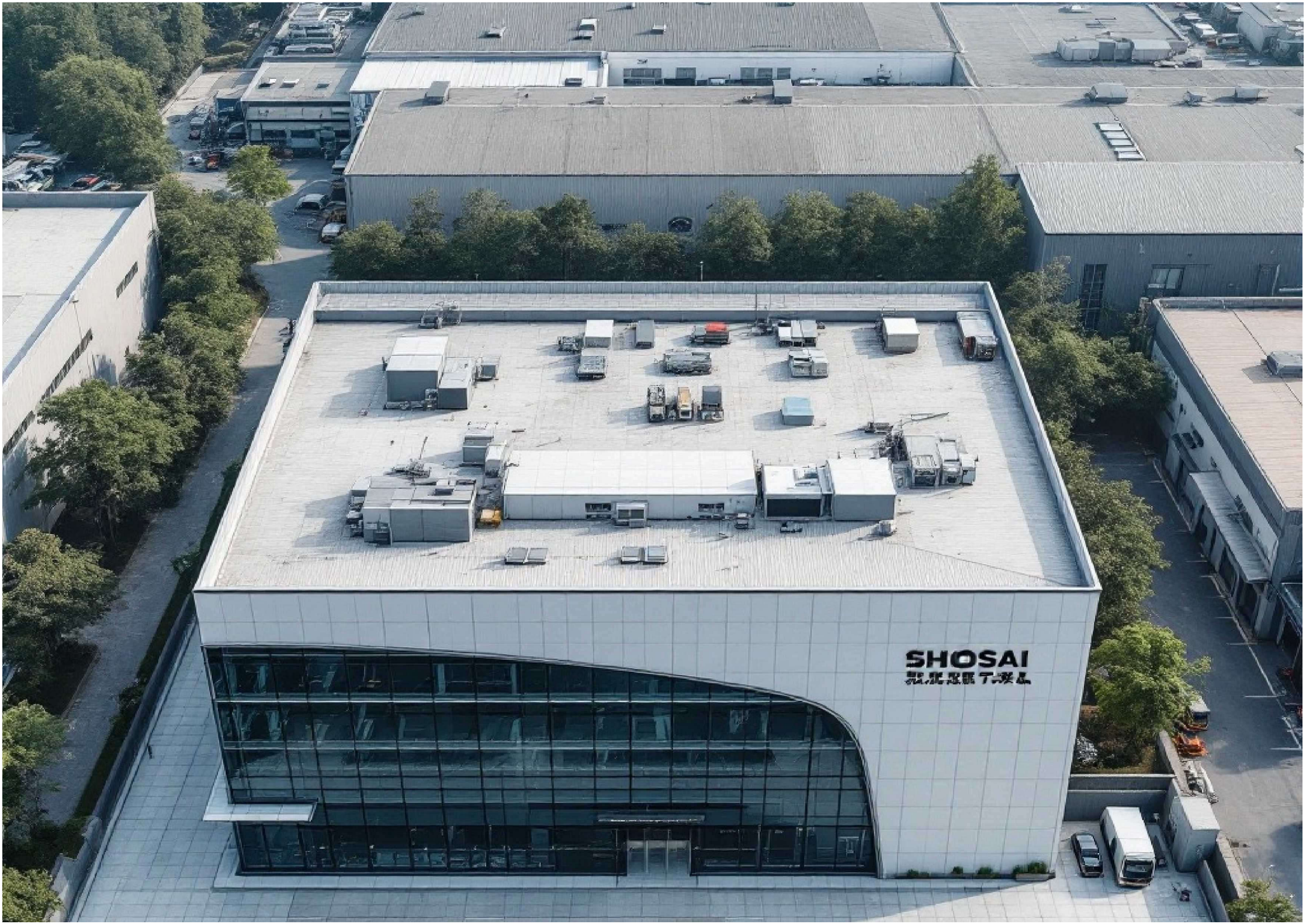

SHOSAI

High Quality Guarantee

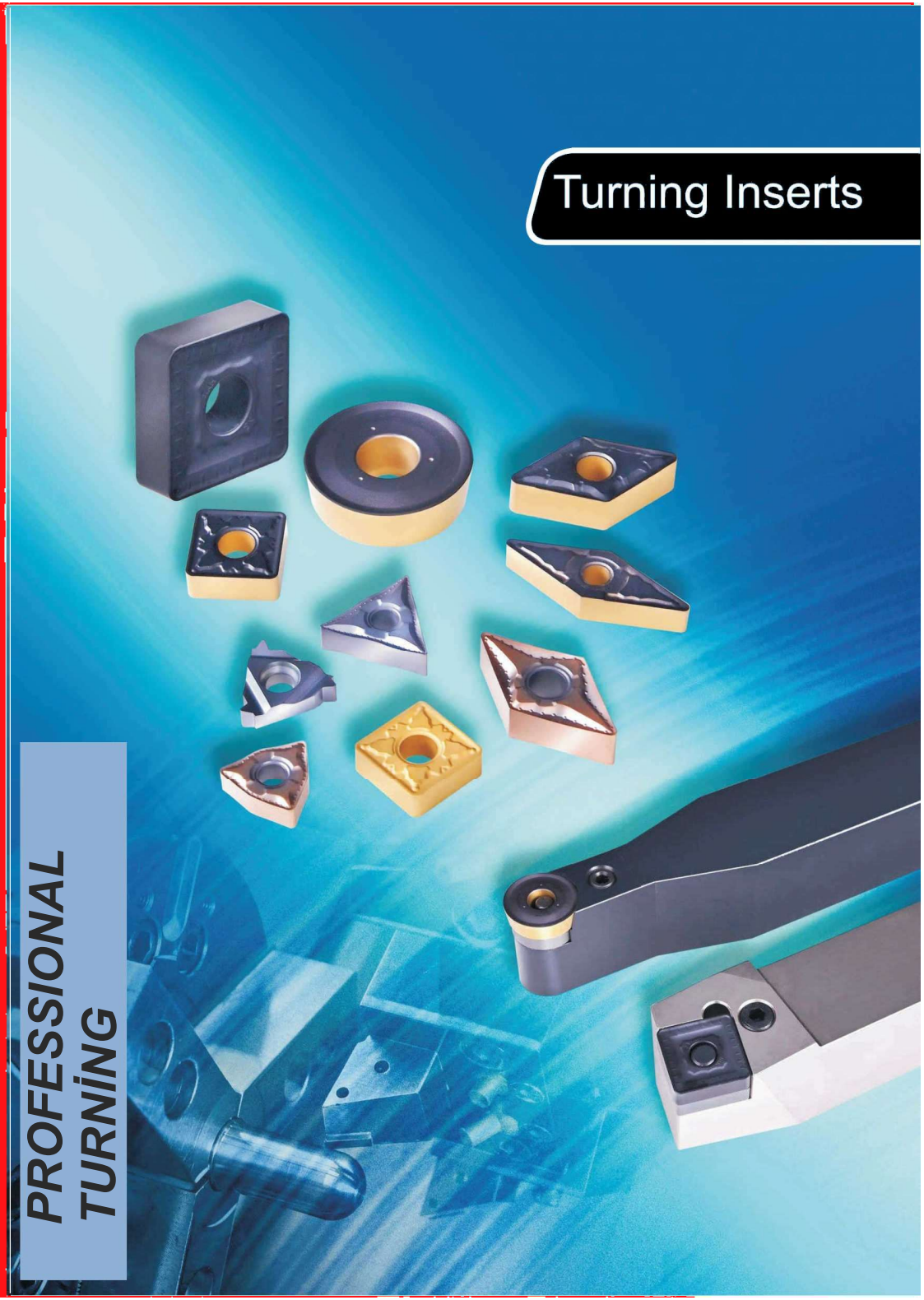
SHOSAİ

Shosai owns a complete CNC insert production line, including compound p reparation, mold making, deep processing, coating, etc., and committed to the R&D and application solutions of high-performan CNC blades.

Equipped with several world' precisio high-end equipment, OSTERWALDER multi-axis electric press, CNCperipheral grinde Balzers coating furnace, adopts automatic numerical control equipments for raw material preparation, pressing, sintering, coating and product inspection. Also has advanced equipments such as M kron machin ng center an Carl Zeiss CMM. At the same time, applys a variety of inte rnational leading coating processes and wor -class quality control system to ensure the same quality of each insert, provi customers with high-quality CNC blades and improve the production efficiency of users, and fully meet the market's high requirements for product quality.

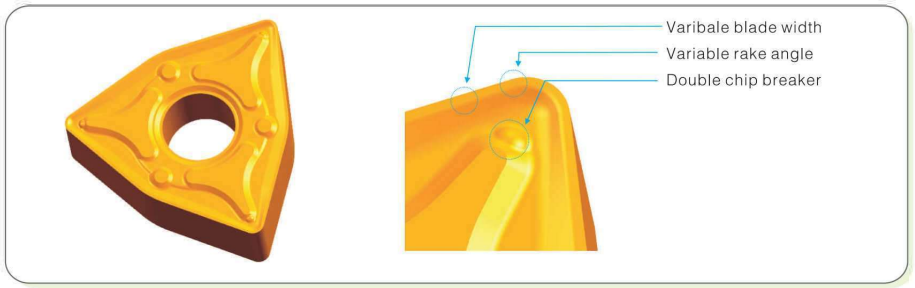
Contents

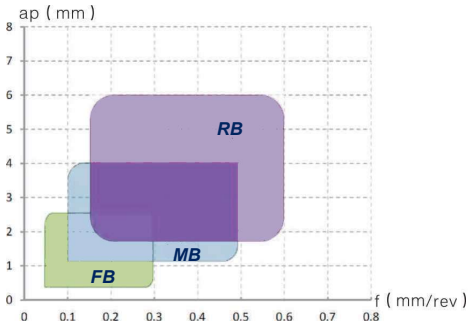
SHOSAI



❸ Chip Breaker Features of Stainless Steel Finishing -RB

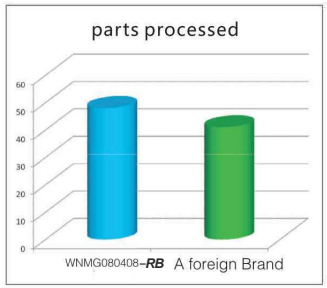
- Variable blade width and variable rake angle design, taking into account the sharpness and strength of the blad
- Large chip breaker and chip pocket design provides excellent chip breaking effect
- Double chip breaker design expands the backbreaking range.
- Suitable for semi-finishing to rough machining of stainless st





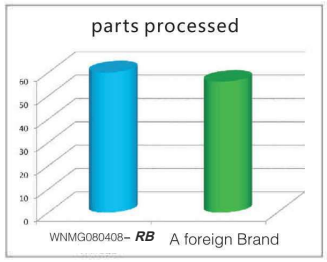
Case No.1

Workpiece material : stainless steel S US304
Workpiece: Flange
Cooling type : Fluid cool ing
Original blade :A foreign brand
Shosai insert: WNMG080408- RB SH2025M
Cutting parameter:Vc : 153m/m in , f:0 .2mm/rev , ap: 1-2mm
Conclusion : Used for boring , uneven cutting allowance , our inserts processed 48 pieces, a foreign brand processed 41 pieces, tooll increased by 17% ,and has the advantage of cost performance .



