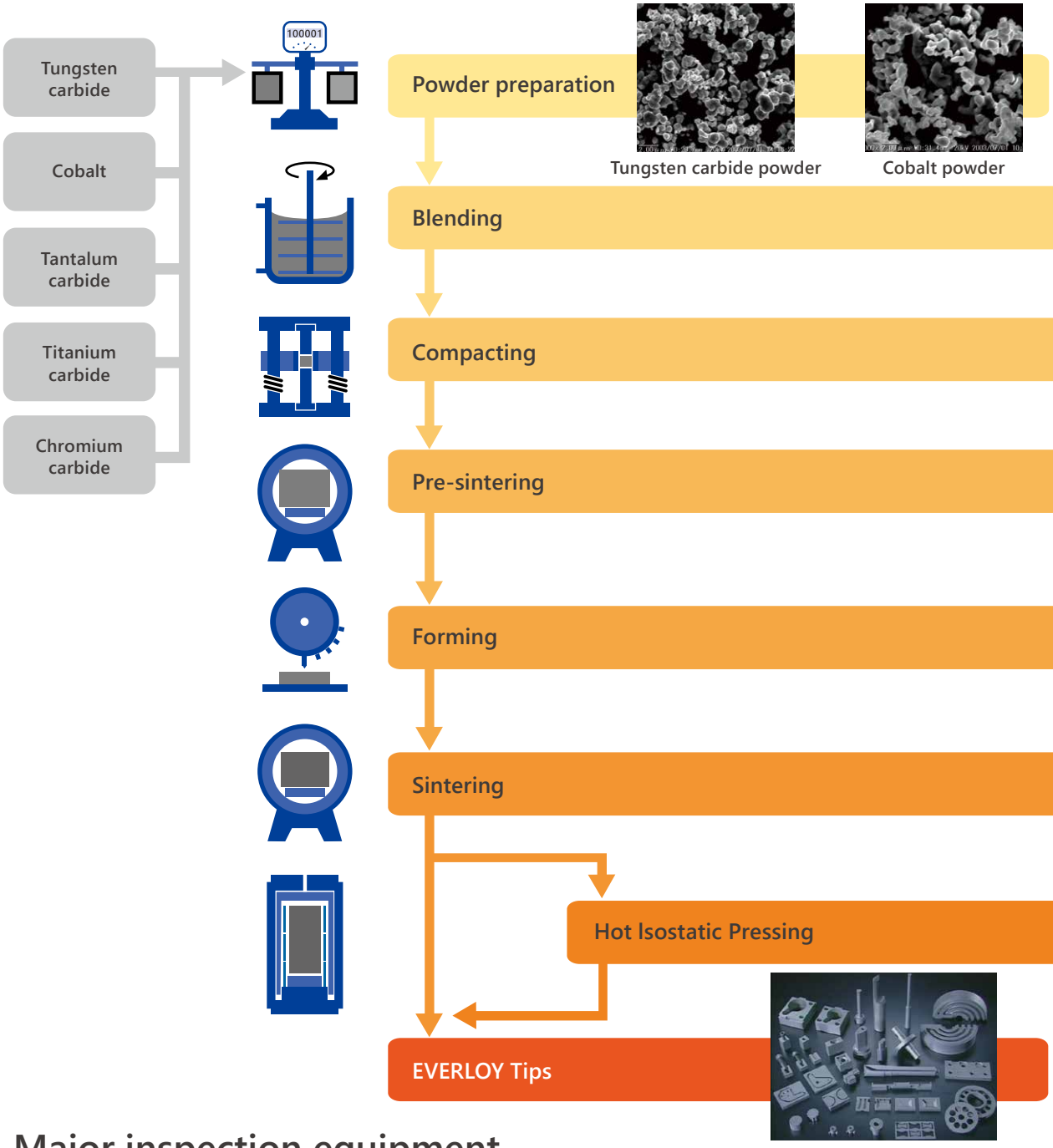
Manufacturing process



Major inspection equipment


Universal testing machine


Metallurgical microscope


Rockwell hardness tester

Major equipment

Ball mill

Crusher (Attritor)

Hydraulic press machine

NC drilling machine

Vacuum sintering furnace

Cold Isostatic Pressing device

Dry Cold Isostatic Pressing device

NC lathe machine

Vacuum pressurization sintering furnace

Multiple spindle drilling machine

Cutting machine

Hot Isostatic Pressing (HIP) device

Large cutting machine

Electronic balance

Carbon analyzer

Magnetic measuring equipment

Grades and physical properties (typical figures)

Division	Our grade	JIS classification	WC grain size [μm]	Cobalt content [%]	Density [×10³ kg/m³] {g/cm³}	Hardness		Transverse rupture strength [GPa]
						HRA	HV	
For wear-resistance and impact-resistance tools	**H1**	VM-10	1.0 - 2.5	6	14.8	93.0	1900	1.9
	G1	VM-20	1.0 - 2.5	6	14.9	92.0	1750	2.0
	G2	VM-30	1.0 - 2.5	6	15.0	91.0	1610	2.5
	G3	VM-40	1.0 - 2.5	8	14.8	90.0	1480	2.7
	G4	VC-40	2.5 - 5.0	10	14.6	89.0	1360	2.9
	G5	VC-50	2.5 - 5.0	13	14.3	88.0	1250	3.2
	TB6	VU-60	5.0 (or more)	15	13.9	86.5	1060	3.1
	TB7	VU-70	5.0 (or more)	21	13.3	84.5	950	3.0
	G8	VU-80	5.0 (or more)	22	13.3	82.5	860	2.6
Fine grain cemented carbide	**KD05**	VF-20	1.0 (less than)	8	14.7	92.0	1750	3.2
	KD10	VF-30	1.0 (less than)	10	14.5	91.0	1610	3.4
	KD20	VF-40	1.0 (less than)	13	14.2	90.0	1480	3.7
	KD30	VF-40	1.0 (less than)	16	13.9	89.0	1360	3.7
	KD40	VF-50	1.0 (less than)	19	13.6	88.0	1250	3.7
	KD50	VF-70	1.0 (less than)	28	12.9	84.5	950	3.0
Ultrafine grain cemented carbide	**EF01**	VF-10	1.0 (less than)*1	8	14.5	94.0*4	2000	3.7
	EF05	VF-10	1.0 (less than)*1	10	14.3	93.0	1900	3.7
	EF10	VF-20	1.0 (less than)*1	13	14.0	92.0	1750	4.0
	EF20	VF-40	1.0 (less than)*1	18	13.6	90.0	1480	4.0
Cemented carbide for magnetic steel sheet processing	**EX20**	VC-40	2.5 - 5.0	6	14.9	90.0	1480	3.0
	EW10	VM-30	1.0 - 2.5	7	14.8	91.0	1610	3.5
	EW25	VM-40	1.0 - 2.5	11	14.3	89.5	1420	3.5
	EW40	VM-50	1.0 - 2.5	15	13.9	88.0	1250	3.5
For stainless steel	**KX01**	VF-20	1.0 (less than)*1	13 *2	14.0	92.5	1820	4.0
For stamping of pure iron and copper	**MC20**	VC-40	2.5 - 5.0	6	14.9	90.0	1480	2.8
Corrosion-resistance/ for EDM	**ME40**	VC-50	2.5 - 5.0	12	14.1	88.0	1250	3.2
For EDM Crack-resistance	**A10W**	VM-30	1.0 - 2.5	9	14.5	91.0	1610	3.7
For EDM Anti-corrosive	**WD20**	VF-40	1.0 (less than)	13 *2	14.1	90.5	1540	3.7
Non-magnetic and anti-corrosive cemented carbide	**KN10**	NF-30	1.0 (less than)	9 *3	14.5	91.0	1610	3.3
	KN20	NF-40	1.0 (less than)	12 *3	14.2	90.0	1480	3.6
	KN30	NF-40	1.0 (less than)	14 *3	13.9	89.0	1360	3.6
	KN40	NF-50	1.0 (less than)	16 *3	13.7	88.0	1250	3.8
For high wear-resistant	**SS13**	VF-10	1.0 (less than)	1	14.2	-	2450	1.0
	SS15	VF-10	1.0 (less than)	4	14.6	-	2100	2.0
For cutting tools	**KW3**	VM-30	1.0 - 2.5	6.5	14.6	91.0	1610	2.5

*1 Grain sizes for EF and KX01 grade are finer than KD grade.
*2 Nickel is comprised partially.
*3 Value of grade KN20 indicates the amount of Nickel.
*4 The number shows the reduced value from HV.

・The above data represents typical figures, not guaranteed figures.
・It is likely to change without a previous notice.

Our grade	Fracture toughness value [MPa • $m^{1/2}$] *5	Tensile strength [GPa] *6	Compression strength [GPa]	Young's modulus [GPa]	Poisson's ratio	Thermal expansion coefficient [$\times 10^{-6}$/K]	Thermal conductivity [W/ (m•K)]	Impact strength [kJ/m^2]
H1	9	1.0	6.1	630	0.21	4.7	80	20
G1	10	1.0	5.7	620	0.21	4.7	80	23
G2	12	1.3	5.4	610	0.21	4.7	80	28
G3	18	1.4	5.0	590	0.21	5.0	75	36
G4	22	1.5	4.7	570	0.22	5.3	75	44
G5	26	1.6	4.3	540	0.22	5.6	71	56
TB6	- *7	1.6	3.9	530	0.23	5.8	67	64
TB7	- *7	1.5	3.3	480	0.23	6.6	63	83
G8	- *7	1.3	3.2	470	0.23	6.7	59	85
KD05	12	1.6	6.1	600	0.21	5.0	75	24
KD10	13	1.7	5.9	580	0.22	5.3	75	28
KD20	16	1.9	5.3	550	0.22	5.6	71	37
KD30	19	1.9	4.9	520	0.23	6.0	67	48
KD40	22	1.9	4.4	490	0.23	6.3	63	59
KD50	30	1.5	3.0	400	0.25	7.3	54	87
EF01	9	1.9	6.5	600	0.21	5.0	71	17
EF05	9	1.9	6.5	580	0.22	5.3	71	21
EF10	10	2.0	6.4	550	0.22	5.6	67	25
EF20	13	2.0	5.4	490	0.23	6.3	59	44
EX20	19	1.5	5.2	620	0.21	4.7	80	-
EW10	15	1.8	5.1	610	0.21	4.9	77	-
EW25	22	1.8	4.7	570	0.22	5.4	73	-
EW40	29	1.8	4.0	530	0.23	5.8	68	-
KX01	10	2.0	6.4	550	0.22	5.6	63	25
MC20	19	1.4	5.2	620	0.21	4.7	80	30
ME40	26	1.6	4.1	560	0.22	5.5	71	52
A10W	13	1.9	6.0	590	0.22	5.2	75	29
WD20	16	1.9	5.3	550	0.22	5.6	67	37
KN10	11	1.6	-	590	0.22	5.1	53	-
KN20	14	1.8	5.0	550	0.22	5.5	47	34
KN30	17	1.8	-	530	0.23	5.8	42	-
KN40	20	1.9	-	510	0.23	6.0	38	-
SS13	5	0.5	-	640	0.20	4.5	34	-
SS15	8	1.0	-	630	0.21	4.6	55	-
KW3	12	1.3	-	-	-	-	-	-

*5 Fracture toughness value is the value measured by the IF method of JIS R1607.
*6 The value of tensile strength or later are reference value from documents.
*7 The value is higher than the value of grade G5.

- The above data represents typical figures, not guaranteed figures.
- It is likely to change without a previous notice.

Glossary

Term	Description
WC grain size	Linear size of grain measured by using bolter or other proper method.
Cobalt content	Quantity of cobalt which is binder phase.(the binder phase is Ni at some grade)
Density	Mass per unit cubic volume.
Hardness	Resistance of object on damage or deformation against material.
Transverse rupture strength	Value of bending stress calculated from load of broken sample which is pressed from one point between two supports.
Fracture toughness value	Resistance value of material when pre-crack started to expand rapidly.
Tensile strength	The highest tensile load which sample was broken on subjecting load.
Compression strength	Strength when object was broken on subjecting compression static load.
Young's modulus	One of elastic properties of material which indicates resistance of elastic property of stress direction.
Poisson's ratio	Ratio of vertical and lateral strain.
Thermal expansion coefficient	Increase of a certain direction(length) per unit temperature when heating material.
Thermal conductivity	Physical property value of heat transmission in material.
Impact strength	Strength against impact measured from size of energy which is absorbed in material of sample broken by impact.

■ JIS(Japanese Industrial Standards) classification symbol

Table 1.
Classification method of 1st digit

Mark	Binder phase elements
V	Co
R	Co/Ni
N	Ni

Table 2.
Classification method of 2nd digit

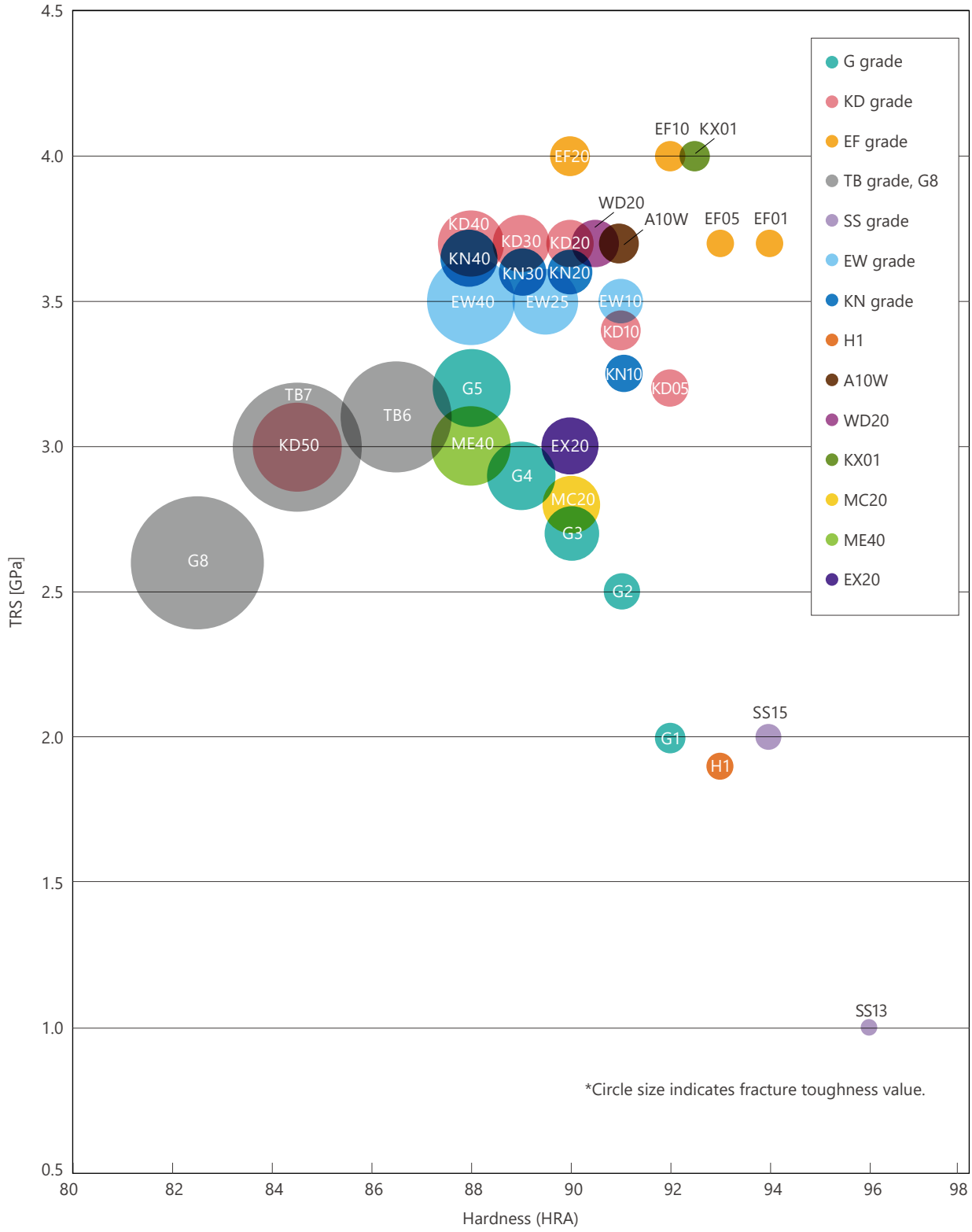
Mark	WC average grain size [μm]
F	1.0 (less than)
M	1.0 - 2.5
C	2.5 - 5.0
U	5.0 (or more)

Table 3.
Classification method of 4th and 5th digit

Mark	Nominal hardness (HRA)
10	93 (or more)
20	92 - 93
30	91 - 92
40	89 - 91
50	87 - 89
60	85 - 87
70	82 - 85
80	82 (less than)

*Table 1 to 3 are quote from the JIS B 4054：2020.

Specification chart



Microstructure of EVERLOY grades

G grade

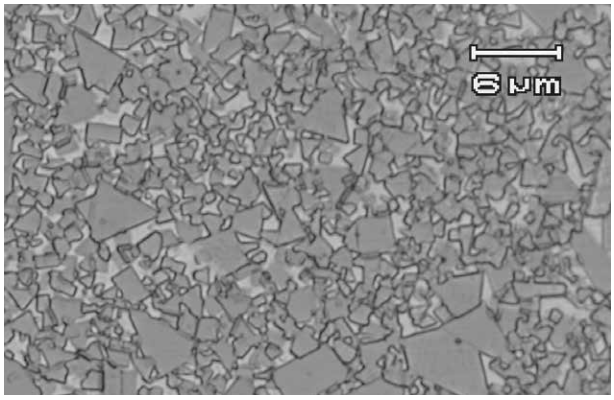


Photo : G5

WC grain size [µm]	1.0 - 5.0
Co content [%]	6 - 22

KD grade

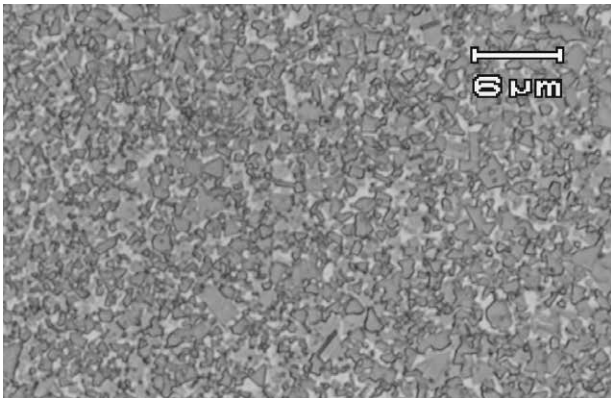


Photo : KD20

WC grain size [µm]	1.0 (less than)
Co content [%]	8 - 28

TB grade

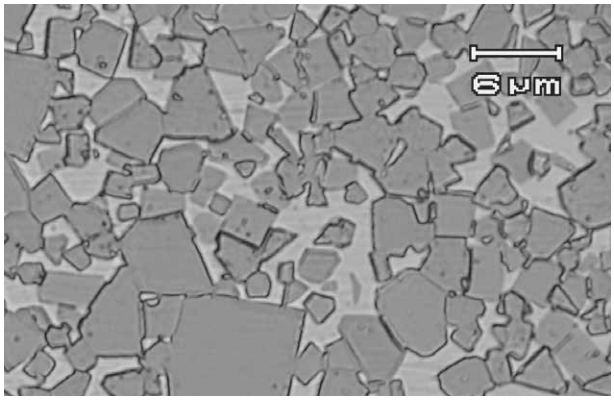


Photo : TB6

WC grain size [µm]	5.0 (or more)
Co content [%]	15, 21

EF grade

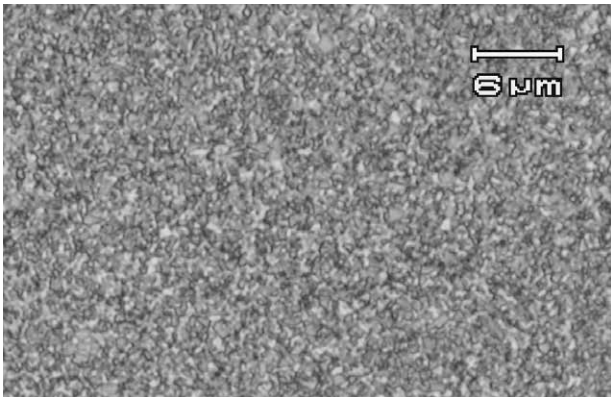


Photo : EF10

WC grain size [µm]	1.0 (less than)
Co content [%]	8 - 18

EX grade

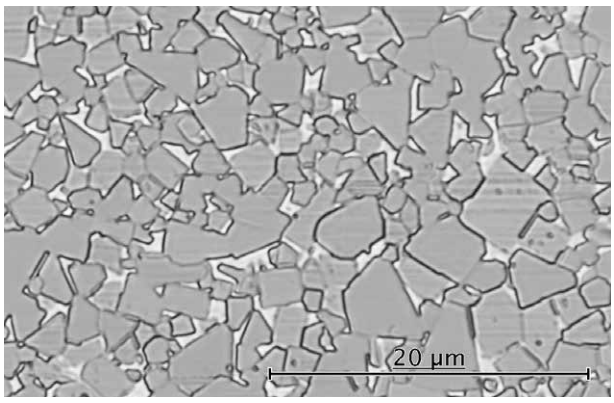


Photo : EX20

WC grain size [µm]	2.5 - 5.0
Co content [%]	6

EW grade

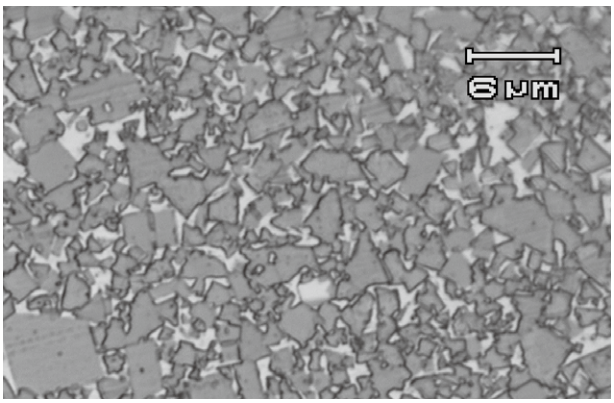


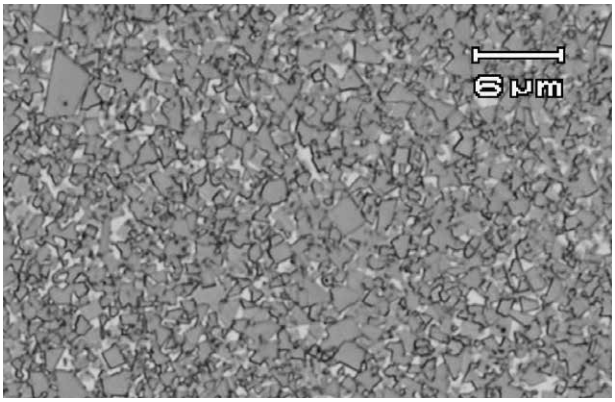
Photo : EW25

WC grain size [µm]	1.0 - 2.5
Co content [%]	7 - 15

By metallurgical microscope (×1000)

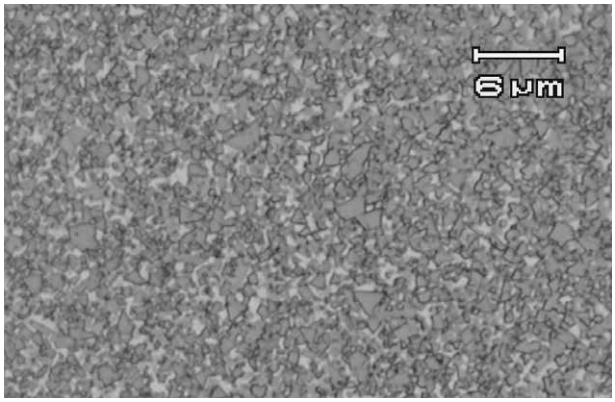
Microstructure of EVERLOY grades

A10W



WC grain size [µm]	1.0 - 2.5
Co content [%]	9

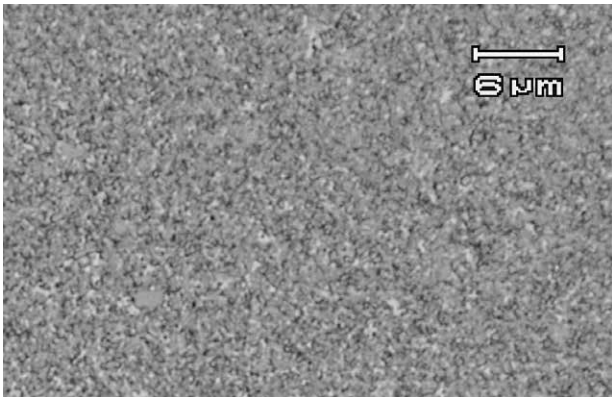
WD20



WC grain size [µm]	1.0 (less than)
Co content [%]	13 *

*Nickel is comprised partially.

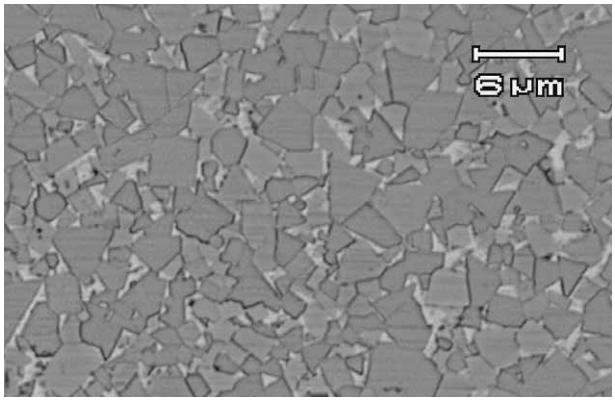
KX01



WC grain size [µm]	1.0 (less than)
Co content [%]	13 *

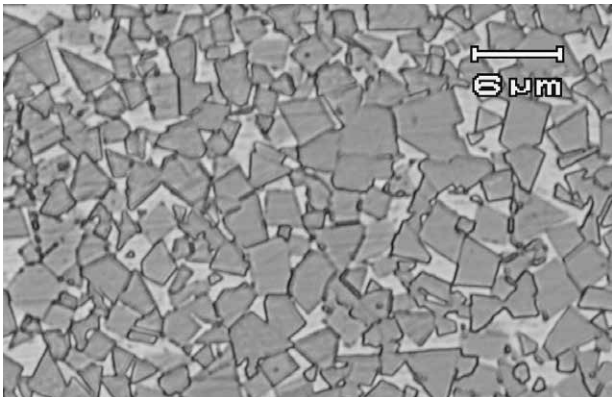
*Nickel is comprised partially.

MC20



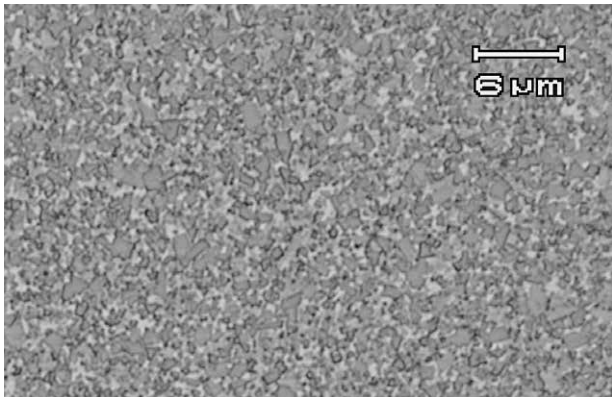
WC grain size [µm]	2.5 - 5.0
Co content [%]	6

ME40



WC grain size [µm]	2.5 - 5.0
Co content [%]	12

KN grade



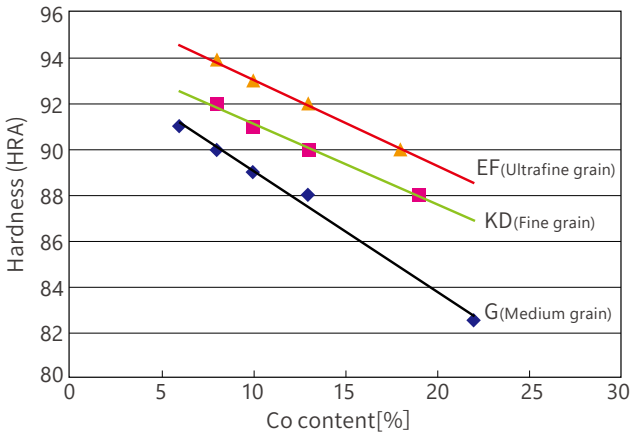
WC grain size [µm]	1.0 (less than)
Ni content [%]	9 -16

Photo : KN20

By metallurgical microscope (×1000)

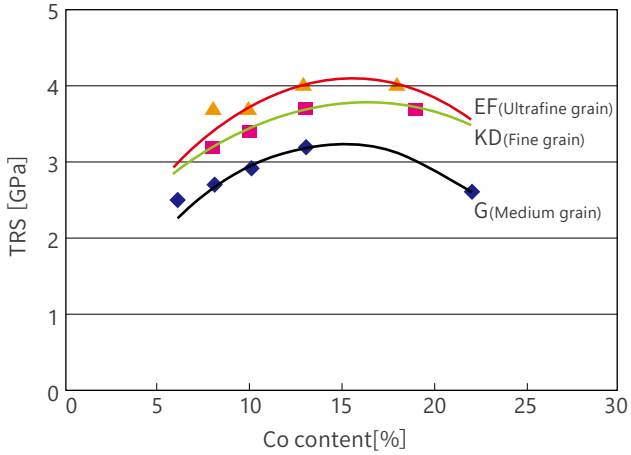
Characteristics of EVERLOY grades

1. Relationship between Co content and hardness



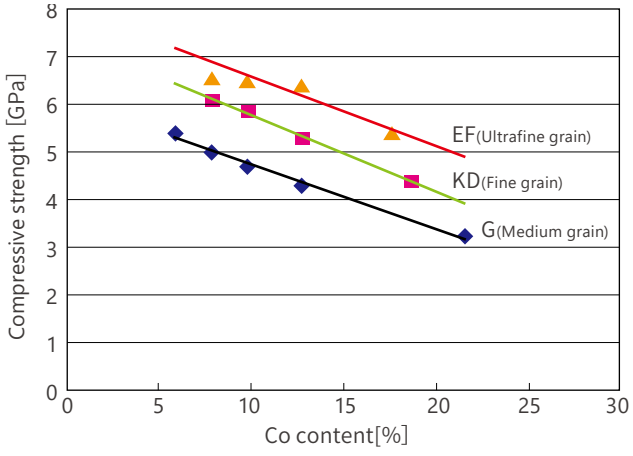
Hardness is increased when Co content is reduced. When the Co content is constant, hardness rises as the WC grain size becomes finer.

2. Relationship between Co content and transverse rupture strength (TRS)



Up to a certain percentage, a higher Co content will increase the transverse rupture strength. Under the condition of constant Co content, finer WC grain size will result in a higher transverse rapture strength.

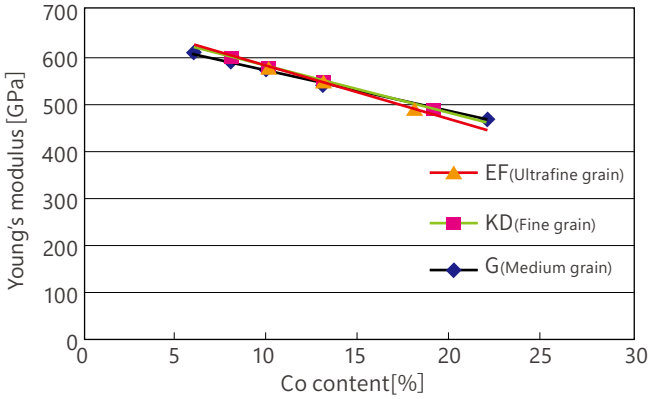
3. Relationship between Co content and compressive strength



Lower Co content gives rise to a higher compressive strength. If the Co content remains constant, finer WC grain size raises the compressive strength.

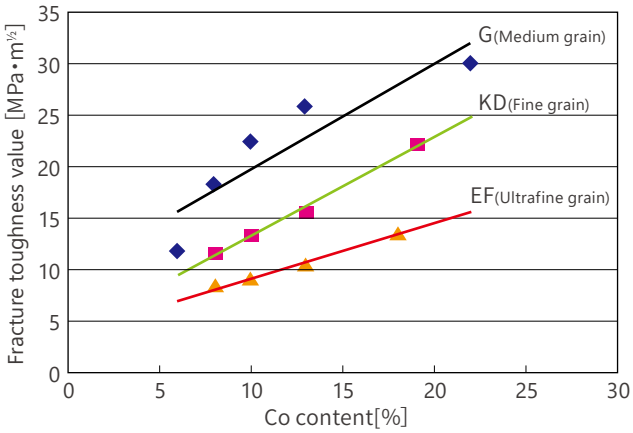
Characteristics of EVERLOY grades

4. Relationship between Co content and young's modulus



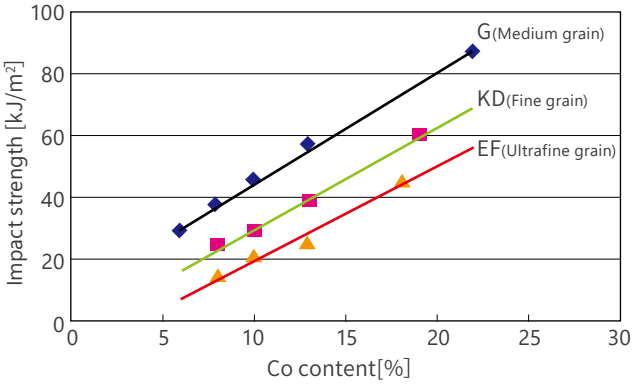
Lower Co content gives to a higher young's modulus.

5. Relationship between Co content and fracture toughness value



A larger content of Co increases fracture toughness value. When the Co constant stays constant, higher fracture toughness is achieved when the WC grain size is larger.

6. Relationship between Co content and impact strength

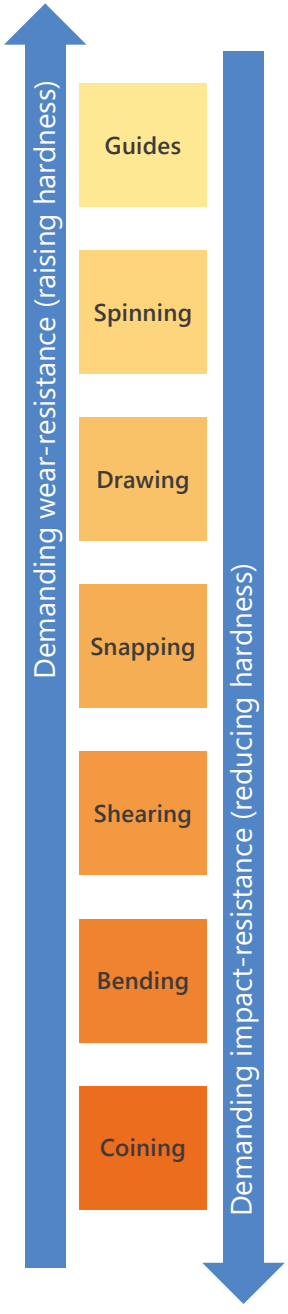


A larger content of Co increases impact strength. If the Co content is constant, larger WC grain size will result in higher impact strength.

Tips for press mold

Everloy selects the most suitable material for respective applications from the materials shown in the chart below.
(A erroneous selection might engender breakage or wear-out in early stage.)

Selection criteria in the general applications



Applications	Grades	JIS classification	Old* classification	Advantage while processing
Spinning dies(slight impact), Guide types (from slight impact to general conditions), Snapping dies (slight impact), Drawing dies (slight impact)	**EF01** (Highly abrasion resistant)	VF-10	Z01	Chipping-resistance
	EF05	VF-10	Z01	
	EF10	VF-20	Z10	
	KX01 (Stainless steel processing)	VF-20	Z10	
	KD05	VF-20	V20	
	KD10	VF-30	V20	
	A10W	VM-30	V20	For EDM
	H1	VM-10	V10, K01	Chipping-resistance
	G1	VM-20	V10, K10	-
	G2	VM-30	V20, K20	-
Spinning dies (from general conditions to heavy impact), Guide types(general conditions), Snapping dies (from slight impact to general conditions), Drawing dies (from general conditions to heavy impact)	**EF20**	VF-40	Z30	Chipping-resistance
	EW10	VM-30	V20	
	KD20	VF-40	V30	
	KN grade (Non-magnetic, Anti-corrosive)	NF-30 ≀ NF-50	V30	
	WD20	VF-40	V30	Chipping-resistance For EDM
	MC20 (Soft metal processing)	VC-40	V20	-
	EX20	VC-40	V10	Adhesion-resistance
	G3	VM-40	V30, K30	-
	G4	VC-40	V30, K30	-
Spinning dies (with impact), Bending dies (most general conditions) , Snapping dies (most general conditions), Shearing blades (general conditions)	**KD30**	VF-40	V30	Chipping-resistance
	KD40	VF-50	V40	Chipping-resistance
	ME40	VC-50	V30	For EDM
	G5	VC-50	V40	-
	EW25	VM-40	V30	Chipping-resistance
	EW40	VM-50	V30	Chipping-resistance
Bending dies (with impact), Snapping dies (with impact, with thick, large plates, etc.), Coining dies (slight impact), Shearing blades (with impact)	**TB6**	VU-60	V40	-
Bending dies (especially with large impact) , Snapping dies(with impact, with thick large plates, etc.), Coining dies (general conditions), Shearing blades (with large impact)	**KD50**	VF-70	V60	Chipping-resistance
	TB7	VU-70	V50	-
Coining dies (with impact)	**G8**	VU-80	V60	-

* Included JIS

Tips for press mold

Selection criteria in the special applications

Timing of selection	Characteristic	Selection criteria
While processing	Chipping-resistance (Grinding-resistance)	Select KD grade for general use and EF grade when a sharper edge is needed.
	For EDM	Select KD grade for general use and A10W to control the electrical discharge crack effect. Select WD20 grade to control corrosion when water is used as a processing fluid.
While using	High abrasion resistant	Generally, H1 and EF05 offers the highest hardness and excellent abrasion resistance. When increased abrasion resistance is needed, select SS grade or EF01, but it must be handled with care.
	Non-magnetic and anti-corrosive	Select KN20 for non-magnetic applications such as molding for forming magnetic fields. Select KN20 for mechanical seals and so on because it is highly corrosion-resistant and acid-resistant.
	Soft metal processing	When processing pure iron, pure copper, and other highly reactive metals with tungsten carbide, select MC20 to suppress reactions.
	Stainless steel processing	Select KX01 when processing stainless steel and other metals with low thermal conductivity that tend to contribute to work-hardening.

Dimension for press mold tips

There are several types of tips for press mold as follows ;
Tips totally sintered to dimensions.
Tips partially ground.
Finished tips.

For sintered chips, standard grinding allowance is 0.5 mm per side, however, in cases of designed various differently shaped holes in a die block, it is common for the block to be supplied with one or several holes left in it. (Liquid solution is passed through the hole for electric discharge machining process.)
Furthermore, direct tapping is available.

■ **Manufacturing coverage of direct tapping (Sintered tapping)**

Nominal designation of thread	M2	M3	M4	M5	M6	M8	M10	M12	M14	M16
Depth of complete thread [mm]	8	30	30	30	30	30	30	30	30	30
Pitch [mm]	0.4	0.5	0.7	0.8	1.0	1.25	1.5	1.75	2.0	2.0

- The screw shape is JIS(ISO) non-standard.
- Please consult about a size other than the above.
- Please consult screw size except above-mentioned.

Cemented carbide - G grade

Line up ... G1, G2, G3, G4, G5, G8

General cemented carbide.
"EVERLOY" cemented carbide is well known as high quality and performance around the world.

Be often adopted as various versatile tools and mold parts.
Excellent balance of wear-resistance, toughness and machinability.

Explanation	Outstanding wear and crack resistance by coarse grained WC.
Note	Be careful of corrosion problem under corroding environment.
Applications	Snapping, Bending, Spinning, Powder compacting, Cold rolling, etc.

Cemented carbide - TB grade

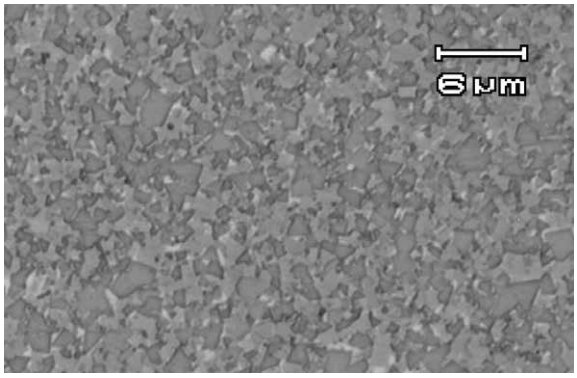
Line up ... TB6, TB7

Cemented carbide for impact-resistance.