Case No.2

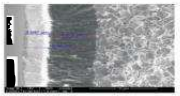
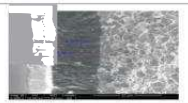
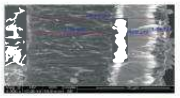
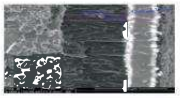
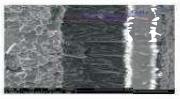
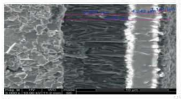
Workpiece material:stainless ste SUS304
Workpiece:Flange
Cooling type:Fluid cooling
Original blade:A foreign bran
Shosai insert:WNMG080408-RB **SH2025M**
Cutting parameter:Vc:170m/min , f:0.2mm/rev. ap:1-1.5mm
Conclusion: Processing stainless stee flange end face, our inserts processed 69 pieces, a foreign brand processed 56 pieces tool life incre by 23%. the advantage is obvious and the customer is very satisfied.



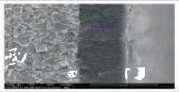
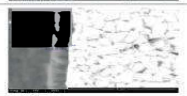
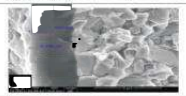
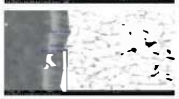
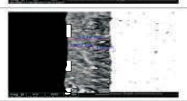
TURNING INSERT

A Turning Insert

The Features of CVD Coating

ISO	Grade	Colour	Coating Structure		Electron Microscopy Images	Features.Application
K Cast Iron	SH3020K	Black	$TiCN+Al_2O_3$			High hardness matrix, thinned CVD coating, excellent wear resistance.Milling gray cast iron and ductile iron under stable working conditions.
	SH3040K	Black	$TiCN+Al_2O_3$			High toughness matrix, thinned CVD coating, excellent resistance to chipping.Rough milling of cast iron, especially in harsh working conditions.
	SH3015K	Black	$TiCN+Al_2O_3$			Optimized and extremely wear-resistant material, nano thick film CVD coating.Continuous or light intermittent turning of gray cast iron and ductile iron.
P Steel	SH215	Yellow Black	$TiCN+Al_2O_3+$ (TiN)			Wear-resistant substrate with resistance to plastic deformation, strongand tough coating with excellent bonding force.High-speed, high-efficiency turning of finishing-roughing steel.
	SH225	Yellow Black	$TiCN+Al_2O_3+$ (TiN)			A matrix with both wear resistance and chipping resistance, and a toughcoating with excellent adhesion.The first choice for intermittent – general turning of steel.
	SH435	Yellow Black	$TiCN+Al_2O_3+$ (TiN)			High toughness matrix, strong and tough coating with excellentbonding force, extremely high processing safetyHeavy-duty machining of steel and interrupted turning.
	NEW SHP1015	Yellow Black	$TiCN+Al_2O_3+TiN$			High toughness matrix, strong and tough coating with excellent bonding strength, and extremely high processing safety.Heavy load machining and intermittent turning of steel parts.
	NEW SHP1025	Yellow Black	$TiCN+Al_2O_3+TiN$			Upgraded product performance, with a matrix that combines wear resistance and blade collapse resistance, and a strong and t[illegible] coating with excellent bonding strength, the resistance to plastic deformation and crescent pit wear is improved.Longer lifespan for intermittent-general turning steel parts, also for heavy-duty machining.

The Features of PVD Coating

ISO	Grade	Colour	Coating Structure		Electron Microscopy Images	Features.Application
P Steel	SH1115	Black	AlTiN			Submicron matrix resistant to abrasive wear and a coating with higher aluminum content.Stable milling of cast iron and steel parts.
	SH1125	Black	AlTiN			The Matrix balances hardness and toughness, and the coating with higher aluminum content.Suitable for general milling of cast iron, steel, and stainless steel, with high processing safety.
	SH2025+	Bronze	AlTiMeN			Ultra fine grain matrix, newly upgraded nano composite coating with high heat resistance and high toughness.Suitable for general milling of cast iron, steel, and stainless steel, with superior wear resistance.Additional grade for stainless steel turning.
M Stainless Steel	SHM2025	Bronze	AlTiMeN			Medium cobalt and ultra fine grain hard alloy matrix.High hardness nano composite PVD coating.The perfect fusion of high-strength, high toughness matrix and wear-resistant surface coating, comprehensive excellent performance.
	SHM2024	Bronze	AlTiMeN			Special ultra-fine grain matrix with enhanced toughness and red hardness, and the latest high wear-resistant coating.General high-performance machining for efficient milling of steel, stainless steel, and heat-resistant alloys, as well asfor stainless steel turning.
	SHM525	Purple Black	AlTiMeN			Nano multilayer coating with ultra-fine grain matrix, good wear resistance and oxidation resistance.Stable and long-life milling of steel and stainless steel.
	SH2025M	Bronze	AlTiMeN			Submicron matrix, newly upgraded nano composite coating with high heat resistance and toughness.Preferred grade for stainless steel turning, supplementary machining of softer steel.
S Heat Resistant Alloy		Bronze	AlTiSiN			Low cobalt, fine-grained wear-resistant and heat-resistant matrix.High hardness coatings deposited y high-energy pulse magnetron sputtering, with higher coating adhesion andHas good wear resistance and heat resistanceSuitable for high-temperaturealloy and titanium alloy turning, continuousandstableworking conditionsprocessing.
		Bronze	AlTiSiN			Superfine grain matrix reinforced with adhesive phase, excellent heat resistance and wear resistance.The high hardness coating deposited by HIPIMS has higher coating adhesion and good wear resistance and heat resistance Suitable for finishing – semi-finishing turning of heat-resistant alloysandhigh hardnessmaterials, and generalmilling.
		Purple Black	AlTiMeN			Superfine grain matrix optimized for heat resistance and toughness of heat-resistant alloys, with wear resistance and oxidation resistance Good nano multilayer coating. The preferred grade for general machining of heat-resistant alloys.
		Black	AlTiN			Specially reinforced super tough matrix, high aluminum coating, higher cost-effectiveness. Efficient rough milling for steam turbine blades, long-life dry cutting, and also suitable for heat resistance Alloy.

Recommended Turning Insert Grade

ISO		CVD			PVD		
K Cast Iron	01						
	10		SH3040K				
	20						
	30						
	40						
P Steel	01						
	10	SH215		SHP1015			
	20	SH225					
	30		SH435		SHP1025		
	40						
M Stainless Steel	01						
	10				SHM2025		
	20					SHM2024	SHM525 SH2025M
	30						
	40						
S Heat Resistant Alloy	01						
	10				SH605	SH610	
	20						SH824 SH525
	30						
	40						

General Turning Insert

Item No.	Application	Chipbreaker	Feature/Shape of Insert
1	Steel Finishing	FA	P-type Material Finishing
			M-level double-sided chipbreaker, two-stage bump effect for stable chip handling in a wide range of feeds.
2	Steel Semi-finishing	SA	P-type Material Semi-finishing
			M-level double-sided chipbreaker, negative chamfer design, high edge strength, suitable for semi-finishing occasions with unstable working conditions.
3	Steel Medium machining	MA	P-type Material Medium machining
			Low cutting resistance due to double-angle cutting edge design, variable width design for sharpness and strength.
4	Steel Roughing	GA	P-type Material Roughing
			The preferred chip breaker for lightload roughing, wide margin design, good edge strength, high metal removal rate, good wear resistance and cutting life.
5	Steel Heavy-duty	DM (Single Side)	P-type Material Heavy-duty
			M-level single-sided chipbreaker, negative chamfer design, under the large cutting depth and large feed processing parameters, high edge strength and high metal removal rate can be obtained.

A Turning Insert

General Turning Insert

Item No.	Application	Chipbreaker	Feature/Shape of Insert
6	Stainless steel finishing	FB	M type material finishing
			M-level double-sided chipbreaker, small edge width + double positive rake angle, sharp blade edge, low cutting resistance, special edge inclination design, can obtain high-quality machined surface.
7	Stainless steel semi-finishing	MG	M type material semi-finishing
			M-level double-sided chipbreaker, double positive rake angle, higher edge strength , widely application for the general processing of stainless steel.
8	Stainless steel roughing	RB	M type materail roughing
			M-level double-sided chipbreaker, variable blade width and variable rake angle design,suitable for semi-finishing and roughing of stainless steel
9	High temperature alloy semi-finishing	DM	S type material semi-finishing
			M-level double-sided chipbreaker.Adopting the double positive rake angle combines the sharpness and strength of the insert;the cutting resistance is small, and the wider chipbreaker ensures enough space for chip deformation,reducing groove wear.

Genera Inner Hole Turning Insert

Item No.	Application	Chipbreaker	Feature/Shape of Insert
10	General semi-finishing	MF	General chipbreaker
			M-level single-sided chipbreaker, suitable forsemi-finishing of inner holes and outer circles of P, M and K type materials
11	Stainless steel finishing	FG	M type material finishing
			M-level single-sided chipbreaker, suitable for innerhole and outer circle finishing of stainless steel.
12	High temperature alloy semi-finishing	MD	S type material finishing
			M-level single-sided chipbreaker, suitable for innerhole and outer circle semi-finishing of S type and M type material.

Special Turning Insert

Item No.	Application	Chipbreaker	Feature/Shape of Insert
13	Train wheel hub machining	175.32 series	Chipbreaker for finishing of P type materal
			M-level double-sided chipbreaker, vertical cutting inserts, especially suitable for the trimming of train wheels.
14		RCMX series	Chipbreaker for heavy-load machining of P type material
			M-level single-sided chipbreaker, negative chamfer design,high edge strength, first choice for profiling.

Recommendation of Inserts and Chip Breakers

Finishing						
	CNMG-FA	DNMG-FA	SNMG-FA	TNMG-FA	VNMG-FA	WNMG-FA
Length	09/12	11/15	12	16/22	16	06/08
Page	A-27	A-38	A-47	A-58	A-68	A-75
Finishing						
	CNMG-FB	DNMG-FB	SNMG-F	TNMG-FB	VNMG-FB	WNMG-F
Length	09/12	15	12	16	16	06/08
Page	A-32	A-42	A-52	A-62	A-71	A-79
Semi-finishing						
	CNMG-SA	CNMG-MA	CNMG-MG	CNMG-MC	CNMA	CNMG-DM
Length	12/16/19	12/16/19	12/16	12/16	12/16/19	12
Page	A-28	A-29	A-33	A-35	A-36	A-37
Semi-finishing						
	DNMG-SA	DNMG-MA	DNMG-MG	DNMG-MC	DNMG-DM	SNMG-AS
Length	15	15	15	15	15	12/15
Page	A-39	A-40	A-43	A-45	A-46	A-48
Semi-finishing						
	SNMG-MA	SNMG-MB	SNMG-MC	SNMA	SNMG-DM	TNMG-SA
Length	12/15	12/15	12/16	12/15/19	12/15	16/22
Page	A-49	A-53	A-55	A-56	A-57	A-59

Semi-finishing						
	TNMG-MA	TNMG-MG	TNMG-MC	TNMA	VNMG-SA	VNMG-MA
Length	16/22	16/22	16	16/22	11/16	11/16
Page	A-60	A-63	A-65	A-66	A-69	A-70
Semi-finishing						
	VNMG-MC	WNMG-SA	WNMG-MA			
Length	16	08	08			
Page	A-73	A-76	A-77			
Roughing						
	WNMG-MG	WNMG-MC	WNMA 08	WNMG-DM	CNMG-GA	CNMG-RB
Length	06/08	06/08	A-83	08	12/16/19	12/16
Page	A-80	A-82		A-84	A-30	A-34
Roughing						
	DNMG-GR	DNMG-RB	SNMG-GA	SNMG-RB		
Length	15	15	12/15/19	12/ 5		
Page	A-41	A-44	A-50	A-54		
Heavy-duty						
	TNMG-GR	TN G-RB	WNMG-GA	WNMG-RB	CNMM-DM	
Length	16/22	16/22	06/08	06/08	19/25	
Page	A-61	A-64	A-78	A-81	A-31	

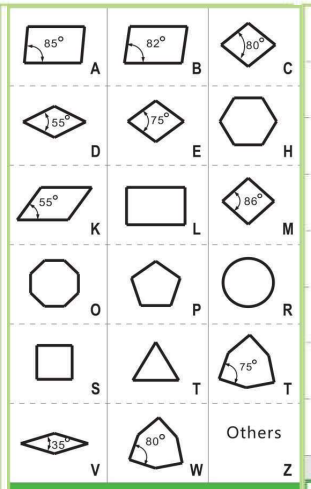
Recommendation of Inserts and Chip Breakers

Semi-finishing						
	SNMM-DM	CCMT-MG	DCMT-MG	SCMT-MG	TCMT-MG	
Length	19/25	06/09/12	07/11	09/12	09/11/16	
Page	A-51	A-85	A-87	A-89	A-91	
M Finishing						
	CCMT-FG	DCMT-FG	SCMT-FG	TCMT-FG		
Length	06、09	07、11	09	09、11、16		
Page	A-86	A-88	A-90	A-92		
NEW Small Parts Machining						
	TNGG-SF	VNGG-SF	DCGT-SF	VBGT-SF	VCGT-SF	
Length	11	16	11	11	11	
Page	A-94	A-95	A-96	A-97	A-98	
GRINDED Small Parts Machining						
	CCGT-FU	DCGT-FU	TCGT-FU	VCGT-FU		
Length	09	07、11	11	08、11		
Page	A-99	A-100	A-10	A-102		
GRINDED Small Parts Machining						
	TNGG-F	TNGG-M	TPGH			
Length	16	16	08、09、11			
Page	A-103	A-104	A-105			

High temperature alloy Semi-finishing						
	CCMT-MD	DCMT-MD	SCMT-MD	TCMT-MD		
Length	12	07、11	09	11		
Page	A-10	A-10	A-108	A-109		
Train Wheel Hub Machining						
	RCMX	175.32-22	175.32-24	175.32-28		
Length	08-32	19	19	19		
Page	A-110	A-111	A-112	A-113		
NEW Parting and Grooving						
	SDC	SDJ	SDT	SDB	MGGN-	MRMN-M
Length	2.0-5.0	2.0-5.0	3.0-6.0	3.0-6.0	2.0- .0	2.0- 0
Page	A-117	A-118	A-119	A-12	A-121	A-122
GRINDED Grooving						
	TGF32R/L	GBA43R/L	TKF12R/L	TKF16R/L		
Length	1.1-3.0	1.25-3.0	0.5-2.0	1.5-2.0		
Page	A-124	A-125	A-127	A-128		

Turning Insert Code Key

1.Shape



4.Chip Breaker and Hole

Code	Center Hole	Chip Breaker	Insert Profile	Code	Center Hole	Chip Breaker	Insert Profile
B	Y	N	>65°	N	N	N	
H	Y	Single	>65°	R	N	Single	
C	Y	N	>65°	F	N	Double	
J	Y	Double	>65°	A	Y	N	
W	Y	N	≤65°	M	Y	Single	
T	Y	Single	≤65°	G	Y	Double	
Q	Y	N	≤65°	X	---	---	Special Type
U	Y	Double	≤65°				

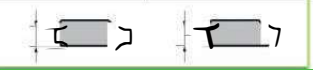
Inscribed Circle diameter (mm)	C	D	R	S	T	V	W	K
32.00			32					
31.75			31	32				
25.40			25	25				
25.00	25	25	25					
20.00			20					
19.05	19		19	19	33			
16.00		19	16					
15.875	16		15	15	27			
12.70	12	15	12	12	22	22	08	
12.00			12					
10.00			10					
9.525	09	11	09	09	16	16	06	16
8.00			08					
6.35	06	07			11	11		
6.00			06					
5.56					09			
5.50			05					
3.97					06			

Insert Shape

5.Cutting Edge Length

6.Thickness

Code	Thickness(mm)
12	12.70
10	11.11
T9	9.72
09	9.52
07	7.94
T6	6.75
06	6.35
05	5.56
T4	4.96
04	4.76
T3	3.97
03	3.18
T2	2.78
02	2.38
T1	1.98
01	1.59
T0	0.99
00	0.79



C N M G

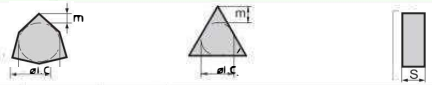
12 04 12 - SA (ISO)

4 4 3 (Inch)

2.Clearance Angle

Code	Clearance Angle	Code	Clearance Angle
A	3°	B	5°
C	7°	D	15°
E	20°	F	25°
G	30°	N	0°
P	11°	O	Others

3.Tolerance



Code	m(mm)	d=I.C	S(mm
A	±0.005	±0.025	±0.025
F	±0.005	±0.013	±0.025
C	±0.013	±0.025	±0.025
H	±0.013	±0.013	±0.025
E	±0.025	±0.025	±0.025
G	±0.025	±0.025	±0.13
J	±0.005	±0.05-±0.13	±0.025
K	±0.013	±0.05-±0.13	±0.025
L	±0.025	±0.05-±0.13	±0.025
M	±0.08-±0.18	±0.05-±0.13	±0.13
N	±0.08-±0.18	±0.05-±0.13	±0.025
U	±0.13-±0.38	±0.08-±0.25	±0.13

Inscribed Circle	Regular Triangle	Square	80° Rhombus	55° Rhombus	35° Rhombus	
6.35	±0.08	±0.08	±0.08	±0.11	±0.16	---
9.525	±0.08	±0.08	±0.08	±0.11	±0.16	---
12.7	±0.13	±0.13	±0.13	±0.15	---	---
15.875	±0.15	±0.15	±0.15	±0.15	±0.18	---
19.05	±0.15	±0.15	±0.15	±0.15	±0.18	---
25.4	---	±0.18	---	---	---	---

*Tolerance of Inscribed Circle(mm)

Inscribed Circle	Regular Triangle	Square	80° Rhombus	55° Rhombus	35° Rhombus	
6.35	±0.05	±0.05	±0.05	±0.05	±0.05	---
9.525	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05
12.7	±0.08	±0.08	±0.08	±0.08	---	±0.08
15.875	±0.10	±0.10	±0.10	±0.10	---	±0.10
19.05	±0.10	±0.10	±0.10	±0.10	---	±0.10
25.4	---	±0.13	---	---	---	±0.13

5.Inscribed Circle

Code	Inscribed Circle diameter(mm)
2	6.35
3	9.525
4	12.7
5	15.875
6	19.05
8	25.4

6.Thickness

Code	Thickness (mm)
2	3.18
3	4.76
4	6.35
5	7.94
6	9.52

7.Corner Radius

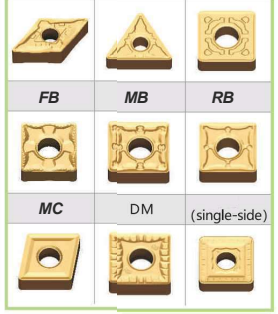
Code	Corner Radius (mm)
0	0.2
1	0.4
2	0.8
3	1.2
4	1.6
5	2.0
6	2.4

7.Corner Radius

Code	Corner Radius (mm)
00	---
02	0.2
04	0.4
08	0.8
12	1.2
16	1.6
20	2.0
24	2.4
32	3.2
X	---
Insert Diameter (Metric)	Circle Insert

8.Chip Breaker

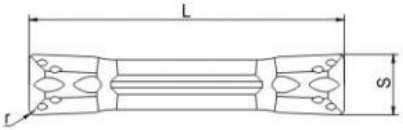
FA	SA	GA
FB	MB	RB
MC	DM	(single-side)