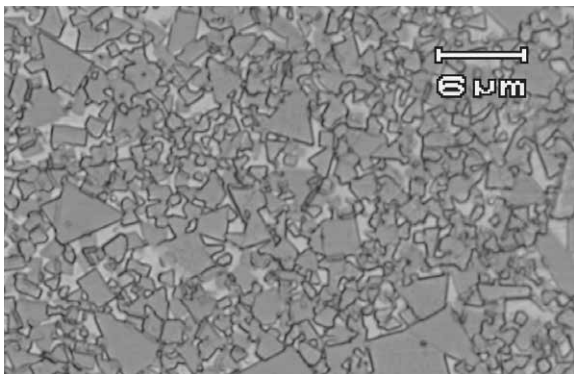
Be often adopted for versatile tools and mold parts which need impact-resistance.
Excellent durability for breakage caused when EDM.

Explanation	Outstanding wear and crack resistance by coarse grained WC and high cobalt content.
Applications	Cold forging mold parts, etc.

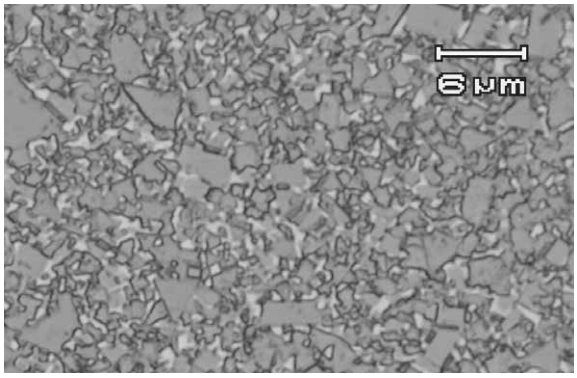
Micrographs of the G grade and TB grade



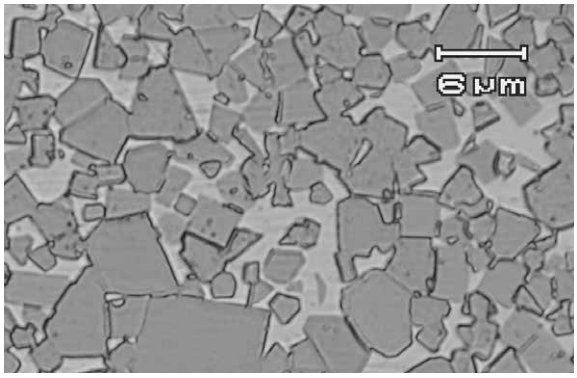
G1



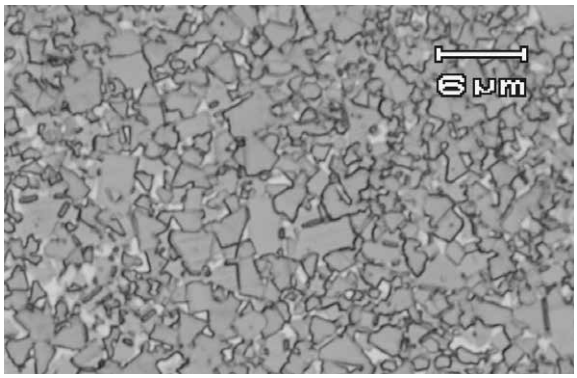
G5



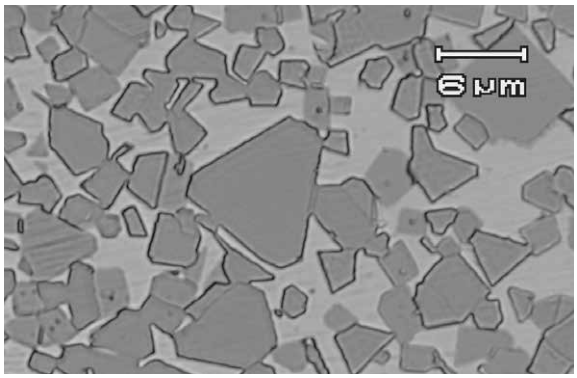
G2



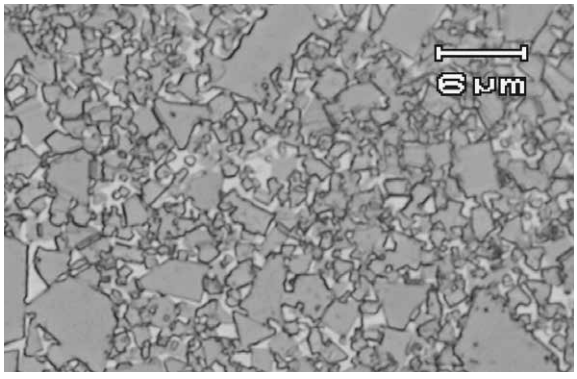
TB6



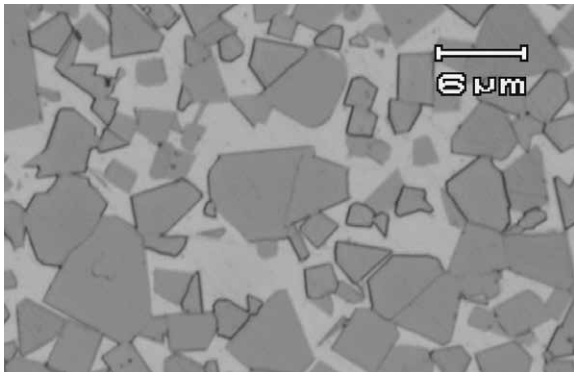
G3



TB7



G4



G8

By metallurgical microscope (×1000)

Fine-grain cemented carbide - KD grade

Line up ... KD05, KD10, KD20, KD30, KD40, KD50

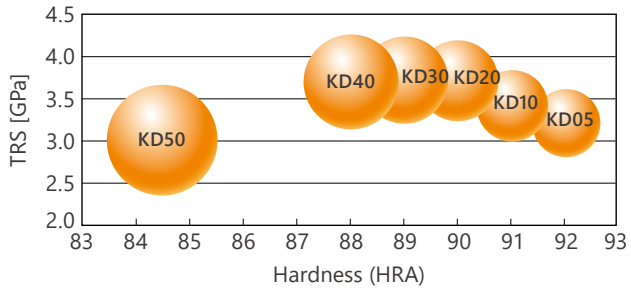
Standard cemented carbide grade for IC lead frame industry.

"EVERLOY" "KD20" cemented carbide is well known as high quality and performance around the world.

Be often adopted for press mold of IC lead frame, magnetic steel sheet and powder compacting.
Excellent balance of wear-resistance, toughness, mold life and machinability.

Explanation	High performance of hardness, toughness, wear and chipping resistance by fine grain WC.
Applications	Mold for Electronic component, Magnetic steel sheet, Powder compacting, etc.

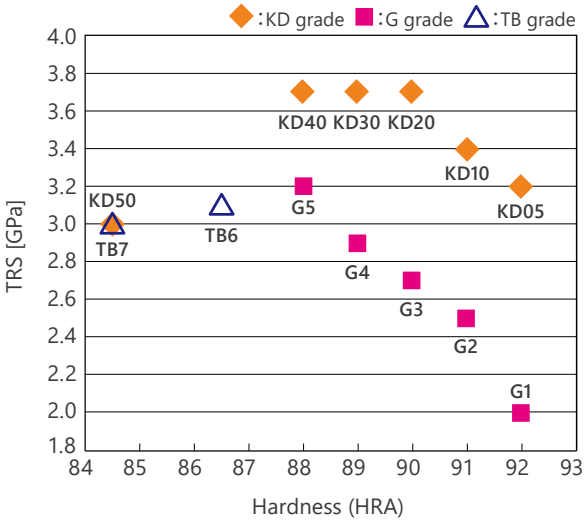
Relation between wear-resistance and machining property for KD grade



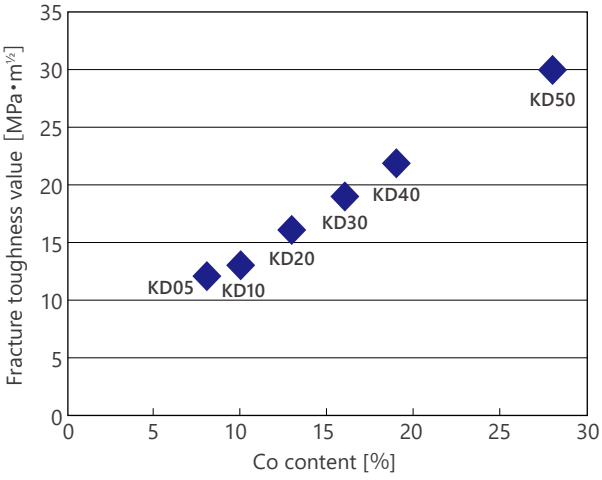
High TRS/Larger circle = Excellent machining property
High Hardness = Excellent wear-resistance

*Circle size indicates fracture toughness value.

Hardness and TRS



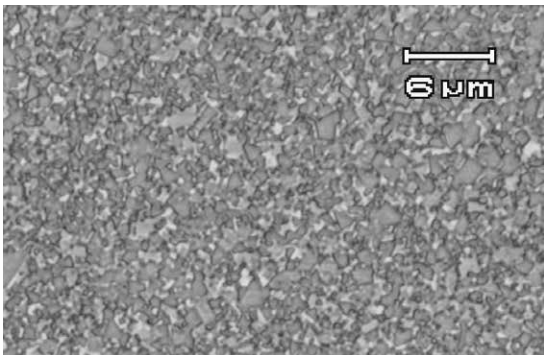
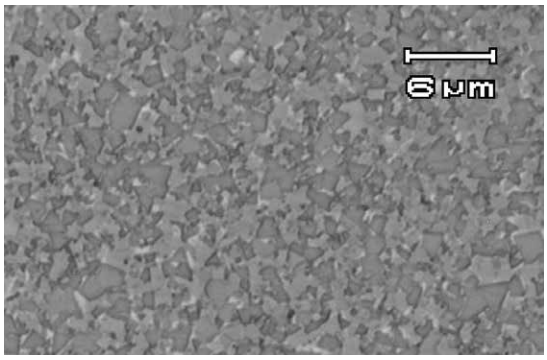
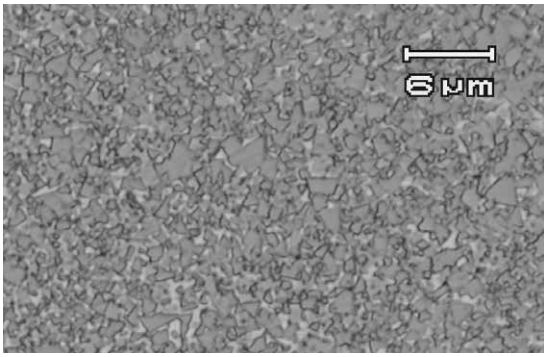
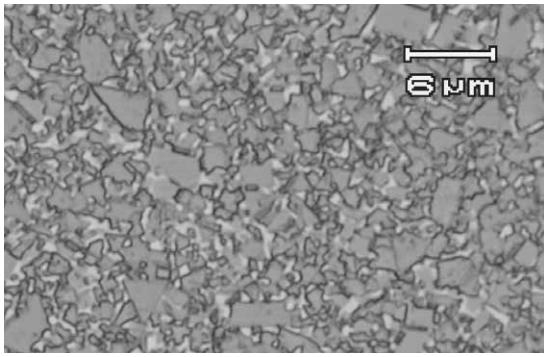
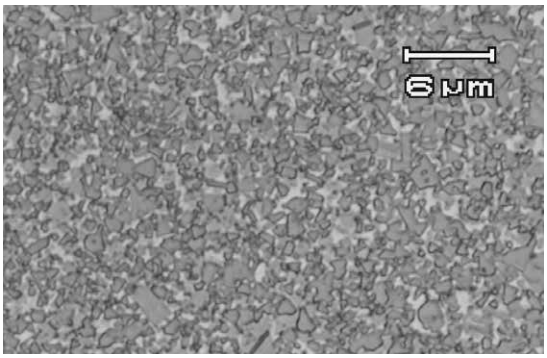
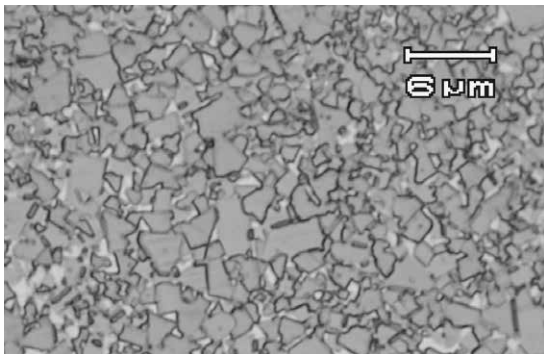
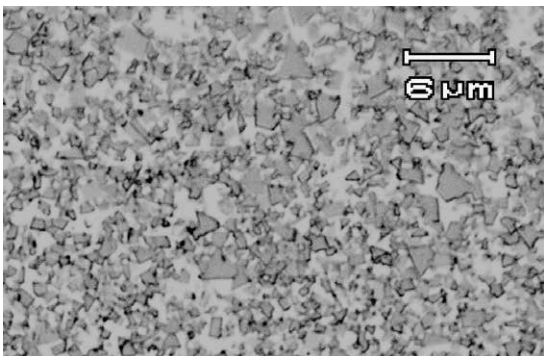
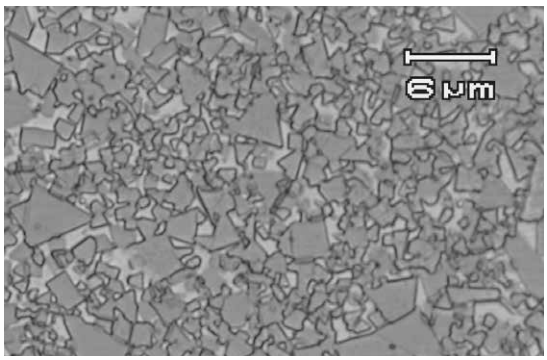
Fracture toughness value



Fine-grain cemented carbide - KD grade

Line up ... KD05, KD10, KD20, KD30, KD40, KD50

Micrographs of the KD grade and G grade

KD grade	G grade
 KD05	 G1
 KD10	 G2
 KD20	 G3
 KD40	 G5

By metallurgical microscope (×1000)

Fine-grain cemented carbide - KD grade

Line up ... KD05, KD10, KD20, KD30, KD40, KD50

Comparison test results of the chipping generated during the surface grinding (micrographs)

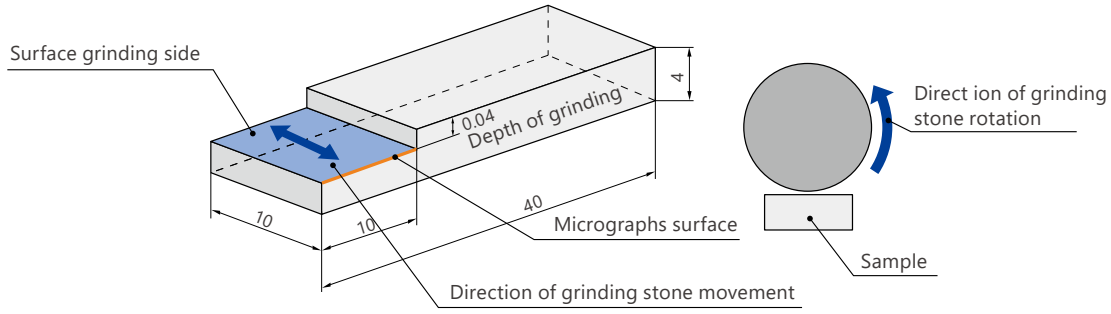
■ **Sample**

KD grade	KD20, KD30, KD50
G grade	G5
EF grade	EF10

■ **Surface grinding conditions**

Amount moved	0.04 mm (10×0.04mm)
Speed	17 m/min
Grinding stone	#600 ϕ180 mm
Grinding stone revolutions	3200 rpm

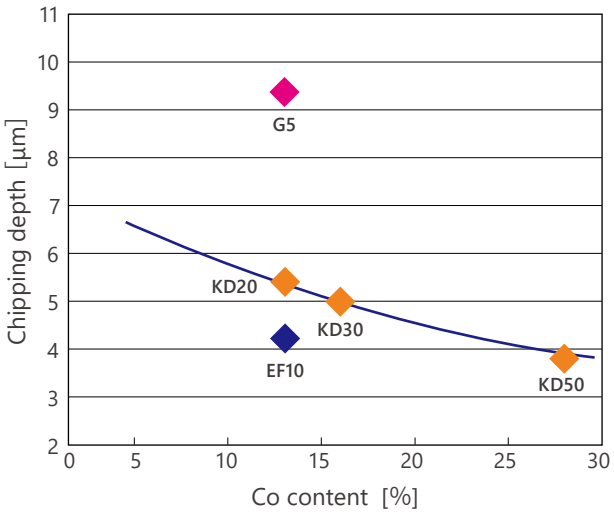
■ **Micrograph surface : Escape side edge of grinding stone**



■ **Test results** **Chipping test results**

Grade	WC grain size [µm]	Cobalt content [%]	Chipping depth [µm]
KD20	1.0 (less than)	13	5.4
KD30	1.0 (less than)	16	5.0
KD50	1.0 (less than)	28	3.8
G5	2.5 - 5.0	13	9.4
EF10	1.0 (less than)	13	4.2

Chipping-resistance characteristics



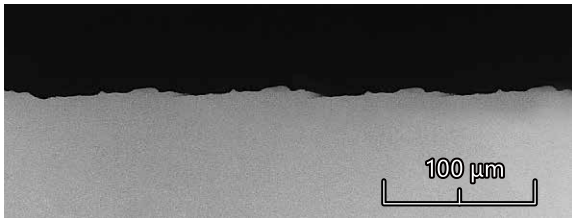
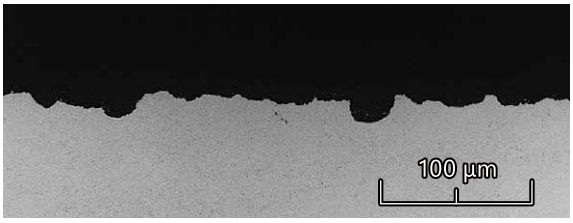
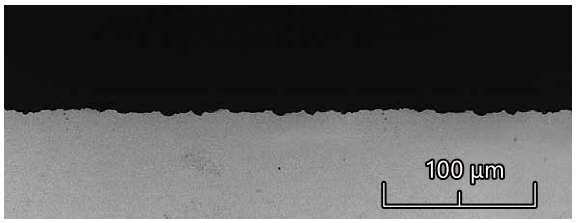
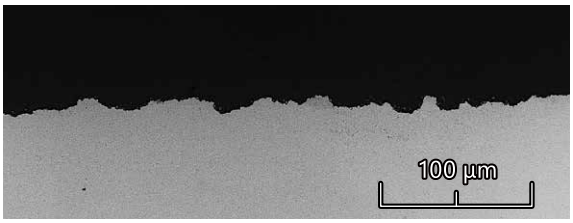
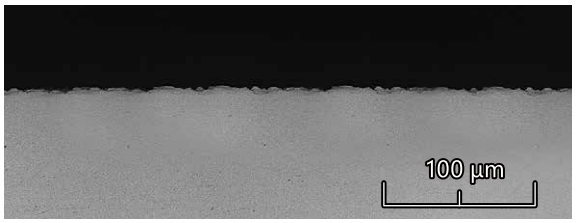
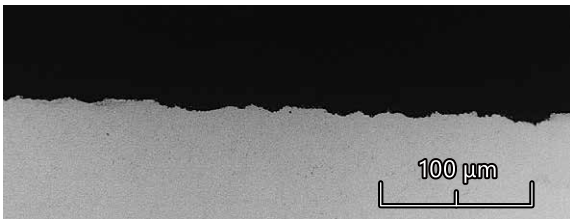
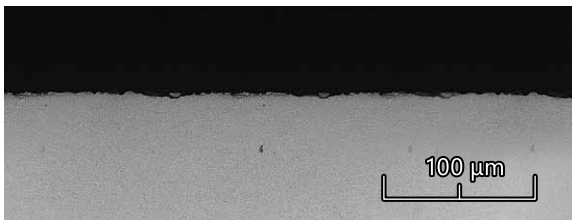
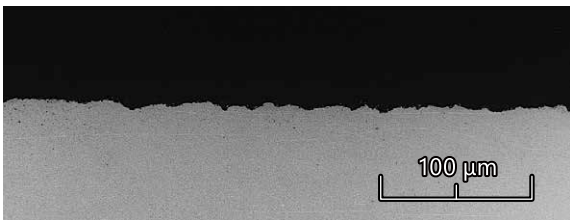
The finer grain and the more cobalt contained, the greater chipping-resistance it has.