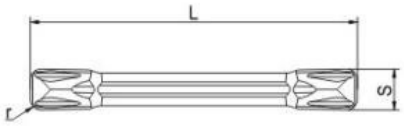
SHOSAI

Parting Grooving Tools

SHOSAI

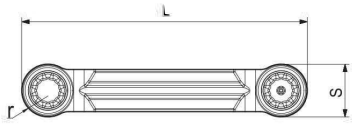


	Type 型号	Dimension(mm) 基本尺寸			Coated Grade 涂层牌号									Uncoated Grade 非涂层牌号			
		S	R	L		SH1125		SH2025+									
	MGMN200-M	2.0	0.2	16.0		•		•									
	MGMN250-M	2.5	0.2	18.5		•		•									
	MGMN300-M	3.0	0.4	21.0		•		•									
	MGMN400-M	4.0	0.4	21.0		•		•									
	MGMN500-M	5.0	0.8	26.0		•		•									
	MGMN600-M	6.0	0.8	26.0		•		•									



	Type 型号	Dimension(mm) 基本尺寸			Coated Grade 涂层牌号									Uncoated Grade 非涂层牌号			
		S	R	L		SH1125		SH2025+									
	MGMN150-G	1.5	0.2	16.0		•		•									
	MGMN200-G	2.0	0.2	16.0		•		•									
	MGMN250-G	2.5	0.2	18.5		•		•									
	MGMN300-G	3.0	0.4	21.0		•		•									
	MGMN400-G	4.0	0.4	21.0		•		•									
	MGMN500-G	5.0	0.8	26.0		•		•									
	MGMN600-G	6.0	0.8	26.0		•		•									

Parting and Grooving Inserts



Width	Size(mm)		
	S	r±0.1	L
300	3.0	1.5	21
400	.0	2	21
500	5.0	2.5	26
600	6.0	3	26

Shape	Type	f (mm/rev)	Grade											
			CVD						PVD					
							SHP1025			SH4025+	SH2025+			
	MRMN 300	0.05-0.18					●		○	●	●			
	MRMN 400	0.07-0.25					●		○	●	●			
	MRMN 500	0.08-0.3					●		○	●	●			
	MRMN 600	0.09-0.35					●		○	●	●			

Note: ●Recommended grade ready to stock

Parting and Grooving Inserts

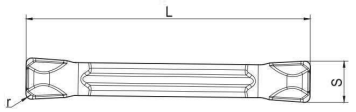
Naming Rules

Code	Width (mm)
500	5.0
400	4.0
300	3.0
200	2.0

4.Cutting Edge Width

A Turning Insert

Parting and Grooving Inserts



Width	Size(mm)		
	S	r±0.1	L
200	2.0	0.2	20
300	3.0	0.4	20
400	4.0	0.4	20
500	5.0	0.4	25

Shape	Type	f (mm/rev)	Grade											
			CVD						PVD					
							SHP1025			SH4025+	SH2025+			
 NEW	SDC 200	0.05–0.18					●			●	●			
	SDC 300	0.07–0.25					●			●	●			
	SDC 400	0.08–0.30					●			●	●			
	SDC 500	0.09–0.35					●			●	●			

Note: ●Recommended grade ready to stock

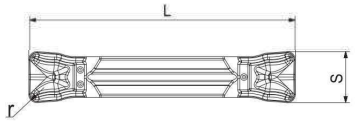
Parting and Grooving Inserts

Width	Size(mm)		
	S	r±0.1	L
200	2.0	0.2	20
300	3.0	0.4	20
400	4.0	0.4	20
500	5.0	0.4	25

Shape	Type	f (mm/rev)	Grade											
			CVD						PVD					
							SHP1025		SH4025+	SH2025+				
 NEW	SDJ 200	0.04-0.12					●		●	●				
	SDJ 300	0.04-0.16					●		●	●				
	SDJ 400	0.05-0.18					●		●	●				
	SDJ 500	0.05-0.20					●		●	●				

Note: ●Recommended grade ready to stock

Parting and Grooving Inserts



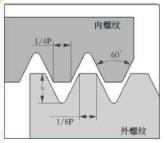
Width	Size(mm)		
	S	r±0.1	L
300	3.0	0.4	21.1
400	4.0	0.8	26.4
500	5.0	0.8	27.2
600	6.0	0.8	27.5

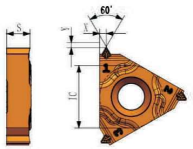
Shape	Type	f (mm/rev)	Grade											
			CVD						PVD					
							SHP1025		SH4025+	SH2025+				
	SDT 300	0.05-0.18					●		●	●				
	SDT 400	0.07-0.25					●		●	●				
	SDT 500	0.08-0.3					●		●	●				
	SDT 600	0.09-0.35					●		●	●				

Note: ●Recommended grade ready to stock

A Turning Insert

ISO Metric Thread



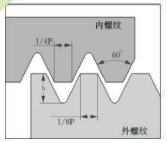


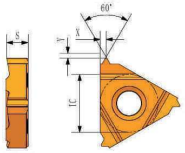
Standard:R262(DIN 13) Tolerance Class:6g/6H ★With End

Shape	Type	Range of Thread Pitch		Insert Dimestions(mm)				Coating	
		mm	pitch/inch	IC	S	X	Y	SH2025+	
	16ER1.00ISO-AC	1		9.525	3.52	0.7	0.6	●	
	16ER1.25ISO-AC	1.25		9.525	3.52	0.9	0.7	●	
	16ER1.50ISO-AC	1.5		9.525	3.52	1	0.8	●	
	16ER1.75ISO-AC	1.75		9.525	3.52	1.1	0.9	●	
	16ER2.00ISO-AC	2		9.525	3.52	1.2	0.9	●	
	16ER2.50ISO-AC	2.5		9.525	3.52	1.5	1.1	●	
	16ER3.00ISO-AC	3		9.525	4.65	1.7	1.2	●	
	16IR1.00IS -AC	1		9.525	3.52	0.7	0.6	●	
	16IR1.25ISO-AC	1.25		9.525	3.52	0.8	0.6	●	
	16IR1.50IS -AC	1.5		9.525	3.52	0.9	0.7		
	16IR1.75IS -AC	1.75		9.525	3.52	1	0.8	●	
	16IR2.00IS -AC	2		9.525	3.52	1.1	0.8	●	
	16IR2.50ISO-AC	2.5		9.525	3.52	1.4	1	●	
	16IR3.00ISO-AC	3		9.525	4.65	1.5	1.		

Note: ●Recommended grade ready to stock

ISO Metric Thread



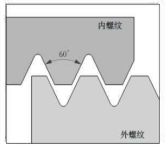


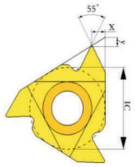
Standard:R262(DIN 13) Tolerance Class:6g/6H ★With End

Shape	Type	Range of Thread Pitch		Insert Dimestions(mm)				Coating	
		mm	pitch/inch	IC	S	X	Y	SH2025+	
	16ER1.00ISO-G	1		9.525	3.52	0.7	0.6	●	
	16ER1.25ISO-G	1.25		9.525	3.52	0.9	0.7	●	
	16ER1.50ISO-G	1.5		9.525	3.52	1	0.8	●	
	16ER1.75ISO-G	1.75		9.525	3.52	1.1	0.9	●	
	16ER2.00ISO-G	2		9.525	3.52	1.2	0.9	●	
	16ER2.50ISO-G	2.5		9.525	3.52	1.5	1.1	●	
	16ER3.00ISO-G	3		9.525	4.65	1.7	1.2	●	
	22ER3.50ISO-G	3.5		12.7	4.65	2.3	1.6	●	
	22ER4.00ISO-G	4		12.7	4.65	2.3	1.6	●	
	22ER4.50ISO-G	4.5		12.7	4.65	2.4	1.		
	22ER5.00ISO-G	5		12.7	4.65	2.5	1.7	●	
	11IR1.00IS -G	1		6.35	3.05	0.7	0.6	●	
	11IR1.25ISO-G	1.25		6.35	3.05	0.9	0.8	●	
	11IR1.50IS -G	1.5		6.35	3.05	1	0.8	●	
	11IR1.75ISO-G	1.75		6.35	3.05	1.1	0.9	●	
	11IR2.00ISO-G	2		6.35	3.05	1.1	0.9	●	
	16IR1.00ISO-G	1		9.525	3.52	0.7	0.6	●	
	16IR1.25ISO-G	1.25		9.525	3.52	0.8	0.6	●	
	16IR1.50ISO-G	1.5		9.525	3.52	0.9	0.7	●	
	16IR1.75ISO-G	1.75		9.525	3.52	1	0.8	●	
	16IR2.00ISO-G	2		9.525	3.52	1.1	0.8	●	
	16IR2.50ISO-G	2.5		9.525	3.52	1.4	1	●	
	16IR3.00ISO-G	3		9.525	4.65	1.5	1		
	22IR3.50ISO-G	3.5		12.7	4.65	2.3	1.6	●	
	22IR4.00ISO-G	4		12.7	4.65	2.3	1.6	●	
	22IR4.50ISO-G	4.5		12.7	4.65	2.4	1.7	●	
	22IR5.00ISO-G	5		12.7	4.65	2.5	1.7	●	

Note: ●Recommended grade ready to stock

55°/60°Gener l Pitch Thread





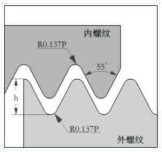
★Without End

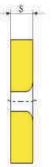
Shape	Type	Range of Thread Pitch		Insert Dimestions(mm)				Coating
		mm	pitch/inch	IC	S	X	Y	SH2025+
	16ERA55	0.5-1.5	48-16	9.525	3.52	0.9	0.8	●
	16ERAG55	0.5-3.0	48-8	9.525	3.52	1.7	1.2	●
	16ERG55	1.75-3.0	14-8	9.525	3.52	1.7	1.2	●
	22ERN55	3.5-5.0	7-5	12.7	4.65	2.5	1.7	●
	11IRA55	0.5-1.5	48-16	6.35	3.52	0.9	0.8	●
	16IRA55	0.5-1.5	48-16	9.525	3.52	0.9	0.8	●
	16IRAG55	0.5-3.0	48-8	9.525	3.52	1.7	1.2	●
	16IRG55	1.75-3.0	14-8	9.525	3.52	1.7	1.2	●
	22IRN55	3.5-5.0	7-5	12.7	4.65	2.5	1.7	●