Fine-grain cemented carbide - KD grade

Line up ... KD05, KD10, KD20, KD30, KD40, KD50

Micrographs surface (×500)

The following photos show the phases of the edges where chipping was notable and are not representative of all the edges. However, the photos do show the tendency for chipping in various types of materials.

KD grade	G grade
 KD05	 G1
 KD10	 G2
 KD20	 G3
 KD40	 G5

■ Sample

KD grade	KD05, KD10, KD20, KD40
G grade	G1, G2, G3, G5

■ Surface grinding conditions

Amount moved	0.07 mm (3×0.02 mm+0.01 mm/both ways)
Speed	3.0 mm/min
Grinding stone	#400 ϕ75 mm
Grinding stone revolutions	3600 rpm
Number of strokes	85 spm
Amount of strokes	27 mm

Cemented carbide for EDM - A10W

Easing damage when EDM.

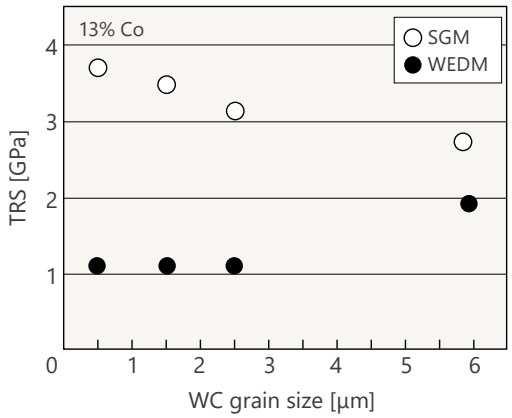
Easing damage when EDM with high hardness.
Crack reduction when EDM.

Explanation	Outstanding wear and chipping resistance by ultrafine grain cemented carbide. This material prevents chipping, corrosion and crack extension when EDM because coarse grain WC are dispersed in the main field of fine grain WC. This material has alteration layer thickness thinning on the surface of cemented carbide for when EDM because of low cobalt content material.
Applications	Precision molds (Snapping, Bending, Spinning and Powder compacting), Molds produced when EDM, etc.

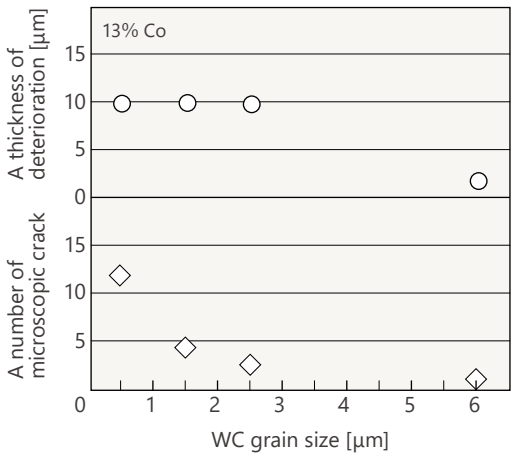
The relation between generality WEDM and cemented carbide

These figures show the relation between the WEDM process and the WC grain size of cemented carbide. It is revealed that the smaller the WC grain size becomes, the lower TRS after WEDM results. This is probably because the finer the alloy grains become the thicker the layer deteriorates after the WEDM process gets and more microscopic cracks are produced.

■ The relation between WC grain size and TRS (Transverse Rupture Strength) after SGM (Surface Grinding Machining) or WEDM (Wire Electric Discharge Machining) of the first cut.



■ The relation between WC grain size and a number of microscopic crack in 500 μm distance of a thickness of deterioration layer after WEDM of the first cut.



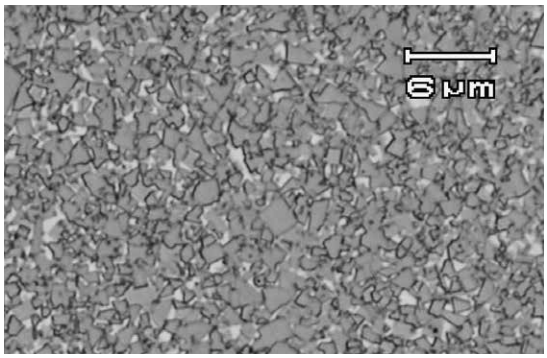
Cemented carbide for EDM - A10W

Physical property of A10W

Our grade	WC grain size [μm]	Co content [%]	Density [×10³kg/m³] {g/cm³}	Hardness HRA	TRS [GPa]
A10W	1.0 - 2.5	9	14.5	91.0	3.7
KD10	1.0 (less than)	10	14.5	91.0	3.4
KD20	1.0 (less than)	13	14.2	91.0	3.7

(Typical figures)

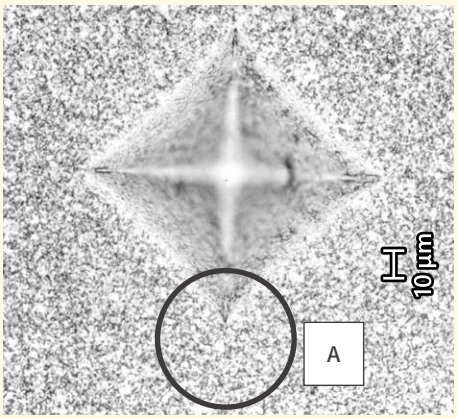
Micrographs of A10W grade



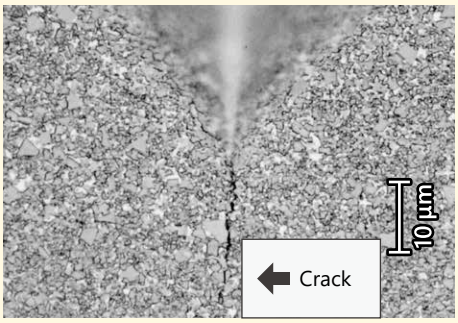
By metallurgical microscope (×1000)

Comparison of crack extension between A10W and KD10

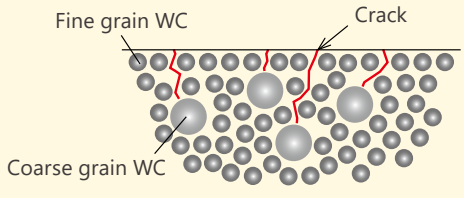
A10W HV(98N)1700



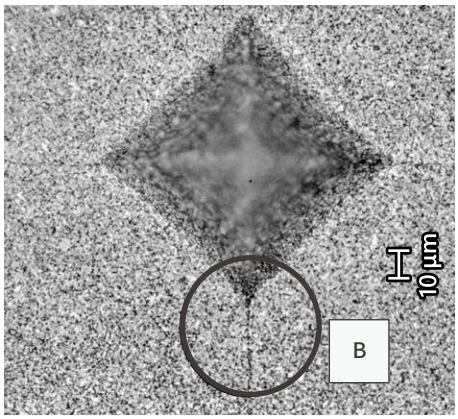
×400



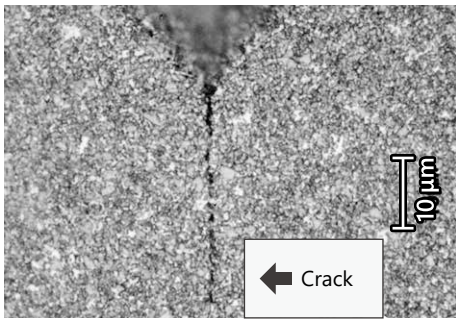
"A" part expansion ×1000



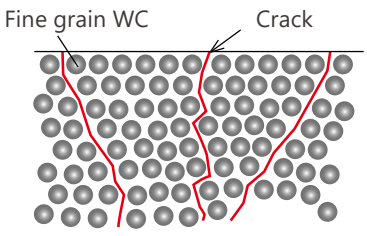
KD10 HV(98N)1700



×400



"B" part expansion ×1000



Cemented carbide for WEDM (Water type)- WD20

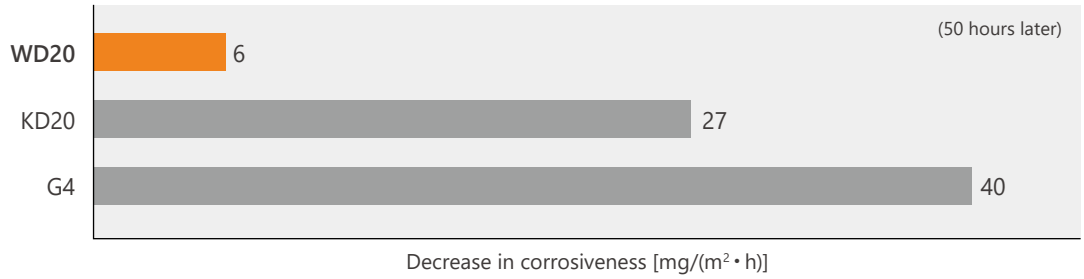
Excellent corrosion-resistance in the WEDM (WATER TYPE) process.

Improvement of corrosion-resistance against KD20 during dielectric water immersed WEDM (WATER TYPE) process over long operating hours.

Explanation	Excellent corrosion-resistance by the special component design. High hardness, toughness, wear-resistance and chipping-resistance by fine grain WC. Has succeeded for thick stainless sheet such as unsuitable for KX01.
Applications	Mold parts concerned when WEDM (water type) in prolonged manufacturing. Mold parts concerned corrosion when wet type processing. Mold parts concerned corrosion under humidity environment at storage, etc.

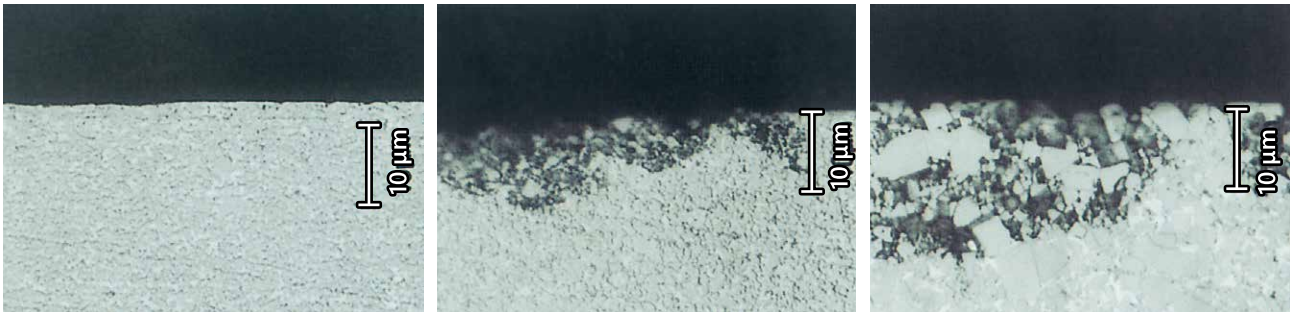
Comparison of corrosion-resistance

The test pieces of WD20, KD20 and G4, were tested to determine the loss in weight resulting from immersion during dielectric water WEDM (WATER TYPE) process.



■ **Microstructure of test pieces showing depth of corrosion after 50 hours of immersion during dielectric water WEDM (WATER TYPE) process.**

×1500



WD20 KD20 G4

Corrosion causes elution of cobalt binder phase and loss of WC grain.

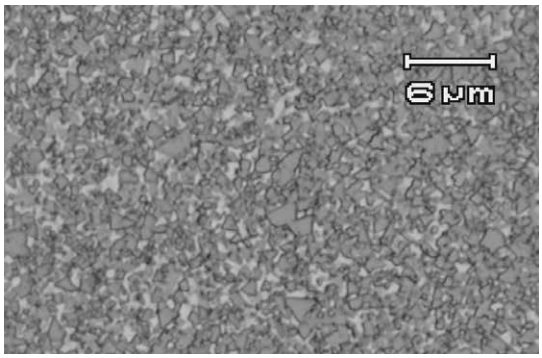
Cemented carbide for WEDM (Water type)- WD20

Physical property of WD20

Our grade	WC grain size [μm]	Binder phase content [%]	Density [×10³kg/m³] {g/cm³}	Hardness HRA	TRS [GPa]
WD20	1.0 (less than)	13	14.1	90.5	3.7
KD20	1.0 (less than)	13	14.2	90.0	3.7
G4	2.5 - 5.0	10	14.2	89.0	2.9

(Typical figures)

Micrographs of WD20



By metallurgical microscope (×1000)

Corrosion test method

A test was carried out with the following procedure :
One surface of each test piece of WD20, KD20 and G4(8 mm × 10 mm × 20 mm) was prepared by WEDM (WATER TYPE).
The test pieces were placed on a cemented carbide workpiece with their WEDM prepared surface facing upwards while the workpiece was subject to dielectric water immersed WEDM process as shown in the figure below (Fig. 1). The surfaces of the test pieces were then observed through a microscope.

Fig. 1 Condition of corrosion test

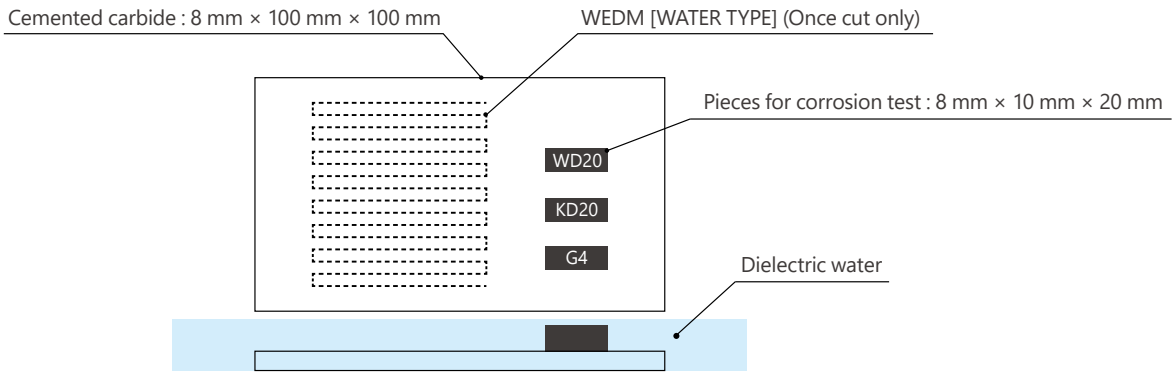
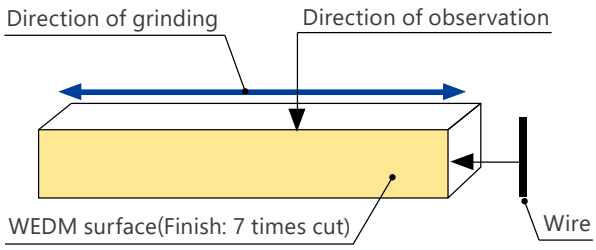


Fig. 2 Magnified figure of a test piece



■ **Cutting condition**

Wire type	0.1 mm/Brass
Workpiece	Cemented carbide(Thickness: 8 mm)
Dielectric	Ion exchange water(Water resistivity: 8×10⁴ Ω・m)
Cutting speed	600 μm/min

Ultrafine-grain cemented carbide - EF grade

Line up ... EF01, EF05, EF10, EF20

Ultrafine grain cemented carbide

High hardness, high transverse rupture strength and sharp edge.

Explanation	Ultrafine grain material grade with various hardness range (HRA 90 - 94) . Long life by high wear-resistance.
Note	Ultrafine grain carbide such as EF have physically unresisting against impact or damage by EDM whereas high hardness and transverse rupture strength.
Applications	Mold for electronic component, powder compacting, resin forming, high speed press(Punch, Dies, Bending punch and Die), etc.

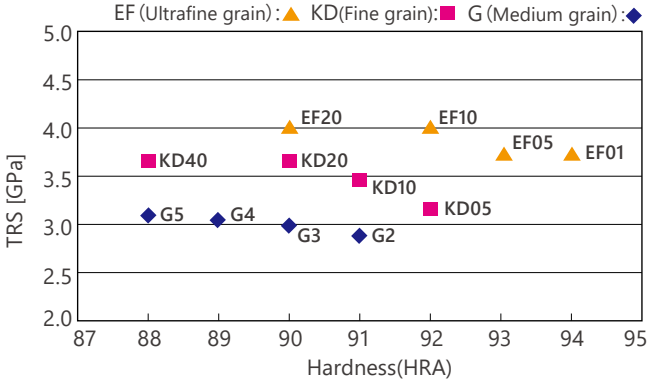
Physical property of EF grade

Our grade	Co content [%]	Density [×10³kg/m³] {g/cm³}	Hardness		TRS [GPa]
			HRA	HV	
EF01	8	14.5	(94.0)*	2000	3.7
EF05	10	14.3	93.0	1900	3.7
EF10	13	14.0	92.0	1750	4.0
EF20	18	13.6	90.0	1480	4.0

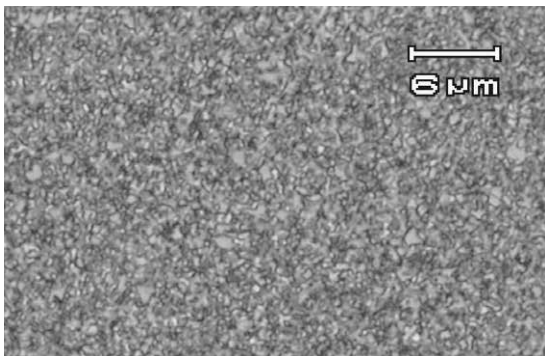
(Typical figures)

Note *The number shows the reduced value from HV.

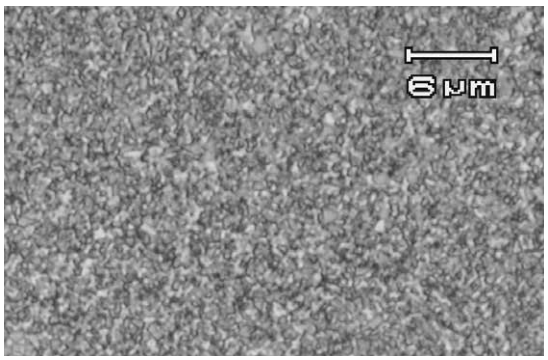
Relation between hardness and TRS



Micrographs of EF grade



EF01



EF10

By metallurgical microscope (×1000)

Non-magnetic and anti-corrosive cemented carbide - KN grade

Line up ... KN10, KN20, KN30, KN40

Non-magnetic and anti-corrosive cemented carbide

Completely free magnetism and magnetization from extraneous effect. Outstanding corrosion-resistance and chemical proof. Excellent oxidation-resistance than general WC-Co cemented carbides.

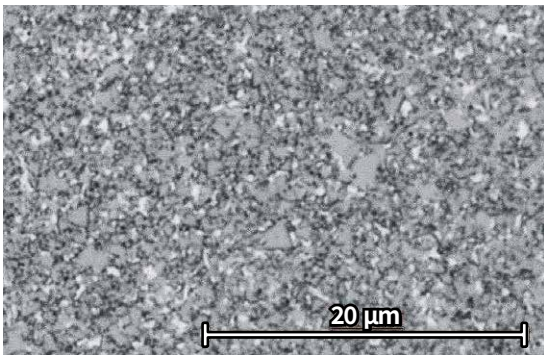
Explanation	Non-magnetic carbide by binder phase with Ni. Stable corrosion-resistance against various liquid solution and atmospherics by binder phase with Ni.
Applications	Magnetic field forming mold, Tools for magnetic tape, Electronic equipment, Parts for chemical equipment, Mechanical seal, Decorative parts, etc.