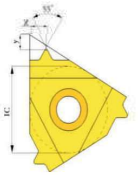
Shape	Type	Range of Thread Pitch		Insert Dimestions(mm)				Coating
		mm	pitch/inch	IC	S	X	Y	SH2025+
	16ERA60	0.5-1.5	48-16	9.525	3.52	0.9	0.8	●
	16ERAG60	0.5-3.0	48-8	9.525	3.52	1.7	1.2	●
	16ERG60	1.75-3.0	14-8	9.525	3.52	1.7	1.2	●
	22ERN60	3.5-5.0	7-5	12.7	4.65	2.5	1.7	●
	11IRA60	0.5-1.5	48-1	6.35	3.52	0.9	0.8	●
	16IRA60	0.5-1.5	48-16	9.525	3.52	0.9	0.8	●
	16IRAG60	0.5-3.0	48-8	9.525	3.52	1.7	1.2	●
	16IRG60	1.75-3.0	14-8	9.525	3.52	1.7	1.2	●
	22IRN60	3.5-5.0	7-5	12.7	4.65	2.5	1.7	●

Note: ●Recommended grade ready to stock

Whitworth Thread







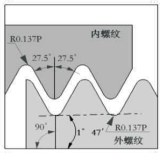
Standard:B.S.84: 1956, DIN259, ISO288/1:1982
Tolerance class: Medium class A

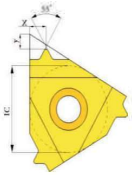
★With End

Shape	Type	Range of Thread Pitch		Insert Dimestions(mm)				Coating
		mm	pitch/inch	IC	S	X	Y	SH2025+
	16ER8W		8	9.525	3.52	1.5	1.2	●
	16ER9W		9	9.525	3.52	1.7	1.2	●
	16ER10W		10	9.525	3.52	1.5	1.1	●
	16ER11W		11	9.525	3.52	1.5	1.1	●
	16ER12W		12	9.525	3.52	1.4	1.1	●
	16ER14W		14	9.525	3.52	1.2	1	●
	16ER16W		16	9.525	3.52	1.1	0.9	●
	16ER18W		18	9.525	3.52	1	0.8	●
	16ER19W		19	9.525	3.52	1	0.8	●
	16IR8W		8	9.525	3.52	1.5	1.2	●
	16IR9W		9	9.525	3.52	1.7	1.2	●
	16IR10W		10	9.525	3.52	1.5	1.1	●
	16IR11W		11	9.525	3.52	1.5	1.1	●
	16IR12W		12	9.525	3.52	1.4	1.1	●
	16IR14W		14	9.525	3.52	1.2	1	●
	16IR16W		16	9.525	3.52	1.1	0.9	●
	16IR18W		18	9.525	3.52	1	0.8	●
	16IR19W		19	9.525	3.52	1	0.8	●

Note: ●Recommended grade ready to stock

British Standard Taper Piper Thread





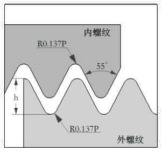
Standard:B.S.21 : 1985
Tolerance class:BSPT

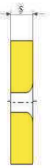
★With End

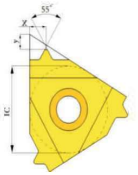
Shape	Type	Range of Thread Pitch		Insert Dimestions(mm)				Coating	
		mm	pitch/inch	IC	S	X	Y	SH2025+	
	16ER11BSPT		11	9.525	3.52	1.5	1.1	●	
	16ER14BSPT		14	9.525	3.52	1.2	1	●	
	16ER19BSPT		19	9.525	3.52	0.9	0.8	●	
	16ER28BSPT		28	9.525	3.52	0.6	0.6	●	
	16IR11BSPT		11	9.525	3.52	1.5	1.1	●	
	16IR14BSPT		14	9.525	3.52	1.2	1	●	
	16IR19BSPT		19	9.525	3.52	0.9	0.8	●	
	16IR28BSPT		28	9.525	3.52	0.6	0.6	●	

Note: ●Recommended grade ready to stock

Unified Thread







Standard:ANSI B1.1:74
Tolerance class: 2A/2B

★With End

Shape	Type	Range of Thread Pitch		Insert Dimestions(mm)				Coating	
		mm	pitch/inch	IC	S	X	Y	SH2025+	
	16ER8UN		8	9.525	3.52	1.6	1.2	●	
	16ER10UN		10	9.525	3.52	1.5	1.1	●	
	16ER12UN		12	9.525	3.52	1.4	1.1	●	
	16ER14UN		14	9.525	3.52	1.2	1	●	
	16ER16UN		16	9.525	3.52	1.1	0.9	●	
	16ER18UN		18	9.525	3.52	1	0.8	●	
	16ER20UN		20	9.525	3.52	0.9	0.8	●	
	16ER24UN		24	9.525	3.52	0.8	0.7	●	
	16IR8UN		8	9.525	3.52	1.5	1.1	●	
	16IR10UN		10	9.525	3.52	1.5	1.1	●	
	16IR12UN		12	9.525	3.52	1.4	1.1	●	
	16IR14UN		14	9.525	3.52	1.2	0.9	●	
	16IR16UN		16	9.525	3.52	1.1	0.9	●	
	16IR18UN		18	9.525	3.52	1	0.8	●	
	16IR20UN		20	9.525	3.52	0.9	0.8	●	
	16IR24UN		24	9.525	3.52	0.8	0.7	●	

Note: ●Recommended grade ready to stock

HIGH FEED - Cyclone Milling

1.LNMU Series

Feature of Chip Breaker

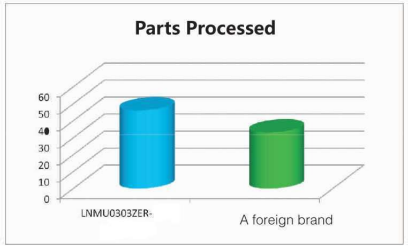
●Double-sided fast feed, cost-effective with 4-edges

● Optimized edge preparation for machini steel, stainless steel, cast iron and high-temperature alloys, etc.

●Inserts Ap is up to 1mm and can be used for shoulder milling, groove milling, ramp milling and small depth milling.

Case：

Workpiece material: Alloy Stee
Workpiece: Cutter groovi
Cooling type: Compressed Air
Original blade: A foreign brand
inser LNMU0 ZER-MG **SH1125**
Cutti parameter: Vc:126m/min fz:0.3mm/z , ap:0.8mm
Conclusion: Our blade processed 46 pcs edge, a foreig brand processed 33 pcs edge, tool life increased by 40% to meet customers' cost-effective needs.



2.LOGU Series

Feature of Chip Breaker

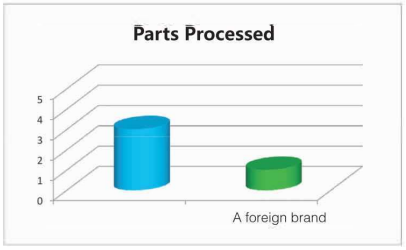
●Double-sided with 4-edges

●Precision ground inserts for higher indexing accuracy

● Small-diameter and multi-edge for efficient machining, end mill diameter range 16~32mm

Case：

Workpiece material: 45# Steel
Workpiece: Automotive mold parts
Cooling type: Compressed Ai
Original blade: A foreign brand
insert: LOGU030310ER-MM **SH2025+**
Cutting parameter: Vc:18 /min, fz:0.77mm/z, ap:0.7mm
Conclusion: Our blade proce 3 pcs edge, a foreign brand processed 1 pcs edge, our blade efficiency increased by 4-5 time , the unit ost reduced by 5 times.



Recommendation of Inserts and Chip Breakers

Should Milling Inserts						
	APMT-RX	APMT-MG	APMT-M2	APMT-H2	ADMT-TJ	TPKT
Length	11/16	11/16	11/16	11/16	11/16	04/09
Page	B-16	B-16	B-17	B-17	B-18	B-19
Double-side Should Milling Inserts						
	ANMX	ANKT-	LNGU-	WNMU-MG	XNEX-LG/MG	
Length	11/15	04/06/09/1	11	05/08	08	
Page	B-20	B-2	B-22	B-22	B-23	
Profile Milling Inserts						
	RPMW	RPMT-MJ	RPMT-	RDKT	RPMT-	RPMT
Length	08/10/12	08/10/12/16	08/10/12	08/20	08/10/12	12
Page	B-24	B-24	B-25	B-26	B-27	B-28
Single-side High Feed Milling Inserts						
	EPNW-HG	LPGT-MG	SDMT-MG	SDMT-HG	SOMT-MG	SOMT-HG
Length	06	01	12/15	06/15	10	14
Page	B-29	B-29	B-30	B-30	B-31	B-31
Double-side High Feed Milling Inserts				45°Face Milling Inserts		
	LNMU-	LOGU-MG	BLMP-MG		SEMT-MG	SEER-MG
Length	03	03	04-11	Length	12	12/15
Page	B-32	B-32	B-33	Page	B-38	B-38

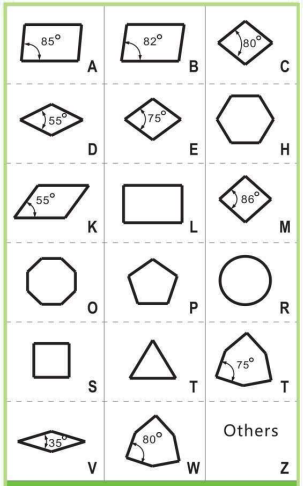
Super Alloy Titanium Alloy						
	RPHX-FD	RPHX-	APMT-FD	SDMT-DM	LNMU-SM	
Length	10/12	10 12	11/16	06/09	03	
Page	B-35	B-35	B-36	B-36	B-37	
Double-side Cost-effective Face Milling Inserts						
	SNMU-M	SNMX-MG	SNGX-FG	PNCU-MG	HNMG-R	
Length	13	12/16	09	09	09	
Page	B-39	B-40	B-40	B-41	B-42	
Double-side Cost-effective Face Milling Inserts						
	HNMG-M	XNMU-MM	XNMU-	ONHU-R	ONHU-FA	
Length	09	07	07/09	05	05	
Page	B-42	B-43	B-43	B-44	B-44	
Double-side Cost-effective Face Milling Inserts		Helix Milling Inserts				
	ONMU-MG		APKT-MP	SP-MK	SP-MP	
Length	09	Length	15	12	12	B-
Page	B-45	Page	B-46	B-46	46	

Helical Milling Inserts			
	CNHX	LNKT	LNKX
Length	16	16	12
Page	B-47	B-47	B-48

B Milling Inserts

Milling Insert Code Key

1.Shape



4.Chip Breaker and Hole

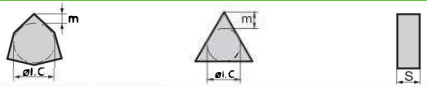
Code	Center Hole	Chip Breaker	Insert Profile	Code	Center Hole	Chip Breaker	Insert Profile
B	Y	N	>65°	N	N	N	
H	Y	Single	>65°	R	N	Single	
C	Y	N	>65°	F	N	Double	
J	Y	Double	>65°	A	Y	N	
W	Y	N	≤65°	M	Y	Single	
T	Y	Single	≤65°	G	Y	Double	
Q	Y	N	≤65°	X	---	---	Special Type
U	Y	Double	≤65°				