Physical property of KN grade

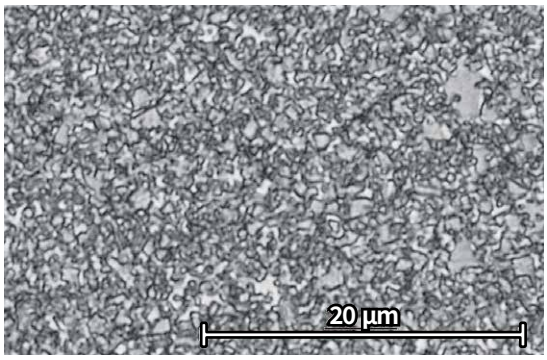
Our grade	WC grain size [μm]	Ni content [%]	Density [$\times 10^3 kg/m^3$] {g/cm^3}	Hardness HRA	TRS [GPa]	Fracture toughness values [$MPa \cdot m^{1/2}$]	Tensile strength [GPa]	Magnetic permeability [H/m]
KN10	1.0 (less than)	9	14.5	91	3.3	11	1.6	1.27×10^{-6}
KN20	1.0 (less than)	12	14.2	90	3.6	14	1.8	1.27×10^{-6}
KN30	1.0 (less than)	14	13.9	89	3.6	17	1.8	1.27×10^{-6}
KN40	1.0 (less than)	16	13.7	88	3.8	20	1.9	1.27×10^{-6}

*The nearer magnetic permeability is 1.26×10^{-6} H/m, the higher non-magnetic performance is. (Typical figures)

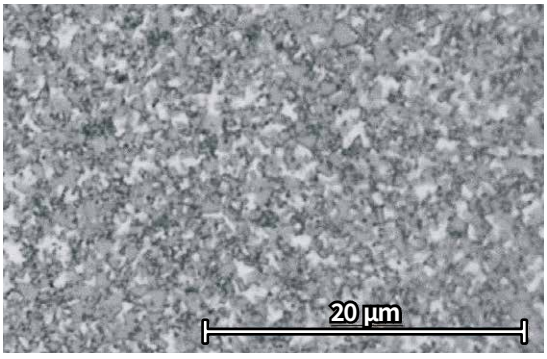
Micrographs of KN grade



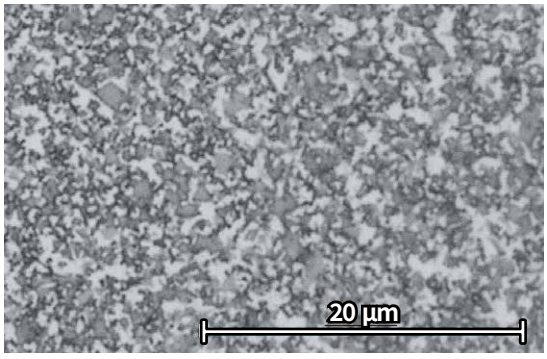
KN10



KN20



KN30



KN40

By metallurgical microscope (×1000)

Non-magnetic and anti-corrosive cemented carbide - KN grade

Line up ... KN10, KN20, KN30, KN40

Corrosion-resistance of KN grade (Comparison with G grade)

Our grade	WC grain size [μm]	Co content [%]	Density [×10³kg/m³] {g/cm³}	Decrease in corrosiveness [g/(m² • h)]			
				10% NaOH	10% KOH	10% HCl	10% HNO_3
KN20	1.0 (less than)	12	14.2	0	0.01	0.08	0.01
G2	1.0 - 2.5	6	15.0	0.02	0.01	0.08	7.99
G5	2.5 - 5.0	13	14.3	0.02	0.04	0.09	28.34

Corrosion resistance test of KN grade

■ **Nitric acid & sulfuric acid corrosion test conditions**

Grades	KN grade(WC-X-Ni)*, KD grade(WC-X-Co)*, G grade(WC-Co)
T.P. Dimensions	7 mm × 6 mm × 23 mm (6 mm × 23 mm surface immersed face down)
Processing condition	SG#200 6-side polished
Immersion conditions	10% nitric acid, 10% sulfuric acid (room temperature 26℃, 6 hours)

*X is a trace additive

■ **Appearance of test pieces after corrosion (typical)**

*Examples where changes by nitric acid are easy to understand.

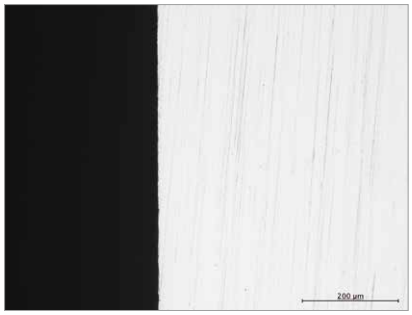
◀ **KN20**
Discoloration due to passive film formation

◀ **KD20**
Decrease in luster due to corrosion

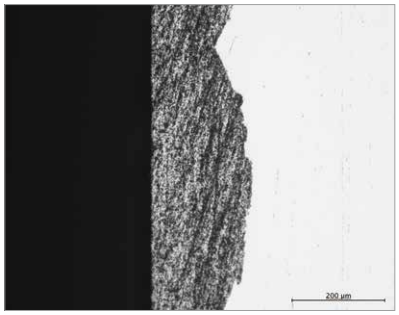
◀ **G5**
Decrease in luster due to corrosion

■ **Cross sections of test pieces after corrosion (typical)** *Examples where changes by nitric acid are easy to understand.

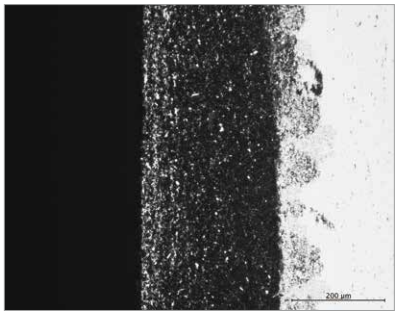
Cut with diamond wheel, with cut surface polished with 2000 grit sandpaper. Surface is then lapped with diamond paste.



KN20
Corrosion inhibited



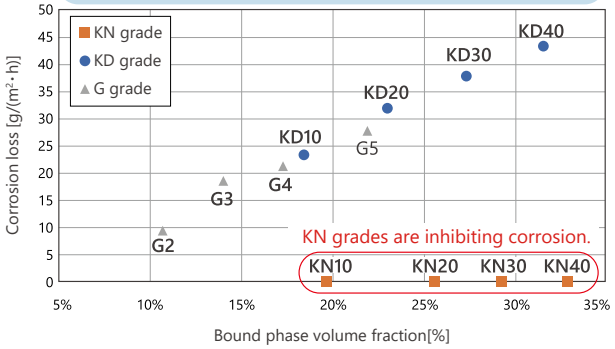
KD20
Corrosion depth approximately few hundred micrometers



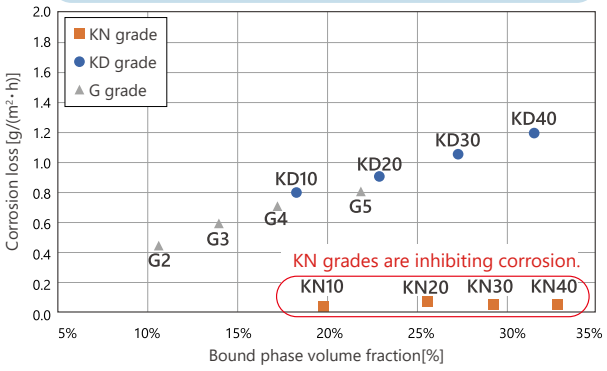
G5
Corrosion depth approximately few hundred micrometers (G grade is slightly deeper).

By metallurgical microscope (×1000)

10% nitric acid 6 hours immersion test



10% sulfuric acid 6 hours immersion test



Non-magnetic and anti-corrosive cemented carbide - KN grade

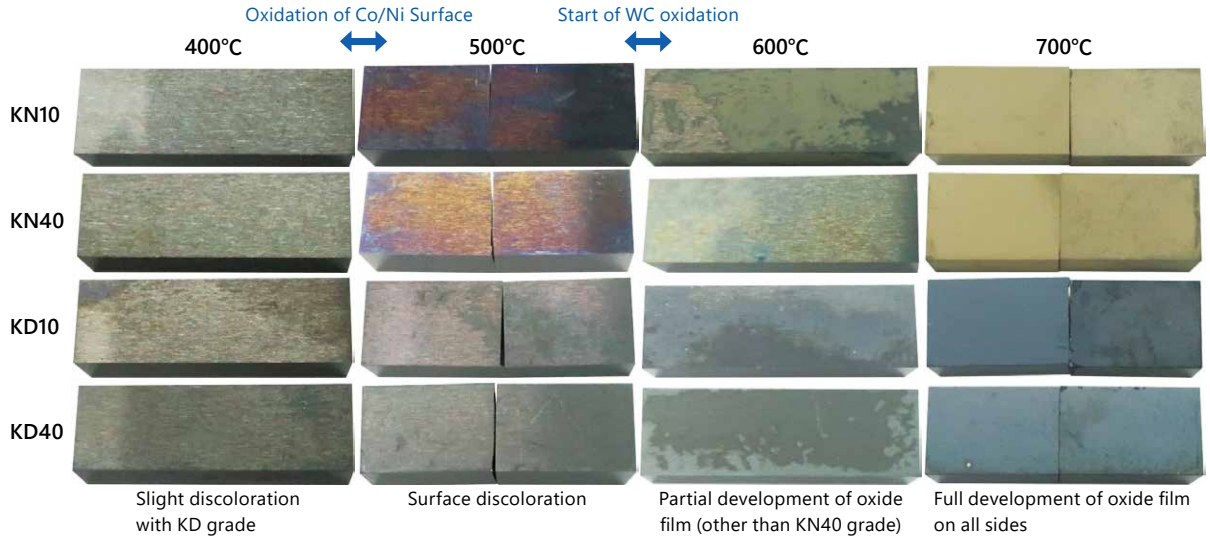
Line up ... KN10, KN20, KN30, KN40

High-temperature oxidation test for KN grade

■ **Test overview**

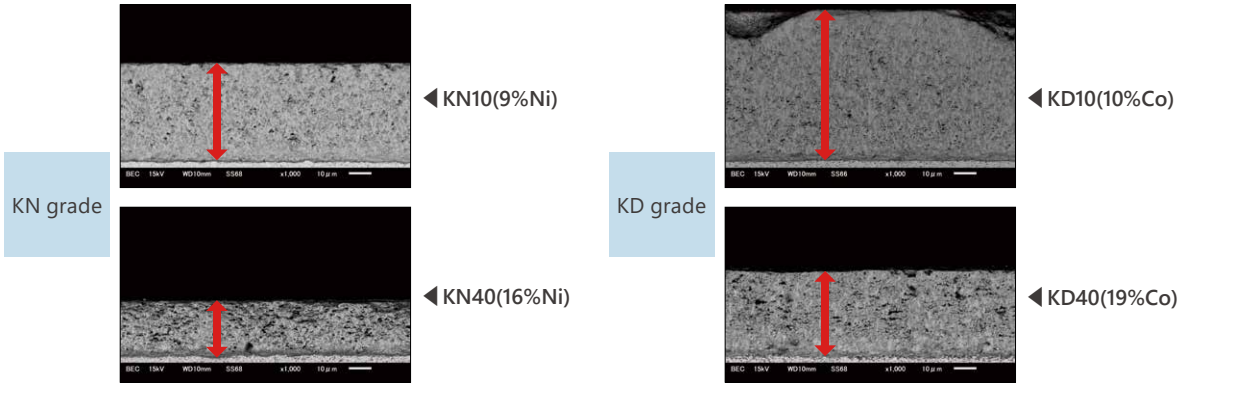
Grades	KN grade, KD grade
T.P. Dimensions	6 mm × 8 mm × 24 mm
Processing condition	SG#200 6-side polished
Heating conditions	Heating at 400°C, 500°C, 600°C, 650°C, and 700°C for 30 minutes each on an alumina plate, using an air atmospheric furnace

■ **Appearance of test pieces (For observation, some test pieces were cut in half)**



■ **Oxide film observation results**

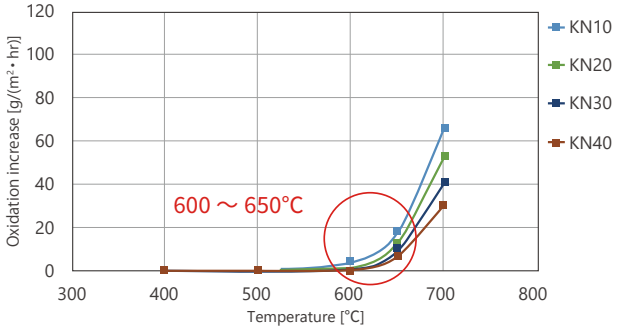
Cross sections of test pieces were lapped and observed after heating at 700°C for 30 minutes .
Red arrows below indicate oxide film thickness.



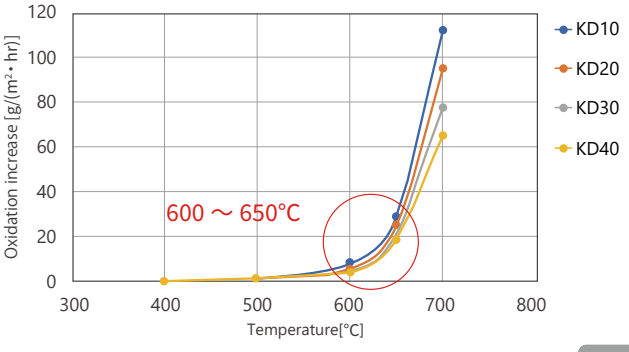
By metallurgical microscope (×1000)

■ **Relationship between temperature and oxidation increase**

Relationship between temperature and oxidation increase(KN grade)



Relationship between temperature and oxidation increase(KD grade)

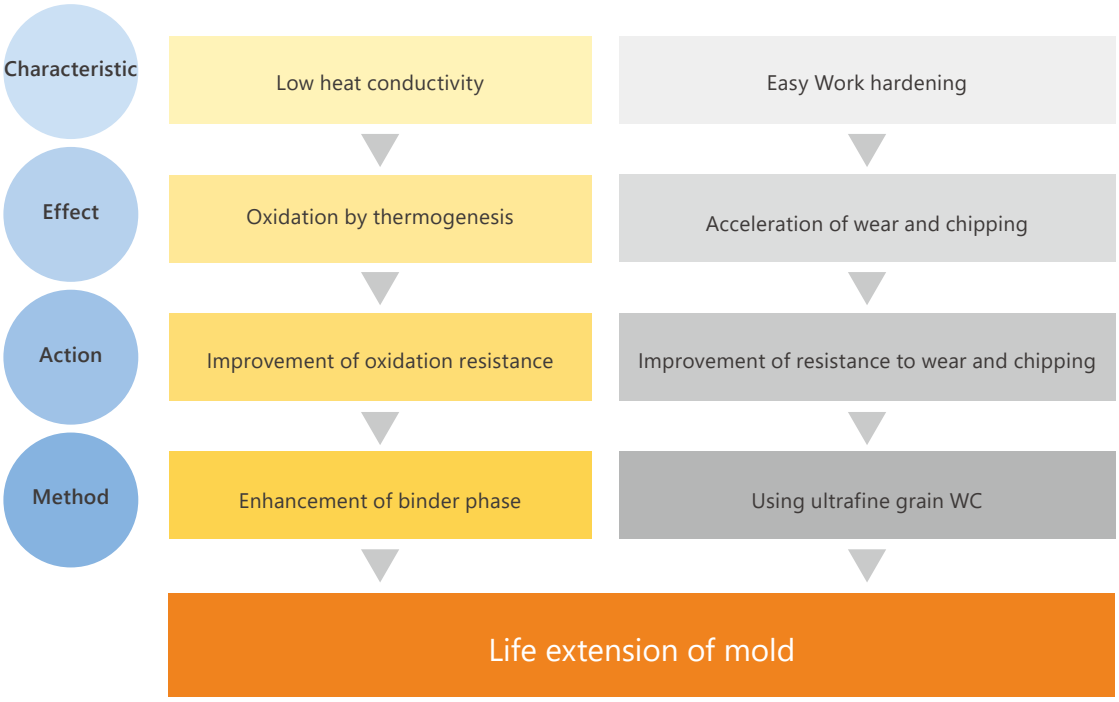


Cemented carbide for stainless-steel products - KX01

Excellent performance for press of stainless.

High wear-resistance for press of stainless or low heat conductivity parts.
High hardness, high transverse rupture strength and sharp edge.

Explanation	KX01 is specially designed by taking into account the characteristics of stainless steel to extend lifetime of the mold. This effect is applied to not only stainless steel but also other material such as phosphor bronze and copper beryllium alloy. This material grade is suitable for usage which requires sharper edge because it has excellent hardness and transverse rupture strength by ultrafine grain WC (under 1 μm).
Note	Suitable material grades for thick stainless parts are WD20 or ME40 because KX01 is developed for thin stainless parts.
Applications	For stainless steel (stamping for cable terminals, switch panels, HDD suspensions, etc.), For hard-to-machine materials (increasing life of punches for narrow-pitch connector terminals), etc.



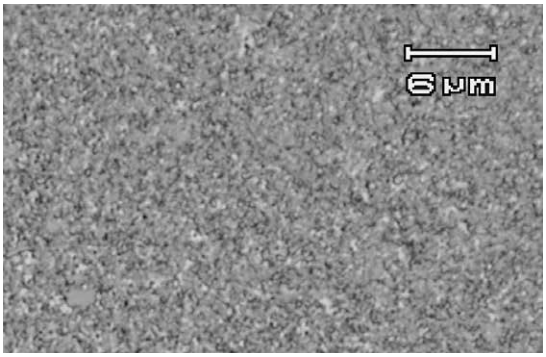
Cemented carbide for stainless-steel products - KX01

Physical property of KX01

Our grade	WC grain size [μm]	Binder phase content [%]	Density [×10³kg/m³] {g/cm³}	Hardness HRA	TRS* [GPa]	Fracture toughness values [MPa・m½]
KX01	1.0 (less than)	13	14.0	92.5	4.0	10.2
EF10	1.0 (less than)	13	14.0	92.0	4.0	10.4
KD10	1.0 (less than)	8	14.7	91.0	3.4	13.2
KD20	1.0 (less than)	13	14.2	90.0	3.7	15.5
G5	2.5 - 5.0	13	14.1	88.0	3.2	25.9

*Value measured by the IF method. (Typical figures)

Micrographs of KX01



By metallurgical microscope (×1000)

Track record of strokes

Workpiece	Workpiece thickness	Stamping condition	Die	Punch	Performance (Stroke number)
SUS	0.10 mm	Snapping	KD10 / Equivalent to KD10	KX01	3 million
			KD10 / Equivalent to KD10	KD10 / Equivalent to KD10	600 thousand
SUS304	0.15 mm	Coining at 700 rpm	KD10 / Equivalent to KD10	KX01	18 million
			KD10 / Equivalent to KD10	KD10 / Equivalent to KD10	1 million
SUS301	0.70 mm	Snapping at 200 rpm	KX01	G5	260-350 thousand
			Conventional cemented carbide (Ultrafine-grain to fine-grain)	G5	80-180 thousand
SUS304	0.60 mm	Snapping at 230 rpm	KX01	KX01	100 thousand
			G3 / Equivalent to G3	G3 / Equivalent to G3	20 thousand

Cemented carbide for stamping of metals high affinity to cobalt - MC20

Cemented carbide for stamping of metals high affinity to cobalt (Adhesive wear-resistance by seizure)

Excellent product life against manufacturing for pure iron or copper which are easy to be seizure.
Excellent performance for EDM and corrosion-resistance.

Explanation	Adhesive wear and seizure resistance by adopting special WC and reducing binder phase of Co. Excellent high hardness, performance of EDM and corrosion resistance by optimizing WC particle and composition design.
Applications	Press mold for lead frame and connector made of copper. Press mold for SPC type steels. Breakage resistance for mold demanded high hardness when EDM, etc.

Usual material problem

Attraction of Co in cemented carbide from metals with high affinity to Co

↓

Displacement of Co in the cemented carbide

↓

Damage of mold

Characteristic of MC20

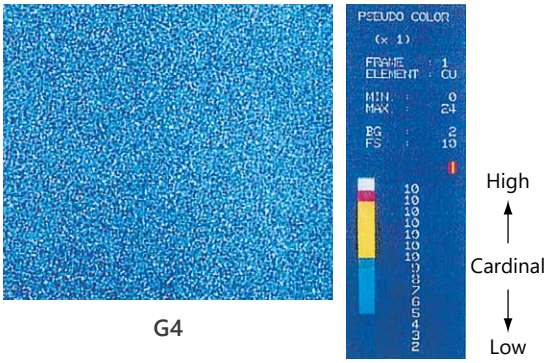
Reduction of Co and Selection of special WC

↓

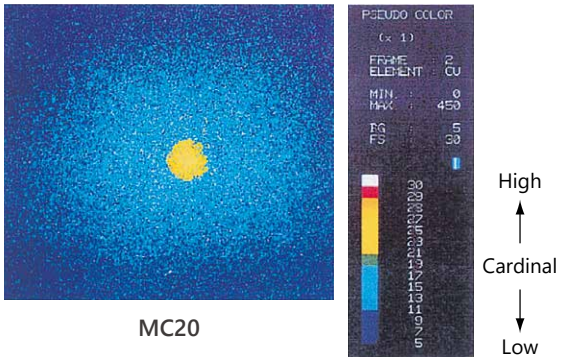
Decreasing the high affinity of Co

Comparison of reaction to copper (Analysis of EPMA)

Comparative reaction test between MC20 and G4 grade.
Above-shown photos are the cross-section surface of the test pieces which are compacted wire copper in center of MC20 and G4 after sintering and treated by HIP.
Result;
MC20: Copper wire remains in the original position without diffusing.
G4: Copper wire has diffused in the material.