A P M T

2.Clearance Angle

Code	Clearance Angle	Code	Clearance Angle
A	3°	B	5°
C	7°	D	15°
E	20°	F	25°
G	30°	N	0°
P	11°	O	Others

3.Tolerance



Code	m(mm)	d=I.C	S(m
A	±0.005	±0.025	±0.025
F	±0.005	±0.013	±0.025
C	±0.013	±0.025	±0.025
H	±0.013	±0.013	±0.025
E	±0.025	±0.025	±0.025
G	±0.025	±0.025	±0.13
J	±0.005	±0.05-±0.13	±0.025
K	±0.013	±0.05-±0.13	±0.025
L	±0.025	±0.05-±0.13	±0.025
M	±0.08-±0.18	±0.05-±0.13	±0.13
N	±0.08-±0.18	±0.05-±0.13	±0.025
U	±0.13-±0.38	±0.08-±0.25	±0.13

Inscribed Circle	Regular Triangle	Square	80° Rhombus	55° Rhombus	35° Rhombus	
6.35	±0.08	±0.08	±0.08	±0.11	±0.16	---
9.525	±0.08	±0.08	±0.08	±0.11	±0.16	---
12.7	±0.13	±0.13	±0.13	±0.15	---	---
15.875	±0.15	±0.15	±0.15	±0.18	---	---
19.05	±0.15	±0.15	±0.15	±0.18	---	---
25.4	---	±0.18	---	---	---	---

* Tolerance of Inscribed Circle(mm)

Inscribed Circle	Regular Triangle	Square	80° Rhombus	55° Rhombus	35° Rhombus	
6.35	±0.05	±0.05	±0.05	±0.05	±0.05	---
9.525	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05
12.7	±0.08	±0.08	±0.08	±0.08	---	±0.08
15.875	±0.10	±0.10	±0.10	±0.10	---	±0.10
19.05	±0.10	±0.10	±0.10	±0.10	---	±0.10
25.4	---	±0.13	---	---	---	±0.13

In	C	D	R	S	T	V	W
32.00			32				
31.75			31				
25.40			25	25			
25.00	25	25	25				
20.00			20				
19.05	19		19	19	33		
16.00		19	16				
15.875	16		15	16	27		
12.70	12	15	12	12	22	22	08
12.00			12				
10.00			10				
9.525	09	11	09	09	16	16	06
8.00			08				
6.35	06	07			11	11	
6.00			06				
5.56					09		
5.50			05				
3.97					06		

Insert Shape

5.Cutting Edge Length

Code	Thickness(mm)
12	12.70
10	11.11
T9	9.72
09	9.52
07	7.94
T6	6.75
06	6.35
05	5.56
T4	4.96
04	4.76
T3	3.97
03	3.18
T2	2.78
02	2.38
T1	1.98
01	1.59
T0	0.99
00	0.79

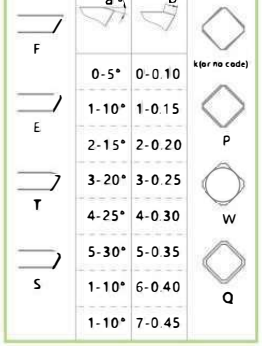
6.Thickness

16 04 PD E R - MG

7.Approach Angle/Relief Angle

A	45°	A	3°
D	60°	B	5°
E	75°	C	7°
F	85°	D	15°
P	90°	E	20°
Z	other	F	25°
		G	30°
		N	0°
		P	11°
		Z	other

8.Cutting Edge Code



a	b
0-5°	0-0.10
1-10°	1-0.15
2-15°	2-0.20
3-20°	3-0.25
4-25°	4-0.30
5-30°	5-0.35
1-10°	6-0.40
1-10°	7-0.45

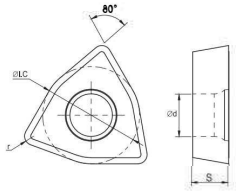
10.Chip Breaker

9.Cutting Direction Code

R	Right
L	Left
N	Neutral

B Milling Inserts

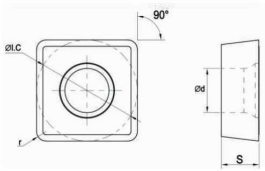
WC□□ Inserts



Shape	Type	Boring Range (mm)	Size					Application	Grade	
			L	øl.C	S	Φd	r		PVD	
									SH1125	SH2025+
	WCMT030208-MG	16-20	3.8	5.56	2.38	2.8	0.8	Semi_finishing	●	●
	WCMT040208-MG	21-25	4.3	6.35	2.38	3.1	0.8		●	●
	WCMT050308-MG	26-30	5.4	7.94	3.18	3.2	0.8		●	●
	WCMT06T308-MG	31-41	6.5	9.525	3.97	3.7	0.8		●	●
	WCMT080412-MG	42-58	8.7	12.7	4.76	4.3	1.2		●	●
	WCMT030208-FG	16-20	3.8	5.56	2.38	2.8	0.8	Finishing	●	●
	WCMT040208-FG	21-25	4.3	6.35	2.38	3.1	0.8		●	●
	WCMT050308-FG	26-30	5.4	7.94	3.18	3.2	0.8		●	●
	WCMT06T308-FG	31-41	6.5	9.525	3.97	3.7	0.8		●	●
	WCMT080412-FG	42-58	8.7	12.7	4.76	4.3	1.2		●	●

Note: ● The Recommended Grade ready to stock

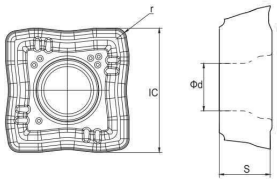
SP□□ Inserts



Shape	Type	Boring Range (mm)	Size					Application	Grade	
			L	øl.C	S	Φd	r		PVD	
									SH1125	SH2025+
	SPMT050204-MG	12.5-15	5	5	2.38	2.2	0.4	Semi_finishing	●	●
	SPMT060204-MG	15.5-21.5	6	6	2.38	2.6	0.4		●	●
	SPMT07T308-MG	22-27.5	7.94	7.94	3.97	2.8	0.8		●	●
	SPMT090408-MG	28-33	9.8	9.8	4.3	4.2	0.8		●	●
	SPMT110408-M	34-41	11.5	11.5	4.76	4.4	0.8		●	●
	SPMT140512-MG	42-50	14.3	14.3	5.2	5.75	1.2		●	●

Note: ● The Recommended Grade ready to stock

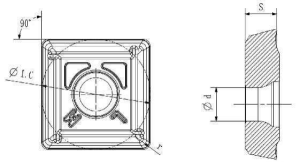
SO□□ Inserts

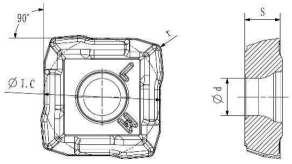


Shape	Type	Boring Range (mm)	Size					Application	Grade	
			L	øI.C	S	Φd	r		PVD	
									SH1125	SH2025+
	SOMT 040204-PV	13-16	1	4.4	2.38	2.2	0.4	Semi_finishing	●	●
	SOMT 050204-PV	13-16	1.2	4.9	2.38	2.2	0.4		●	●
	SOMT 060204-PV	16.5-17	1.8	5.7	2.38	2.6	0.4		●	●
	SOMT 070306-PV	17.5-19	1.8	6.8	2.8	2.6	0.6		●	●
	SOMT 08T306-PV	22.5-26.5	2	7.8	3.97	2.8	0.6		●	●
	SOMT 09T308-PV	27.5-31.5	2.4	9.2	3.97	3.8	0.8		●	●
	SOMT 11T308-PV	32-36.5	3	11	3.97	3.8	0.8		●	●
	SOMT 130408-PV	37-43	3.2	12.8	4.4	4.5	0.8		●	●

Note: ● The Recommended Grade ready to stock

SO SP□□ Inserts





Shape	Type	Boring Range (mm)	Size				Application	Grade	
			øI.C	S	Φd	r		PVD	
								SH1125	SH2025+
	SOMT 050305C-ML	24-29	8.40	3.00	3.20	0.50	Medium Machining	●	●
	SOMT 060406C-ML	30-41	10.20	3.50	4.00	0.60		●	●
	SOMT 070406C-ML	30-41	12.36	4.00	4.00	0.60		●	●
	SOMT 080508C-ML	44-63	14.90	4.50	4.70	0.80		●	●
	SOMT 090608C-ML	44-63	17.90	5.50	4.70	0.80		●	●
	SPMT 050308P-ML	24-29	8.90	3.00	3.20	0.80		●	●
	SPMT 060408P-ML	30-41	10.70	3.50	4.00	0.80		●	●
	SPMT 070410P-ML	30-41	12.70	3.95	4.00	1.00		●	●
	SPMT 080510P-ML	44-63	15.50	4.50	4.70	1.00		●	●
	SPMT 090610P-ML	44-63	18.60	5.50	4.70	1.00		●	●

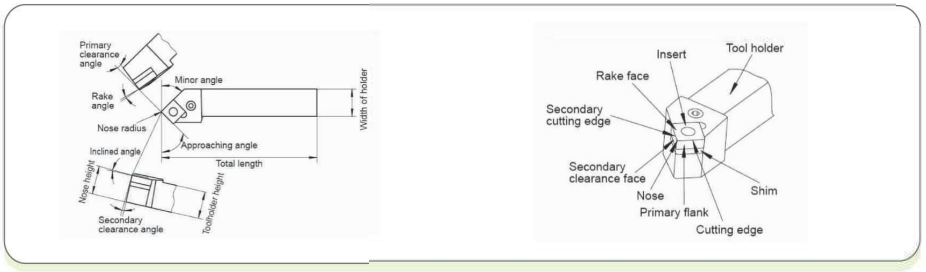
Note: ● The Recommended Grade ready to stock

C Drilling Inserts

Part One: General Technical Information for Turning Machining

The Functions of Each Part of Turning Tools

❶ The Names of Each Part of Turning Tools



❷ Effects of Rake Angle

Larger rake angle makes cutting edge sharper. reduces resistant forces of chip flow. diminishes friction and prevent deformation. leading to smaller, less abrasion and higher surface quality. However. too large rake angle would reduce the rigidity and strength of tool. Heat can' t be diffused easily. Serious breakage and abrasion on tool would occur, reducing too life. Please choose rake angle according to machining conditions.