G4



MC20

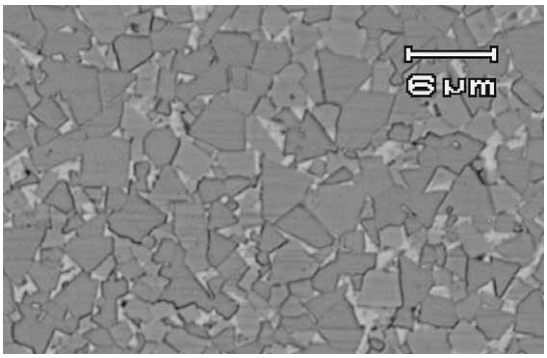
Cemented carbide for stamping of metals high affinity to cobalt - MC20

Physical property of MC20

Our grade	WC grain size [μm]	Co content [%]	Density [×10³kg/m³] {g/cm³}	Hardness HRA	TRS* [GPa]
MC20	2.5 - 5.0	6	14.9	90.0	2.8
G3	1.0 - 2.5	8	14.8	90.0	2.7

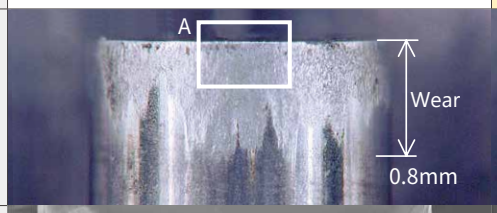
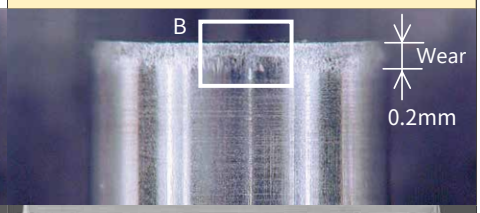
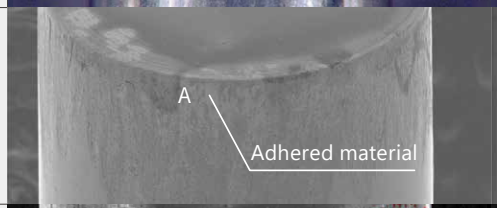
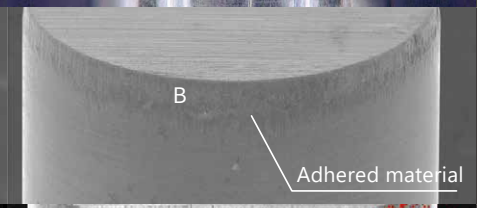
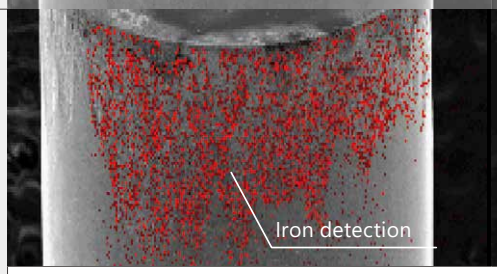
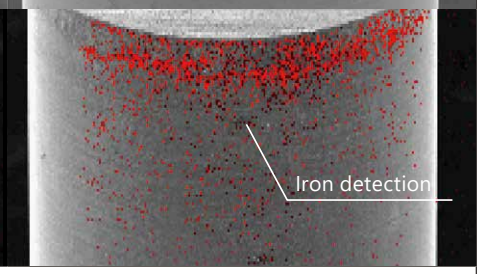
(Typical figures)

Micrographs of MC20



By metallurgical microscope (×1000)

Wear comparative example

Compare item	G3	MC20
Manufacturing condition	Workpiece ： S65C Workpiece ： 1.3 mm Press method ： Punching	
Stroke number	50-150 thousand	180 thousand
Wear condition of punch edge (with microscope)		
Wear condition of punch edge (with SEM)		
Work adhesive condition (Mapping of iron element)		
	(Upper pictures are composition of SEM observation and mapping of Iron element. The red points show Iron.) Position of adhered material accord with Iron detection.	
Comment	Even though the stroke number of MC20 is larger than G3, the amount of adherence to MC20 is smaller than G3.	

Corrosion-resistant cemented carbide for EDM - ME40

Corrosion-resistant cemented carbide

Damage reduction when EDM.
Corrosion reduction when WEDM (water type).
Crack reduction by impact in pressing process.

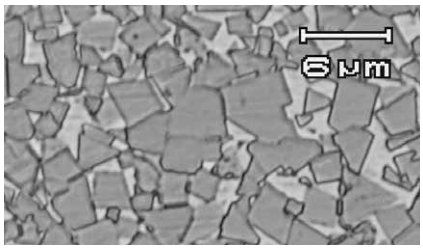
Explanation	1. Design to resist corrosion and strength decrease when WEDM (water type). ① Increased transverse rupture strength after WEDM (water type) by optimized WC grain. ② Improved corrosion-resistance by optimized component design. 2. Design to resist chipping when grinding process so that cutting performance when pressing process is improved. (Improved chipping-resistance by exclusion of coarse grain WC which influences chipping problem.) 3. Suitable material grade for crack resistance when crack problems are happened in KX01 or WD20 when pressing process of stainless parts.
Applications	For WEDM (water type) processing in prolonged manufacturing. (Especially for Die) Proceeded by WEDM has an issue regarding chipping in pressing process. Concerned corrosion by wet type processing. Concerned corrosion under humidity environment at storage, etc

Physical property of ME40

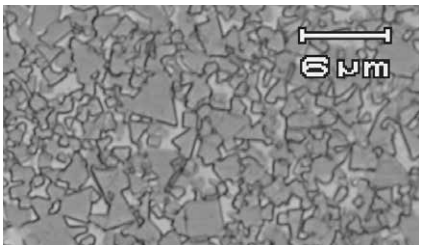
Our grade	WC grain size [μm]	Binder phase content [%]	Density [$\times 10^3$kg/m^3] {g/cm^3}	Hardness HRA	TRS [GPa]	
					TRS before WEDM	TRS after WEDM
ME40	2.5 - 5.0	12	14.1	88.0	3.2	2.3
G5	2.5 - 5.0	13	14.3	88.0	3.2	2.2
KD40	1.0 (less than)	19	13.6	88.0	3.7	1.9

(Typical figures)

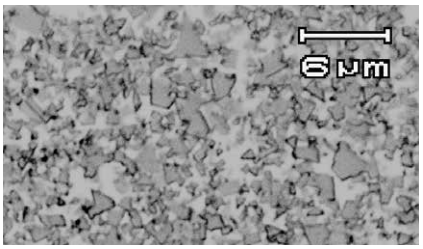
Micrographs



ME40



G5

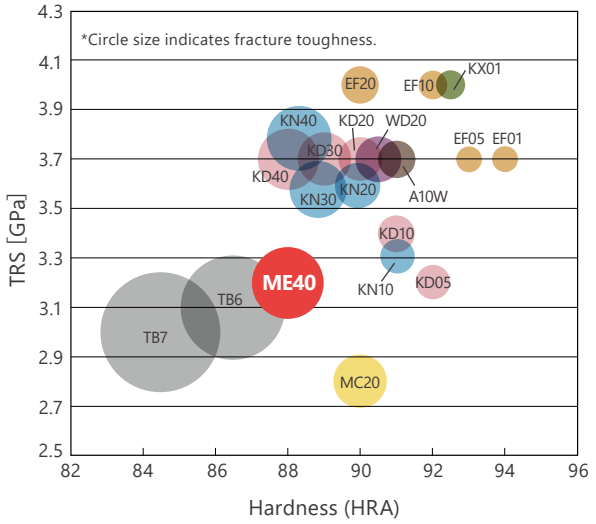


KD40

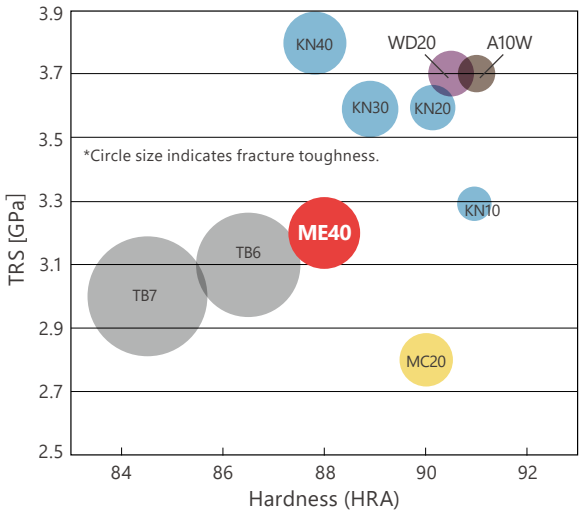
By metallurgical microscope (×1000)

Corrosion-resistant cemented carbide for EDM - ME40

Positioning in corrosion-resistant cemented carbide

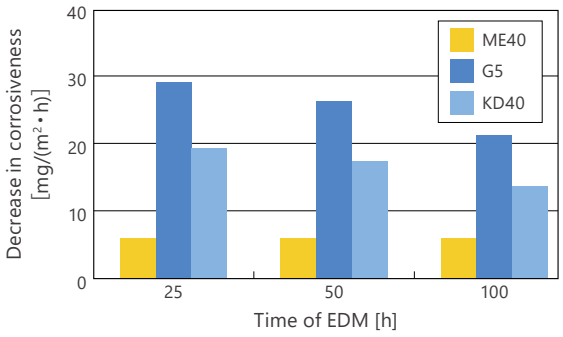


Positioning in cemented carbide for EDM



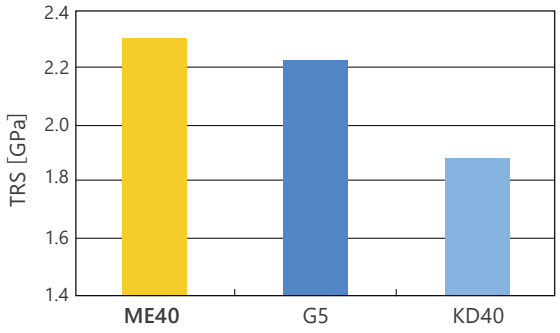
ME40 has excellent balance of wear-resistance and toughness in cemented carbide for EDM.

Performance of corrosion-resistance



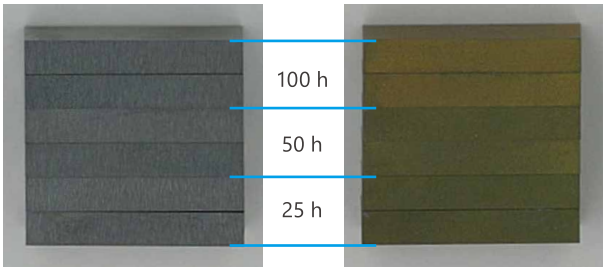
ME40 has excellent corrosion-resistance comparing to other grades which have same hardness.

Performance comparison of TRS after WEDM



ME40 restrains deterioration of strength after EDM comparing to other grades which have same hardness.

■ **Appearance after corrosion test**



ME40 keeps same color while G5 became dark brown. (G5 gets rusty)

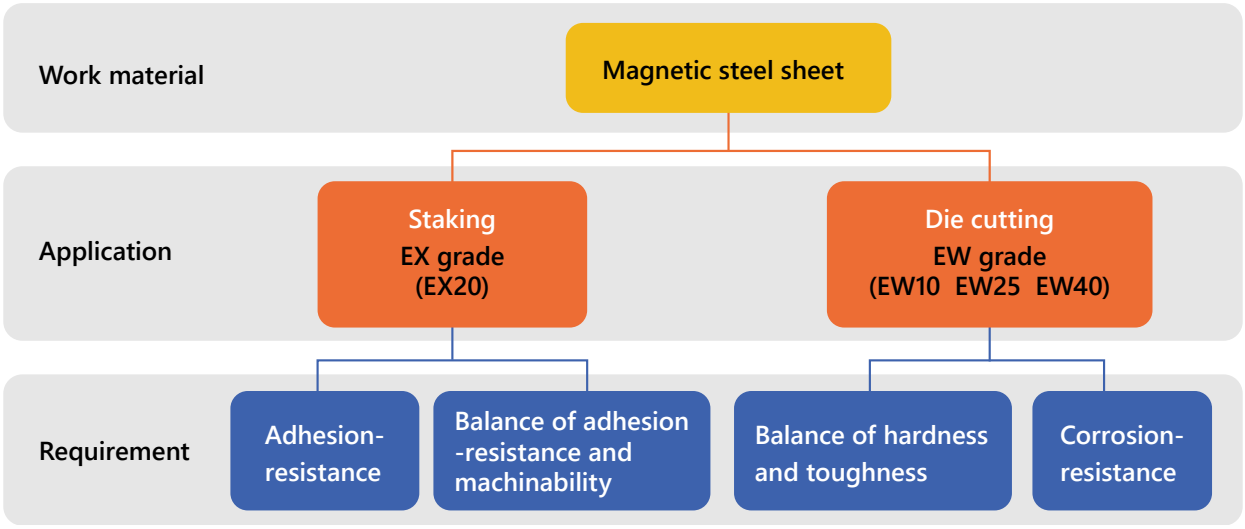
Corrosion-resistance 500% up
*Compared with G5

Cemented carbide for magnetic steel sheet - EX grade, EW grade

Lineup which has an excellent performance on processing magnetic steel sheet

EX grade is for magnetic steel sheet staking, which is well suited for adhesion resistance.
EW grade is for magnetic steel sheet die cutting, which is well suited for hardness, toughness and corrosion resistance.

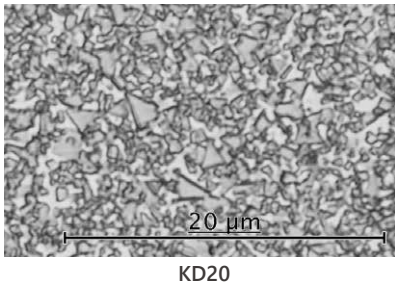
Criterion for selecting grades for processing magnetic steel sheet



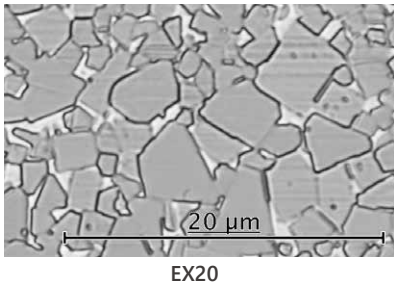
Physical property

Our grade	TAS classification	WC grain size [μm]	Co content [%]	Hardness HRA	TRS [GPa]	Fracture toughness value [MPa • m$^{1/2}$]	Thermal expansion conefficient [×10^{-6}/K]	Thermal conductivity [W/(m • K)]
KD20	VF-40	1.0(less than)	13	90.0	3.7	16	5.6	71
EX20	VC-40	2.5 - 5.0	6	90.0	3.0	19	4.7	80
EW25	VM-40	1.0 - 2.5	11	89.5	3.5	22	5.4	73

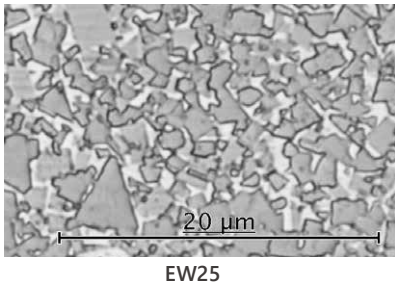
Micrographs



KD20



EX20



EW25

By metallurgical microscope (×1000)

Cemented carbide for magnetic steel sheet staking - EX grade

High hardness, toughness and corrosion-resistant cemented carbide

Mold life expansion by special composition design, which improves adhesive wear.

Explanation	Grade which has excellent adhesion resistance in staking magnetic steel sheet.
Applications	1. For punch and die staking magnetic steel sheet. 2. For resistance of adhesion wear. 3. In case that chipping and defect are caused by adhesion wear. 4. Resistance against the damage caused by WEDM, corrosion and others to improve the above 2 and 3 features.

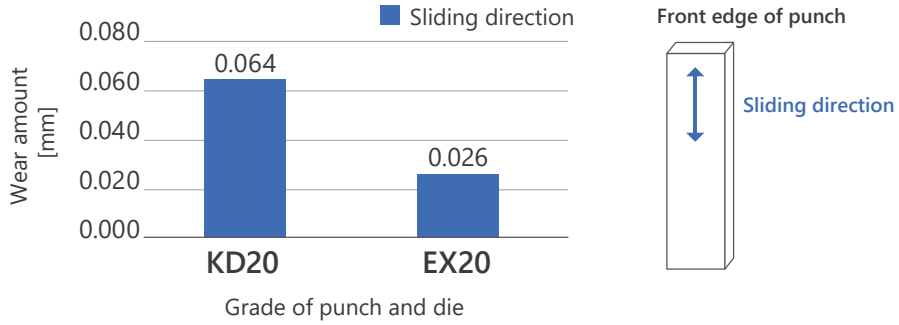
Physical property of EX20

Our grade	Hardness HRA	TRS [GPa]	Fracture toughness value [MPa • m$^{1/2}$]	Density [×10^{3}kg/m^3] {g/cm^3}
EX20	90.0	3.7	19	14.9

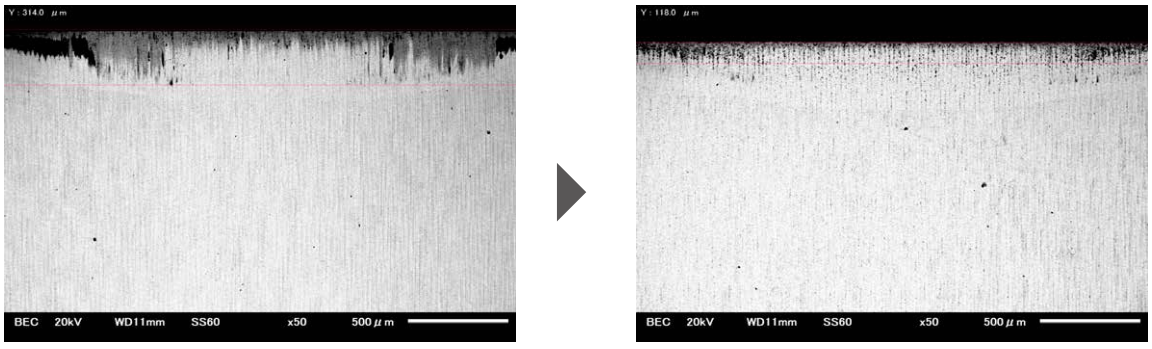
(Typical figures)

Comparison of wear

① Comparison of wear by press material's adhesion



② Adhesion of pressed material



KD20 EX20

Both of die cutting/staking molds have to have longer life to extend a maintenance period of mold for motor core. EVERLOY EX grade and EW grades have a high possibility to make the maintenance period longer.

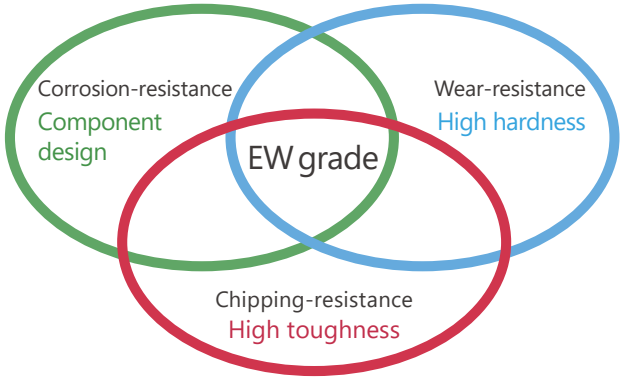
Cemented carbide for magnetic steel sheet die cutting - EW grade

Line up ... EW10, EW25, EW40

High hardness, toughness and corrosion-resistant cemented carbide

Optimized resistance balance of wear, chipping and corrosion.
Suppresses cracking and chipping which often occur on processing magnetic steel sheet.

Explanation	Resistance of cracking, chipping and defects can be improved without using softer material as fracture toughness is relatively high, compared to the materials with same hardness. Corrosion-resistance is excellent also.
Applications	Magnetic steel sheet. For wear-resistant parts which has concern about chipping or defect, EDM process or WEDM (water type) processing in prolonged manufacturing.



Physical properties of EW grade

Our grade	Co content [%]	Density [×10³kg/m³] {g/cm³}	Hardness HRA	TRS [GPa]	Fracture toughness value [MPa • m½]
EW10	7	14.8	91.0	3.5	15
EW25	11	14.3	89.5	3.5	22
EW40	15	13.9	88.0	3.5	29

(Typical figures)

Characteristics

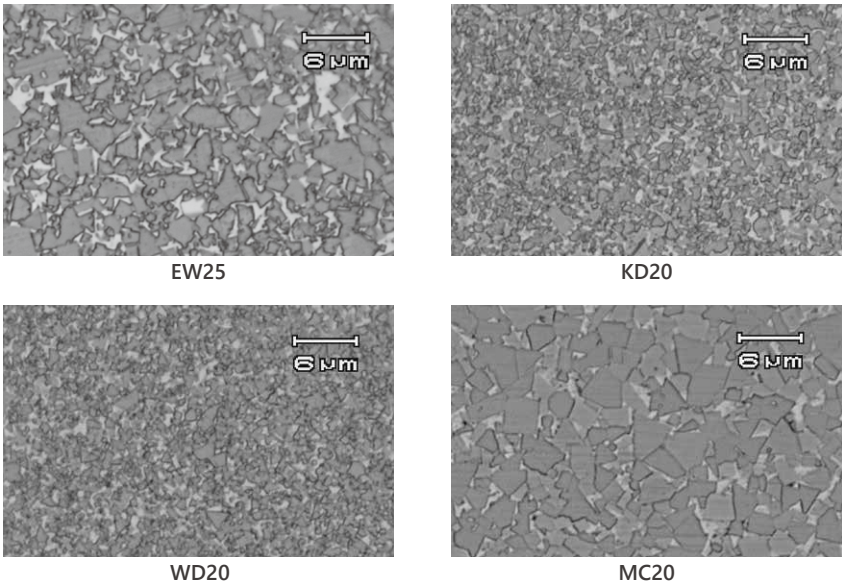
Our grade	WC grain size [µm]	Binder phase content [%]	Density [×10³kg/m³] {g/cm³}	Hardness HRA	TRS [GPa]	Fracture toughness value [MPa • m½]
EW25	1.0 - 2.5	11	14.3	89.5	3.5	22
KD20	1.0 (less than)	13	14.2	90.0	3.7	16
WD20	1.0 (less than)	13	14.1	90.5	3.7	16
MC20	2.5 - 5.0	6	14.9	90.0	2.8	19

(Typical figures)

Cemented carbide for magnetic steel sheet die cutting - EW grade

Line up ... EW10, EW25, EW40

Micrographs

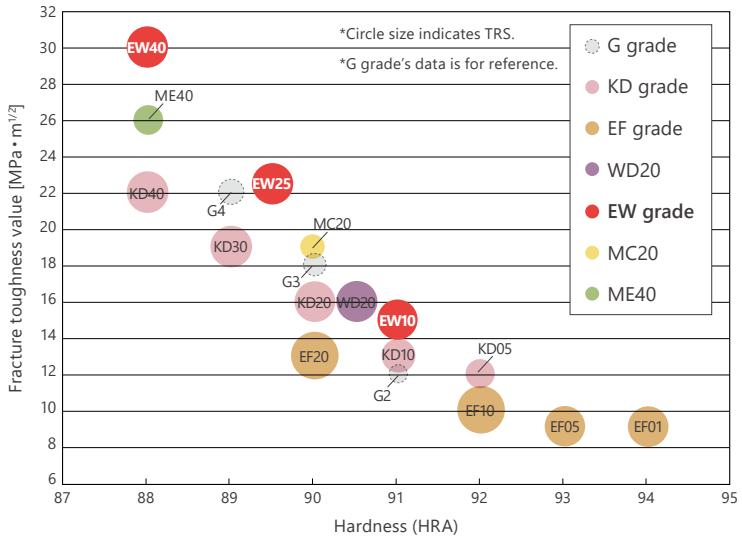


EW25 KD20

WD20 MC20

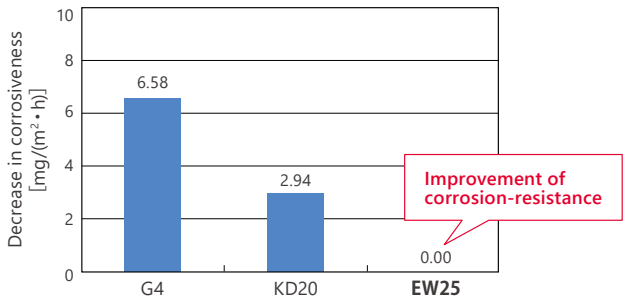
By metallurgical microscope (×1000)

Positioning in corrosion-resistant cemented carbide



Performance of corrosion-resistance

After 100 hours immersion during WEDM (water type) process.



High wear-resistant cemented carbide - SS grade

Line up ... SS13, SS15

High wear-resistant cemented carbide (Abrasive wear-resistance)

Extremely high hardness for outstanding abrasive wear-resistance.

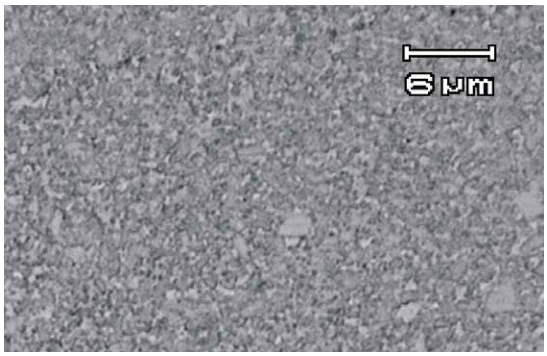
Explanation	Regarding abrasive wear, hardness is inversely related to wear amount. Outstanding improved hardness by special composition design.
Note	Attention to handling and processing because of lower fracture toughness than general cemented carbides physically.
Applications	Sandblasting nozzle, Power supply die for EDM, Water jet nozzle, Descaling nozzle, etc.

Physical properties of SS grade

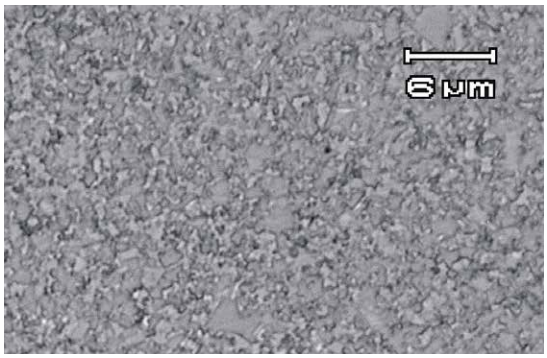
Our grade	WC grain size [μm]	Co content [%]	Density [×10³kg/m³] {g/cm³}	Hardness HV	TRS [GPa]
SS13	1.0 (less than)	1	14.2	2450	1.0
SS15	1.0 (less than)	4	14.6	2100	2.0
Reference G1	1.0 - 2.5	6	14.9	1750	2.0

(Typical figures)

Micrographs of SS grade



SS13



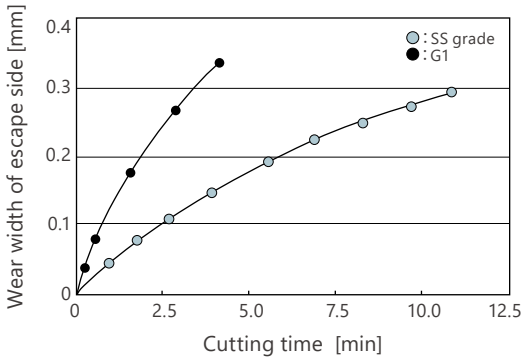
SS15

By metallurgical microscope (×1000)

Characteristic of wear-resistant

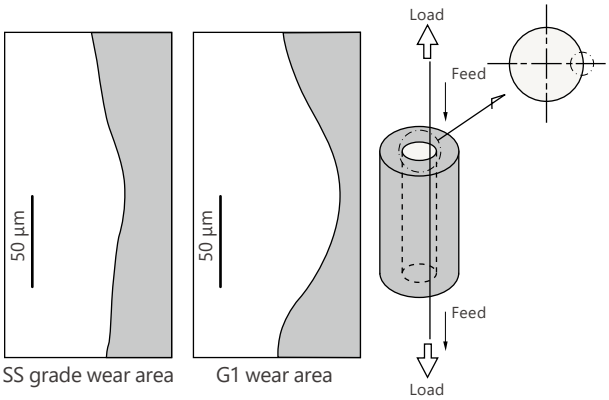
Blast wear of low pressure

Conducted carbon cutting test by SNGN120308 tip which is made from SS grade. Figure shows wear quantity of cutting part.



Rub wear with metal

Figure shows the inside of feed die by electric discharge machining using fine wire.



SS grade wear area G1 wear area

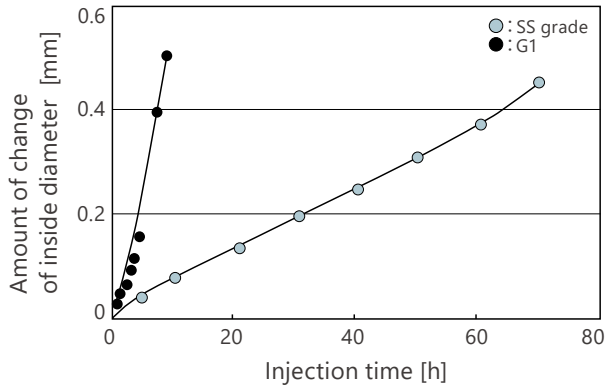
High wear-resistant cemented carbide - SS grade

Line up ... SS13, SS15

Characteristic of wear-resistant

Blast wear of high pressure

Figure shows life of blast nozzle injected under high pressure. (Injection pressure 245 MPa)



Blast wear of low pressure

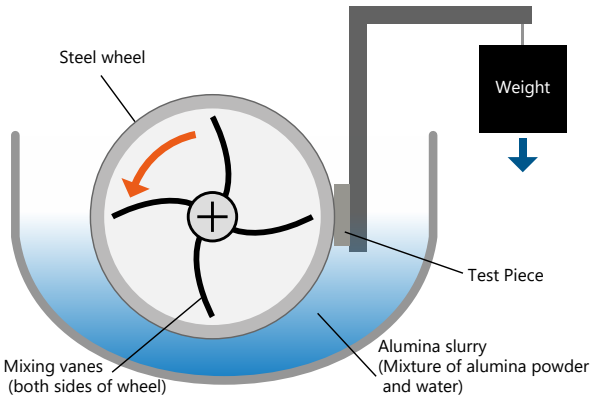
Photo shows the inside of blast nozzle after injected for eight hours running time.(Use the air pressure 1.3 MPa and alumina 10 - 50 μm. Nozzle diameter 7 mm.)

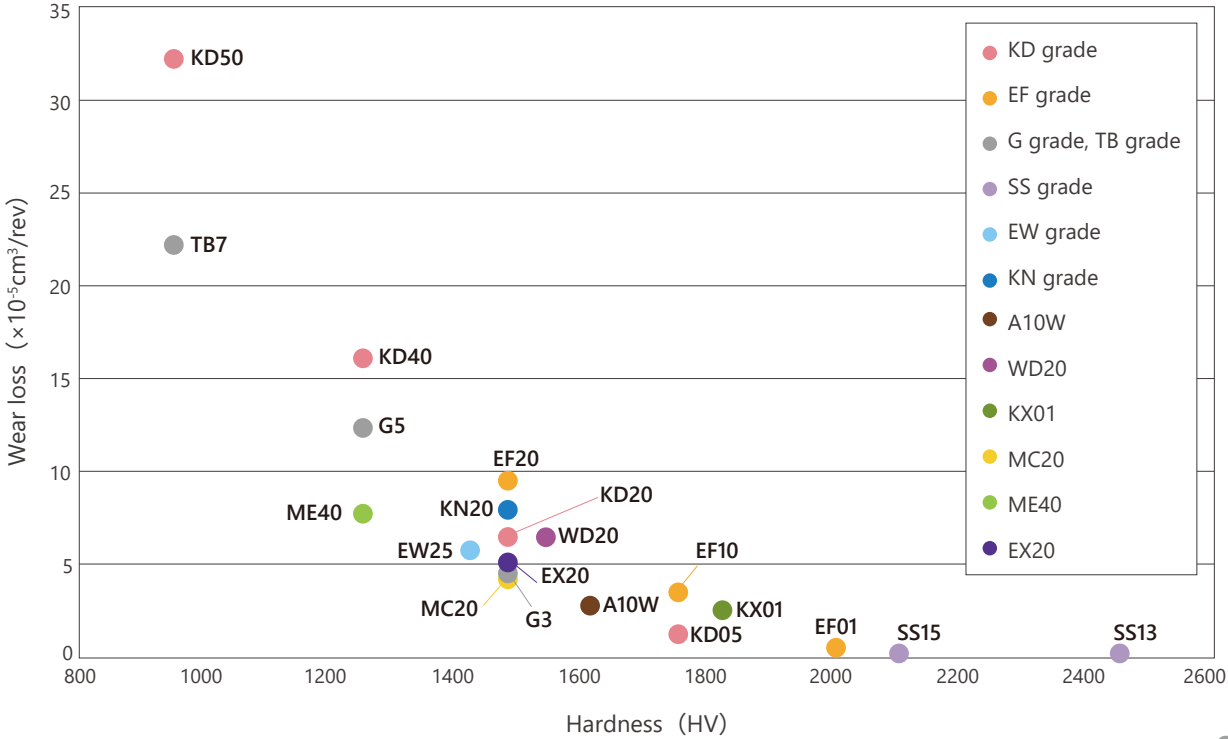
Grade	SS13	SiC (A's product)	ZrO_2 (B's product)
Nozzle entrance			
Nozzle exit			
Notes	No change	Entrance high worn,exit also worn	Overall wear, exit is large wear

ASTM B611 abrasive wear testing result

■ **Abrasion test conditions (in accordance with ASTM B611)**

Medium	Alumina powder (#30)
Slurry	Medium + water
Weight	5kgf (*Normally 10 kg, but changed due to euipment reasons)
Measurement time	10 minutes (1000 rotations)
Test Piece dimensions	10 mm × 8 mm ×24 mm
Wear loss formula	Wear loss = weight of wear loss/density/number of rotations



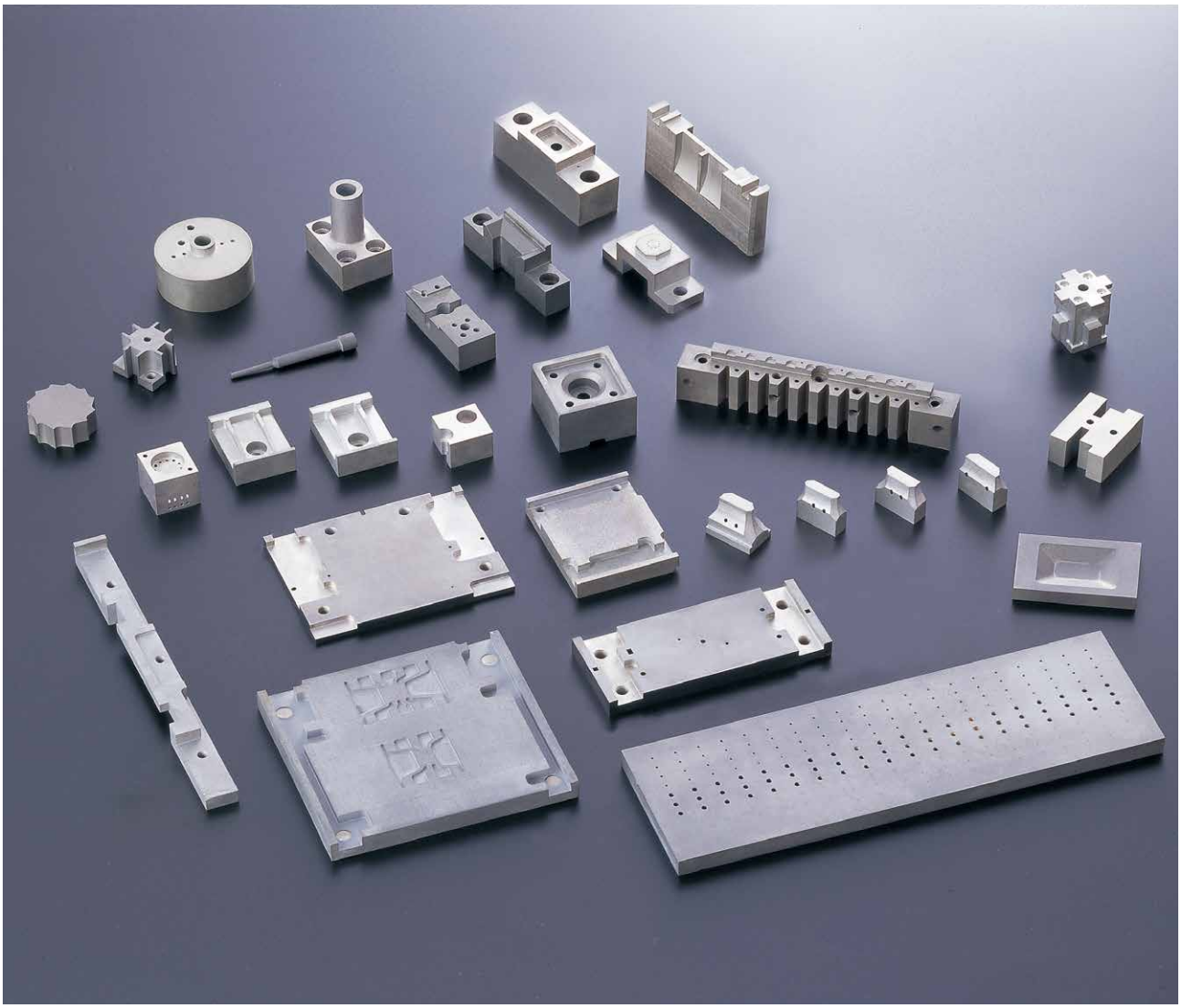


Cemented carbide products

EVERLOY has developed new grade of cemented carbide in various industries mainly wear-resistant tools and mold parts.

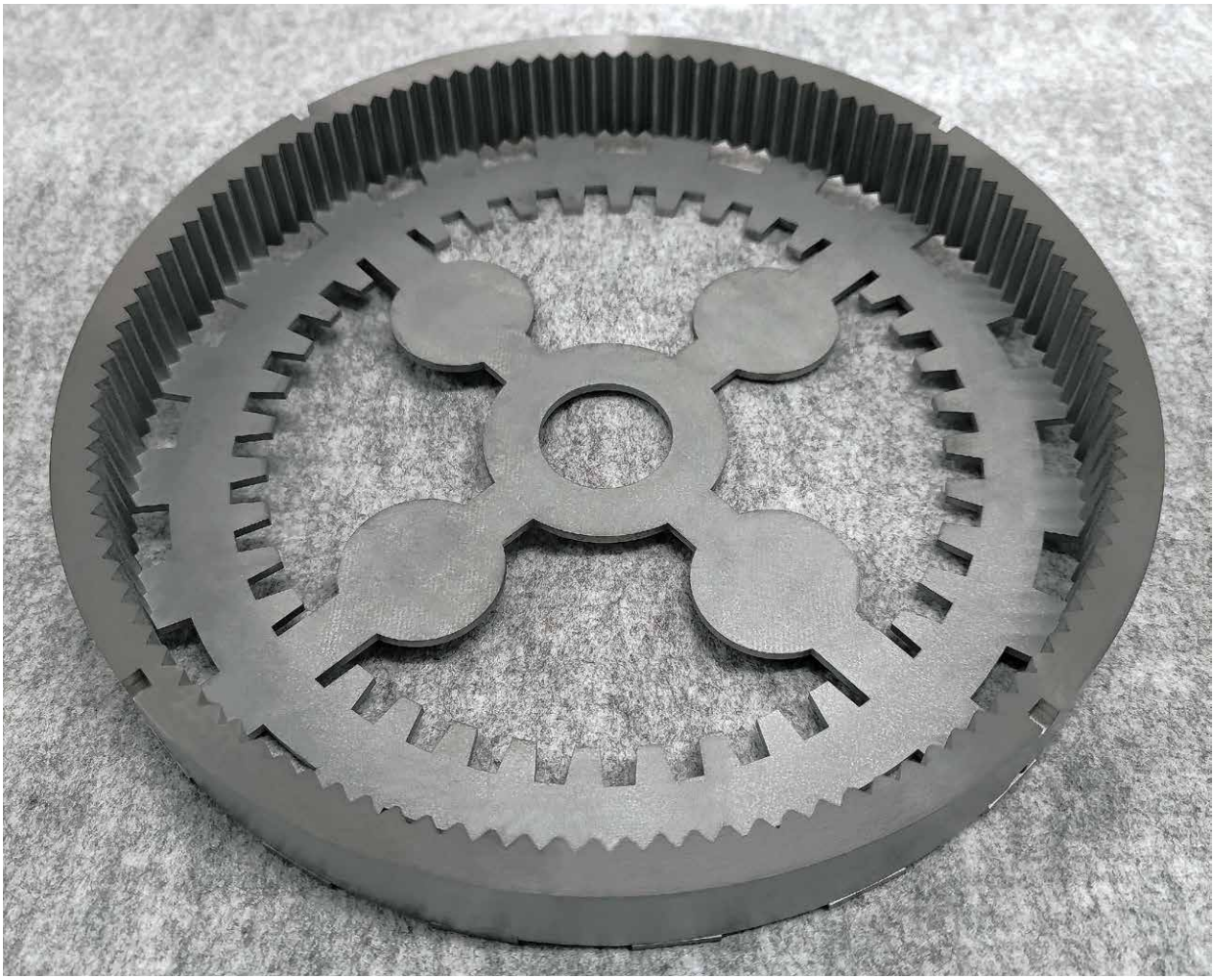
Preformed carbide which is complicate shape is available by processing before sintering.
It helps saving manufacturing time and cost.