Value selection	Situations
Small rake angle	•When machining brittle and hard materials; •When roughing and interrupted cutting
Big rake angle	•When machining Plastic or soft materials; •When finishing;

❸ Effects of Clearance Angle

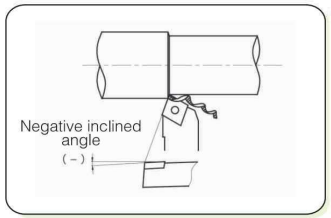
The main function of clearance angle to reduce the friction between the clearance face of tool and the surface of workpiece. When the rake angle is fixed, larger clearance angle can increase and the achieve higher surface quality. However, if clearance angle is too large, the strength of cutting edge would decrease. Also, heat can' t be diffus easily and serious abrasion would occur, reducing tool life. The principle of choosing clearance angle: Choose small clearance angle if friction is not serious

Value selection	Situations
Small clearance angle	•In order to increasenose strength when roughing •When machiningbrittle and hard materials
Large clearance angle	•In order to reduce friction when finishing •When machining materials easy to be hardened;

❹ Effects of Inclined Angle

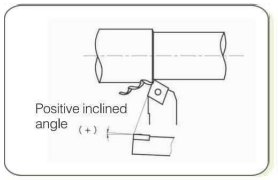
Positive or negative inclined angle determines the direction of chip flow, and also affects the strength and impact resistance of insert nose.

◆ As diagram(1) shows, when the inclined angle is negative, namely nose is in the lowest point as apposed to the bottom of tool. chips flow to the machined surface of workpiece.



◆ As diagram(2)shows , when inclined angle is positive. namely the nose is in the highest point as apposed to the bottom of the tool. chips flow to the areas of workpiece surface that haven' t been machine

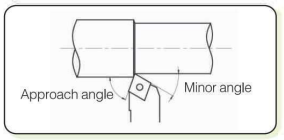
◆ The change of inclined angle also affects insert nose strength and impact resistance. When the inclined angle is negative. the nose is in the lowest point of cutting edge. When the cutting edge enters the workpiece, the contacting point is on the cutting edge or rake face, protecting the nose from impact and increase the strength of the nose. Normally, negative inclined angle should be chosen for tools with big rake angle. This can not only increase nose strength. But also prevent the impact of entry.



❺ Effects of Approach Angle

Reduces approaching angle increases the strength of tools and enable heat to diffuse easily, improving surface quality. This is becauce when the approach angle is small. cutting edge width is large, and then the unit width of cutting edge bears less cutting force. Meanwhile, tool life can be improved.

Normally, select 90° approach angle for turning of slender and step shaft; select45° approach angle for external turning. End surface machining and chamfering. When approach angle is larger. radial force is reduced. cutting is stable .cutting thickness is increased. and chip breaking is excellent.



Value selection	Situations
Small approach	For those materials with high intensity, high hardness and hardened layer on the surface
Big approach angle	When rigidity of the machine is not enough

❻ Effects of Minor Angle

Minor angle is the main angle that can affect surface quality, and it can also affect tool strength. If the approach angle is too small, the friction between the secondary flank and machined surface of workpiece will increase, causing vibration. The principle of selecting minor angle: Select small minor angle when roughing or when the friction is unaffected and is on vibration. Select large minor angle when finishing.

❼ Effects of Cutting Edge Grinding

According to different use occasions. choose a cutting edge method from the table below

Shape of the cutting edge	shape
sharp edge	
corner	
chamfer	

D Technical Information

❸ Cutting Time Calculation of External and Internal Turning

$$T = \frac{l}{f \times n} (\text{min})$$

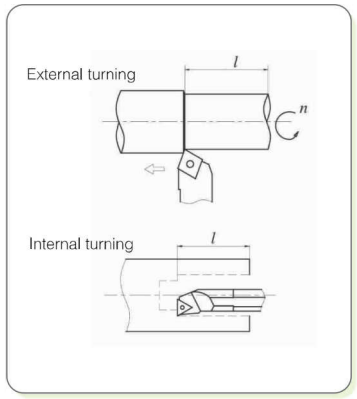
In the formula: T: Cutting time(min)

L: length of machined areas(mm)

F: Feed rate(mm/rev)

N: Rotating speed of main axle(rev/min) For example. When the rotating speed of main axle is 300rev/min, and the feed rate is 0.15mm/rev. the time needed for a cutting length of 180mm should be:

$$T = \frac{l}{f \times n} = \frac{180}{0.15 \times 300} = 4\text{min}$$



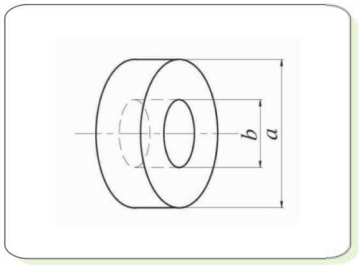
❹ Time Calculation End Surface Turning (Constant Linear Speed)

$$T = \frac{\pi \times (a^2 - b^2)}{4000 \times Vc \times f} (\text{min})$$

In the formula: T: Cutting time(min)

Vc: length of machined areas(mm)

F: Cutting speadFor end surface without hole, b =0,the formula is still Valid.



❺ The Oretical Value Calculation of Machined Surface Roughness

$$R = \frac{f^2}{8r_c} \times 1000 (\mu m)$$

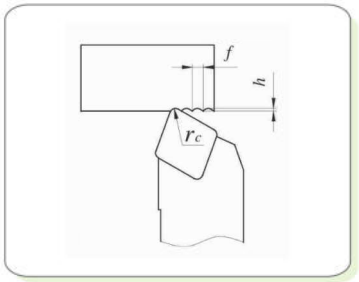
In the formula: R: Theoretical roughness value of machined surface

F: Feed rate(mm/rev)

Rc: Nose radius(mm)

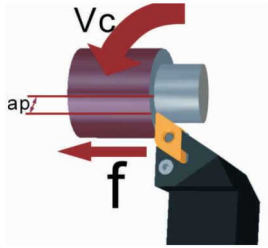
For example: When the feed rate is 0.25mm/rev.and the nose radius is 0.8mm. the theoretical roughness value of machined surface should be

$$R = \frac{f^2}{8r_c} \times 1000 = \frac{0.25^2}{8 \times 0.8} \times 1000 = 9.76 (\mu m)$$



The Influence of Three Elements of Turning on Machining

Normally, short machining time, long tool life and high machining precision are expected in machining, so the material quality. hardness. and shape of the workpiece. and properties of machine should be fully considered and then we can select suitable tools and adopt high-efficiency cutting parameters, namely three parameters.



❶ Cutting Speed(Vc)

(1)Definition of cutting speed

When the workpiece is rotating on the machine, the number of is rotation per minute is defined as Rotating speed of main axle(n). Because of its rotation, the cutting speed measured on the contacting point of diameter is defined as linear speed. (m/min). Normally. linear, linear speed is considered to measure the effect of cutting speed on machining.

(2)Effect of Cutting Speed

Cutting speed has significant effect in tool life. When the cutting speed is increased, cutting temperature will increase and tool life will be shortened. Cutting speed varies according to the different types and hardness of work-piece. The below conclusions are reached after many cutting experiments:

- Normally tool life would be reduced to half when the cutting speed is increased by 20%. Tool life would be 20% of the original life if the cutting speed is raised by 50%.
- Low speed(20-40m/min)cutting could easily cause vibration and shorten tool life.

❷ Feed Rate(Fn)

(1)Definition of feed rate

Feed rate is defined as the moving distance of tool after workpiece rotates for one circle, measured by mm/rotation.

(2)The influence of feed rate

Feed rate is a key factor that determines surface quality. Meanwhtile it also affect the range of chip forming and the thickness of chips during machining.

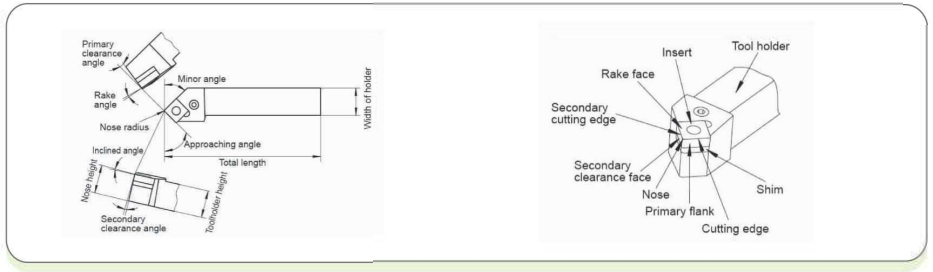
In term of the effect on tool life, small feed rate leads to serious abrasion on clearance face, reducing tool life.

Technical Information

Part One: General Technical Information for Turning Machining

The Functions of Each Part of Turning Tools

❶ The Names of Each Part of Turning Tools



❷ Effects of Rake Angle

Larger rake angle makes cutting edge sharper. reduces resistant forces of chip flow. diminishes friction and prevent deformation. leading to smaller, less abrasion and higher surface quality. However. too large rake angle would reduce the rigidity and strength of tool. Heat can' t be diffused easily. Serious breakage and abrasion on tool would occur, reducing too life. Please choose rake angle according to machining conditions.

Value selection	Situations
Small rake angle	•When machining brittle and hard materials; •When roughing and interrupted cutting
Big rake angle	•When machining Plastic or soft materials; •When finishing;

❸ Effects of Clearance Angle

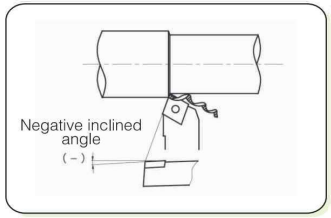
The main function of clearance angle to reduce the friction between the clearance face of tool and the surface of workpiece. When the rake angle is fixed, larger clearance angle can increase and the achieve higher surface quality. However, if clearance angle is too large, the strength of cutting edge would decrease. Also. heat can' t be diffus easily and serious abrasion would occur, reducing tool life. The principle of choosing clearance angle: Choose small clearance angle if friction is not serious

Value selection	Situations
Small clearance angle	•In order to increasenose strength when roughing •When machiningbrittle and hard materials
Large clearance angle	•In order to reduce friction when finishing •When machining materials easy to be hardened;

❹ Effects of Inclined Angle

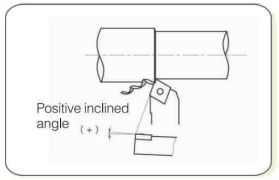
Positive or negative inclined angle determines the direction of chip flow, and also affects the strength and impact resistance of insert nose.