Applications	Snapping, bending, spinning, powder compacting, cold/hot roller, header dies, impact dies, mechanical seal, chemical instrument parts, sealing mold for battery, powder compacting magnetic field mold, electronic device parts, abrasive nozzle and burst protector, etc.



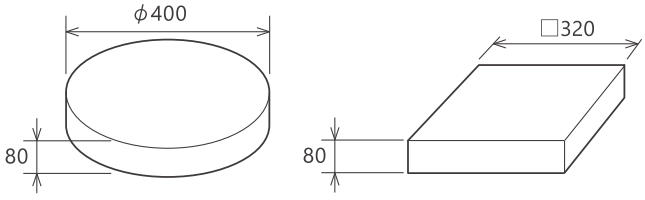
Large-size cemented carbide products

We can meet a wide variety of demand including larger-sized cemented carbide products.



■ Material size (Maximum)

Round shape	ϕ400 mm × 80 mm
Angle shape	320 mm × 320 mm × 80 mm



■ Supporting grades

KD20, KD30, KD40
G3, G4, G5
WD20
EW25

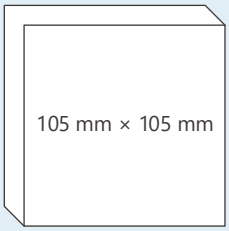
■ Applications

Motor core mold parts	Reduction of processing costs through integrated mold.
Powder-compacting mold	Cost reduction in production. (Multi-cavity mold)
Drawing dies	Long life of mold. (Improvement in adhesive wear resistance with cemented carbide instead of steel.)

Cemented carbide plate

Standard-sized plates (T × 105 mm × 105 mm)

Standard plate size is great for customer which considers cutting purchasing cost.



■ **Standard size**

105 mm × 105 mm with starting 2.2 mm thickness.

Realized cost cutting by optimizing manufacturing process.

*Correspond material : G3, G4 and KD20

Width × Length [mm]	Thickness [mm]	Our grade		
		G3	G4	KD20
105 × 105	2.2 $^{+0.1}_{-0}$	●	●	●
	3.2 $^{+0.1}_{-0}$	●	●	●
	4.2 $^{+0.1}_{-0}$	●	●	●
	5.2 $^{+0.1}_{-0}$	●	●	●
	6.2 $^{+0.1}_{-0}$	●	●	●
	7.2 $^{+0.1}_{-0}$	●	●	●
	8.2 $^{+0.1}_{-0}$	●	●	●
	9.2 $^{+0.1}_{-0}$	●	●	●
	10.2 $^{+0.1}_{-0}$	●	●	●
	12.2 $^{+0.1}_{-0}$	-	-	●
	15.2 $^{+0.1}_{-0}$	-	-	●
	20.2 $^{+0.1}_{-0}$	-	●	●

- 2-surface grinding.
- Multiple thickness of other than those above thickness are also in stock as requested.
- If standard-sized plates are urgently needed, please inquire about stock status.
- It is available to make any other materials and sizes upon request.

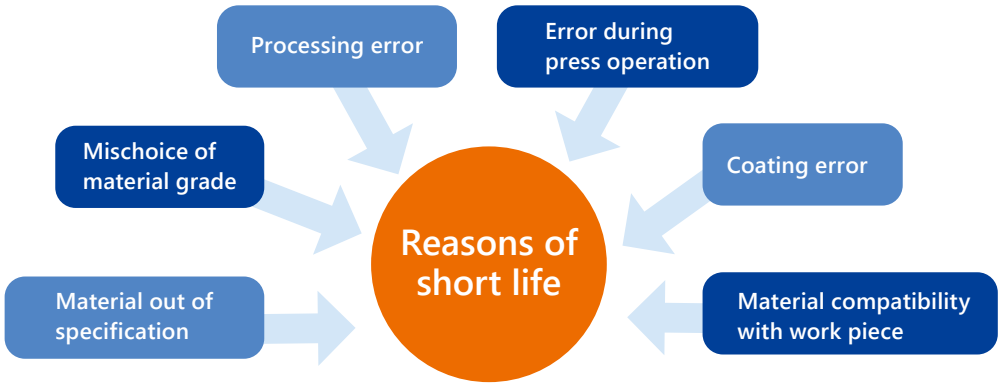
Properties inspection

Proposal skill and servicing

Proposal improving tool life by wide experience as cemented carbide manufacturer.

Features

- Propose in customer's shoes.
- Proper inspection service for non-EVERLOY products also, depending on the situation.
- Supply technical service.



EVERLOY keeps growing up with gaining experience with customer.

Excellent analytical faculty by using testing / analytical equipment

Stereoscopic microscope

Metallurgical microscope

Digital microscope

Scanning electron microscope

X-ray diffractometer

Precision processing technology

EVERLOY's processing technology has achieved success in various industries which are mainly mold industry demanding submicron precision.

EVERLOY processes precision parts of not only cemented carbide but also high hardness hardened steel, zirconia and alumina, etc. EVERLOY processes form requested regardless of round or square shape at material our customer demand due to excellent processing technology.

Explanation	EVERLOY processes with utilizing their characteristics of material. Brittle materials are unable to exercise original characteristics due to processing method.
Applications	Precision mold (cutting, bending, etc.), mold for powder compacting, motor, connector and IC leadframe and resin sealing manufacturing, etc. ■ Corresponding material Cemented carbide, zirconia, alumina, steel (SKD11, SKD61, DC53, SKH51, YXR3, YXR7, HAP40, HAP10, HAP72, HAP5R, MH85, PD613, SKS3, KD11-MAX, SLD-MAGIC, SNCM439, SNCM443, SCM415, SCM435, SS400, S45C, S50C, S55C, SK3, ASP23, ASP60, HPM1, HPM38, SUJ2, DEX40, CENA1, GO40F, NAK55, DH2F, DRM1, DRM3, SUS303, SUS304, SUS316, SUS440C) etc.

Ultra high-precision and high-speed micro fine machining center

Graphical profile grinding machine

Super precision high reciprocating forming grinder

Major processing equipment and inspection equipment (KYORITSU GOKIN CO., LTD.)

Extrude hone

CNC external cylindrical grinding machine

Machining center

Profile grinding machine

CNC 3D coordinate measurement machine

Contour measuring instrument

Major processing equipment and inspection equipment (KYORITSU GOKIN CO., LTD.)

Major processing equipment list

Surface grinding machine	12 units
External cylindrical grinding machine	11
CNC-external cylindrical grinding machine	6
Internal cylindrical grinding machine	10
CNC-internal cylindrical precision grinding machine	4
Honing machine	1
Wire EDM	4
Electric discharge machine	4
Small hole EDM	1
Profile grinding machine	9
Extrude Hone	1
Aero lapping machine	2
Machining center	3
Lathe	5
NC Lathe	3
Milling machine	1
High frequency induction heating equipment	1
Electric furnace	1
CNC-vertical-internal and external cylindrical grinding machine	1

Major inspection equipment list

Factory microscope	2 units
Electronic micrometer	1
Optical comparator	1
Data treatment system	1
Gauge	Many
Smart Scope	3
Contour measuring instrument	4
3D structural analysis	1
Laser marker	1
CNC-3D coordinate measuring machine	1
Roundness measuring machine	1

Die sinking electric discharge machine

Wire electrical discharge machine

Major processing equipment and inspection equipment (KYUSYU EVERLOY CO., LTD.)

Major processing equipment list

Profile grinding machine	11 units
Graphical profile grinding machine	1
Cylindrical grinding machine	3
External cylindrical grinding machine	1
Ultra precision composite small cylindrical grinding machine	1
Surface grinding machine	19
Ultra precision multi grinding machine	2
Ultra precision CNC molding grinding machine	1
Casting surface remover	1
Fine cutter	1
Table tap chamfering machine	1
Wire EDM	4
Lathe	1
Electric discharge machine	2
Small hole EDM	1
Aero lapping machine	1
Machining center	2
CNC milling machine	1
Chart drawing system(Plotter)	1
Electric furnace	2

Equipment for larger cemented carbide products

CNC Vertical multi-grinding machine	1
Surface grinding machine	1

Major inspection equipment list

Contour measuring instrument	1
Universal projector	1
Smart scope	2
Laser marker	1
Factory microscope	2
3D Laser Scanning Confocal Microscope	1
Gauge	Many

Large Wet Cold Isostatic press

Vacuum pressurization dewaxing-sintering furnace

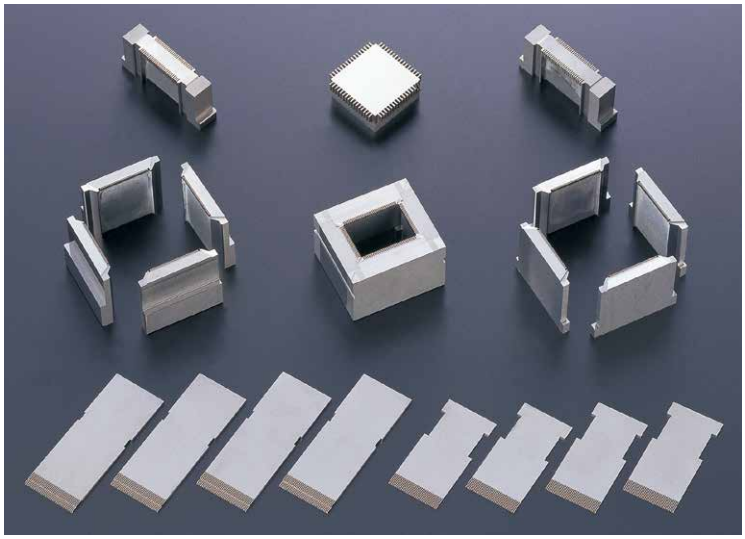
CNC vertical type lathe machine

Machining center

Cemented carbide precision mold parts (Bending and cutting)

Characteristics

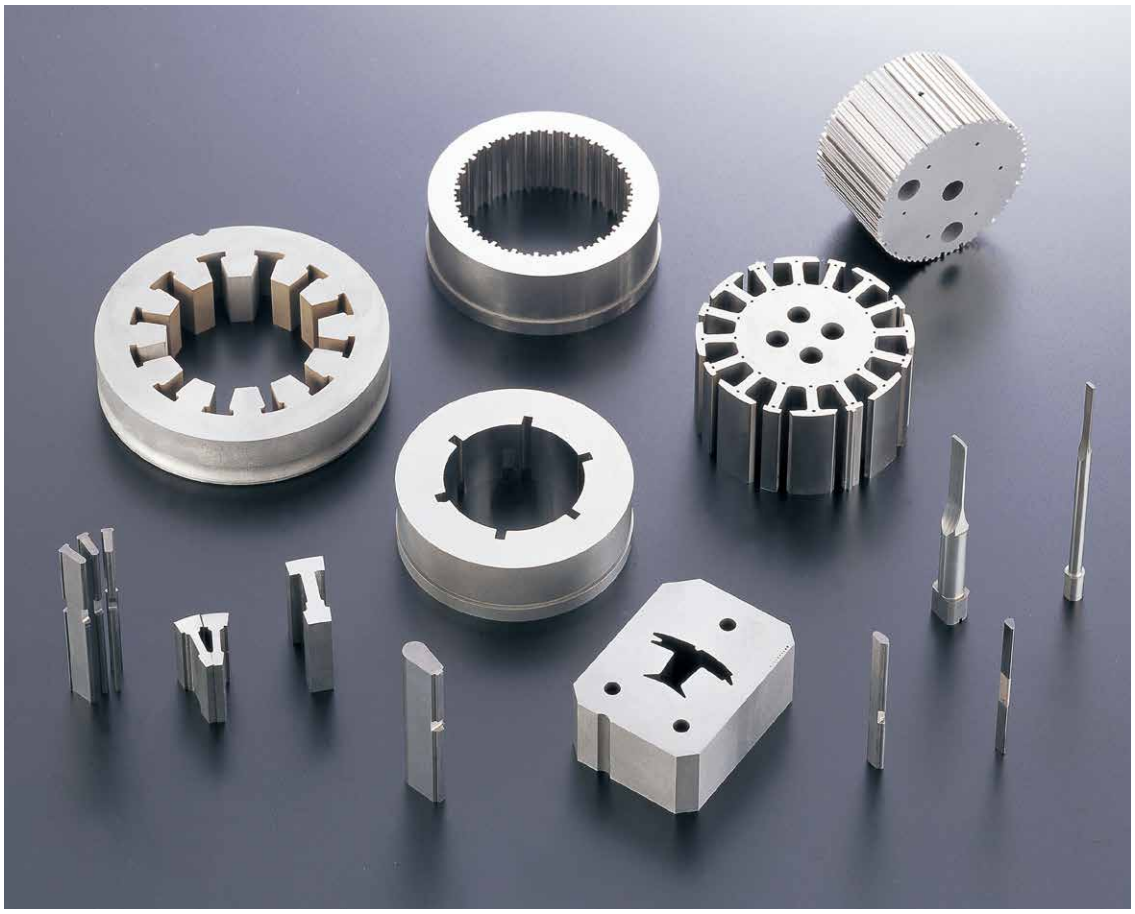
By grinding processes, sharper edges can be maintained.
Fine-pitch products are also available.



Cemented carbide precision mold parts (Motor core mold parts)

Characteristics

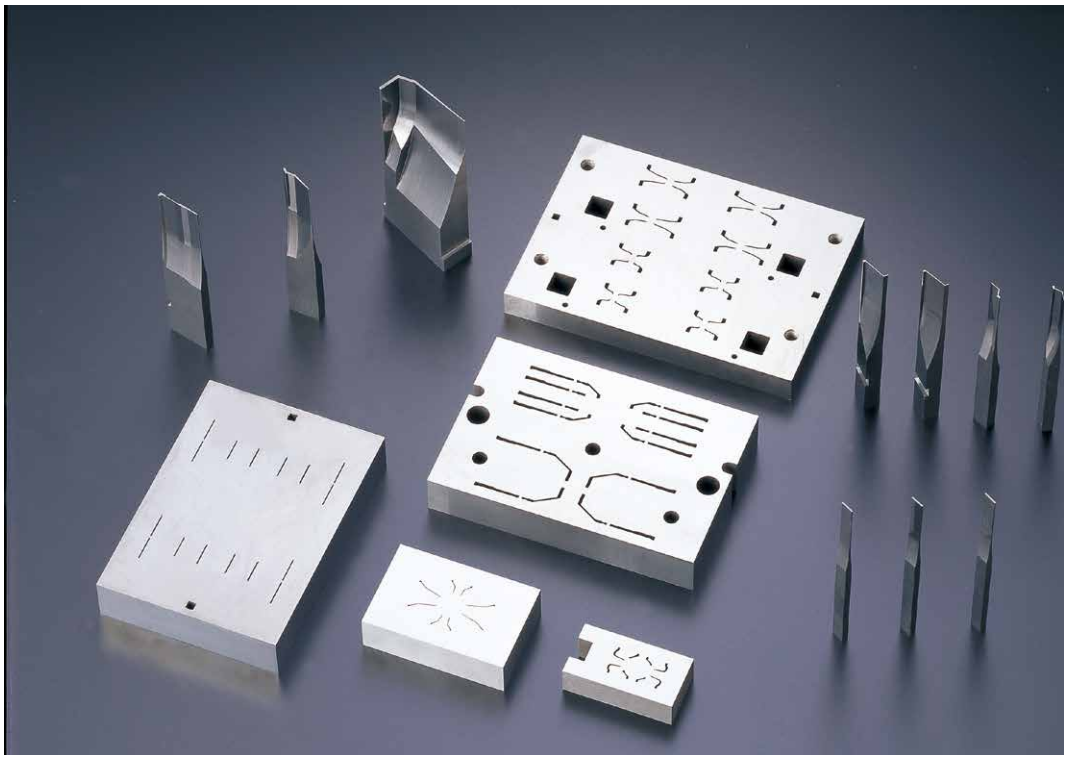
We can offer reasonable parts in using our own cemented carbide.



Cemented carbide precision mold parts (For IC leadframe)

Characteristics

Our abundant experiences allows us to make high precision parts.
We improve all products to better surface roughness by our own processes.



Cemented carbide precision mold parts (For IC packaging)

Characteristics

We use own designed equipment to produce high precision parts and extend their lifetimes.

Cemented carbide precision mold parts

Characteristics

We respond to quick delivery utilizing various plates in stock.

Please consult us on short lifetime issues of tools especially regarding stainless steel, copper, pure iron and nickel materials.

Powder compacting mold parts

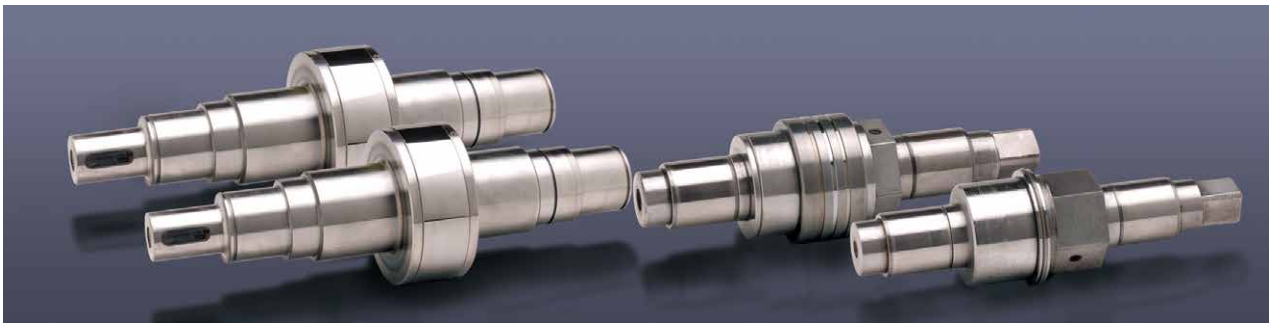
Characteristics

From our experience, we offer suitable material for powder compacting mold parts.
We also offer non-magnetic carbide for magnets.

Rolls

Characteristics

Considering the shape and size of the joining method of the cemented carbide and the steel material, we will manufacture a roll that adopts the optimum method.
We will respond to consultation on how to fit the cemented carbide part and case.



Ball header dies, Shear dies, Shear blade

Characteristics

Our own designed lapping machine makes high accurate spherical surface and extends tool life.

EVERLOY SPRAY NOZZLES

EVERLOY initially started to manufacture spray nozzles for steel industry utilizing our own cemented carbide. Currently, we are covering many industries all over the world through our continued efforts and technical developments.

EVERLOY Network

Everloy can act quickly on various kinds of customer needs such as quality assurance, fast delivery, and quality improvement as Everloy group covers whole manufacturing process.

KYORITSU GOKIN CO., LTD.

Head Office, Factory
Sales department /
Cemented carbide division Machining department

Kaibara Works
Cemented carbide division Alloy department

Subsidiary Company

KYUSYU EVERLOY CO., LTD.

Kaibara Works
Nozzle division

General Agent

EVERLOY SHOJI CO., LTD.

Osaka sales division

Tokyo branch office

Kyushu branch office

Kurashiki branch office

Global company activity to go for partnership and mutual prosperity

General Agent

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ISO9001/14001 certification
Rev. November 2021