◆As diagram(1) shows, when the inclined angle is negative, namely nose is in the lowest point as apposed to the bottom of tool. chips flow to the machined surface of workpiece.



◆As diagram(2)shows , when inclined angle is positive. namely the nose is in the highest point as apposed to the bottom of the tool. chips flow to the areas of workpiece surface that haven' t been machine

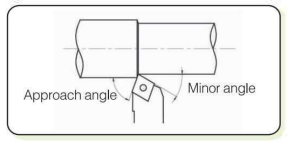
◆The change of inclined angle also affects insert nose strength and impact resistance. When the inclined angle is negative. the nose is in the lowest point of cutting edge. When the cutting edge enters the workpiece, the contacting point is on the cutting edge or rake face, protecting the nose from impact and increase the strength of the nose. Normally, negative inclined angle should be chosen for tools with big rake angle. This can not only increase nose strength. But also prevent the impact of entry.



❺ Effects of Approach Angle

Reduces approaching angle increases the strength of tools and enable heat to diffuse easily, improving surface quality. This is because when the approach angle is small, cutting edge width is la ge, and then the unit width of cutting edge bears less cutting force. Meanwhile, tool life can be improved.

Normally, select 90° approach angle for turning of slender and step sha'ft; select45° approach angle for external turning. End surface machining and chamfering. When approach angle is larger, radial force is reduced. cutting is stable .cutting thickness is increased. and chip breaking is excellent.



Value selection	Situations
Small approach	For those materials with high intensity, high hardness and hardened layer on the surface
Big approach angle	When rigidity of the machine is not enough

❻ Effects of Minor Angle

Minor angle is the main angle that can affect surface quality, and it can also affect tool strength. If the approach angle is too small, the friction between the secondary flank and machined surface of workpiece will increase, causing vibration. The principle of selecting minor angle: Select small minor angle when roughing or when the friction is unaffected and is on vibration. Select large minor angle when finishing.

❼ Effects of Cutting Edge Grinding

According to different use occasions, choose a cutting edge method from the table below

Shape of the cutting edge	shape
sharp edge	
comer	
chamfer	

D Technical Information

Cutting edge grinding is a processing method used to maintain the cutting edge strength. The grinding amount is large, the cutting edge strength is high, not easy to damage, the tool life is improved, but the excessive grinding amount will cause the edge sharpness is not enough, the cutting force will be large, but also may produce vibration.

Value selection	Situations
Small regrinding amount	• Finishing machining – small Ap & Fn • For processing soft materials • When the machine or workpiece is not rigid enough
Large regrinding amount	• Rough machining • When machining hard materials and intermittent cutting • When machin rigidity is good

❽ Nose Radius

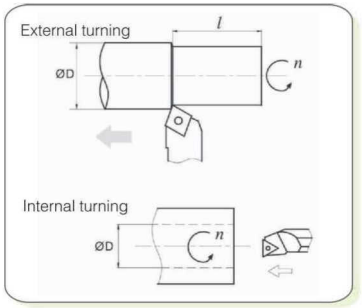
Nose radius significantly affects nose strength and surface quality.

Large nose radius means higher cutting edge strength, and the abrasion on the rake face and clearance face can be reduced to some extent. However, if the nose radius is too large, radial force will increase, and vibration is easy to occur, affecting machining precision and surface quality

Value selection	Situations
Small nose radius	●Finishing at small cutting depth ●Machining parts such as slender shaft ●When the rigidity of the machine is not enough
Large nose radius	●When roughing ●When machining hard materials (intermittent cutting) ●When the rigidity of the machine is good enough

Calculation Method of Turning Parameters

❶ Calculation of Cutting Speed



$$Vc = \frac{\pi \times D \times n}{1000} (m/\min)$$

In the formula:

Vc: Cutting speed(m/min)

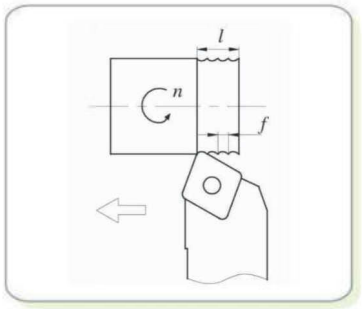
n: Rotating speed of main axle (rev/min)

D: Diameter of workpiece(mm)

For example: When the rotating speed is 500ev/min and the diameter of workpiece is 80mm, the cutting

$$Vc = \frac{\pi \times D \times n}{1000} = \frac{3.14 \times 80 \times 500}{1000} = 125.6(\mathrm{m/min})$$

❷ Calculation of Feed Rate



$$f = \frac{l}{n} (mm/rev)$$

In the formula:

f : Feed rate per rotation(mm/rev)

L: Cutting length per minute(mm/min)

N: Rotating speed of main axle(rev/min)

For example: When the rotating speed of main axle is 600ev/min, and the cutting length per minute is 150mm/min, the feed rate per rotating should be:

$$f = \frac{l}{n} = \frac{150}{600} = 0.25(mm/rev)$$

Technical Information

③ Cutting Depth(ap)

(1)Definition of cutting depth

Cutting depth is defined as the difference between machined surface and unmachined surface. Measured by mm, it is half the difference value between the original diameter and machined diameter.

(2)Effect of Cutting Depth

Cutting depth should be determined by the machining alllowance and shape of workpiece, power and rigidity of machice, and tool rigidity.

The change of cutting depth has little effect on tool life. If the cutting depth is too low. The cutting nose only scrapes the hardened layer on the workpiece surface. reducing tool life. When there is hardened oxide layer on workpiece surface. higher cutting depth should be adopted within the possible range of machine' s power to avoid cutting nosr just cutting the hardened layer of workpiece.

Blade Wear and Solution

(1)Flank Wear

Problem:
Higher cutting resistance. Notch wear on flank. Poor roughness of surface or deterioration of accuracy
Reason :
Soft grades. Excessive cutting speed. Small flank angle. Low feed
Solutions:
Select a higher. wear-resistant grade. Reduce cutting speed Increase flank angle Increase feed

(2) Crater Wear

Problem:
Uncontrolled chip Poor surface quality when finishing High speed processing carbon steel
Reason:
Soft grades Excessive cutting speed Excessive feed The strength of chip breaker Insufficient
Solutions:
Change to a higher wear-resistant grade Reduce cutting speed Reduce feed Select a higher strength chip breaker

(3) Plastic Deformation

Problem:
Variation of dimension Nose wear,cutting edge drape or passivating, when processing alloy steel Poor surface roughness
Reason:
Soft grade Excessive cutting speed Excessive cutting depth and feed rate Overheaton cutting edge
Solutions:
Select a higher red hardness cutting material Decrease cutting speed Decrease cutting depth and feed rate Select a higher thermal conductivity cutting material(CVD+sufficient coolant)

(4) Build-Up-Edge

Problem:
Workpiece dissolve with Cutting edge Poor surface roughness when finishing Cutting resistance increased Cutting soft materials
Reason:
Cutting speed too low Cutting edge obtuse Unsuitable tool material
Solutions:
Increase cutting speed Increase rake angle Select small sticking force

(5) Chip Hammering

Problem:
Part of the cutting edge that does not participate in cutting is damaged by chip hammering, the upper and support of the insert may be damaged.
Reason:
Chip folds back to the cutting edge
Solutions: Change the feed rate and choose another type of chip breaker

(6) Insert Fracture

Problem:
Cutting resistance increased Poor surface Roughness
Reason:
Toughness insufficient Excessive feed rate Strength of cutting edge insufficient Instability of the tool
Solutions:
Select a tougher grade Decrease feed rate Increase honing of cutting edge(chamfering to rounding) Increase the stability and setting angle

(7) Themal Crack

Problem:
Crack by heat cycle(often happen in milling and interrupted cutting)
Reason :
Toughness of tool grade insufficient Swell and shrink by cutting heat(cold-thermocycling)
Soultions:
Cutting without coolant/Sufficient coolant Select a tougher and more thermal shock resistance grade

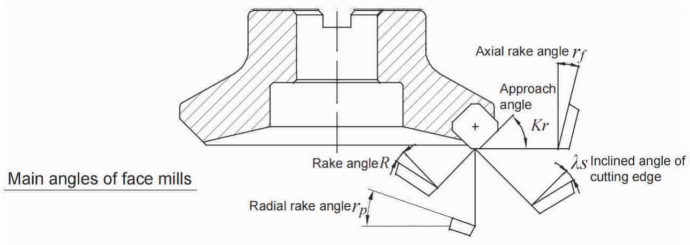
(8) Chipping

Problem:
Sudden fracture of cutting edge (rake face and flank) Instability insert life
Reason :
Toughness insufficient Excessive feed rate Strength of cutting edge insufficient Instability of the tool
Solutions:
Select a tougher grade Decrease feed rate Increase honing of cutting edge (chamfering to rounding) Increase the stability and setting angle

Technical Information

Second Part:Technical Information About Indexable Miling Tools

Function of Each Part in Face Milling

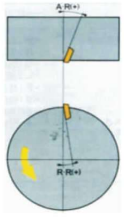
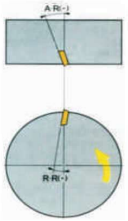
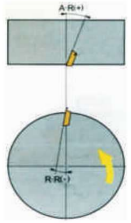
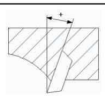


Main angles of face mills

Designation	Function	Effect		
Axial rake angl f	Determining the chip direction	Negative,excellent capability of chip removal		
Radial rake an	Determining whether the cutting is easy and fast or not	Positive angle;good cutting performance		
Approach angle Kr	Determining the chip thickness	Kr↑, chip thickness ↑; Kr↓ chip thickness		
Rake angle Ro	Determining whether easy and fast the cutting is or not	Poor cutting performance, High- Poor cuttingstrength cutting edge	(-)←0→(+)	Good cutting performance, Lowstrength cutting edge
Inclined angle λs	Determining the chip flow direction	Poor capability of chip removal,High-strength cutting edge	(-)←0→(+)	Good performance of chip removal, Low-strength cutting edge

❶ Milling Cutter Parameters Selection

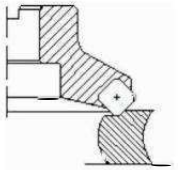
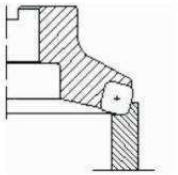
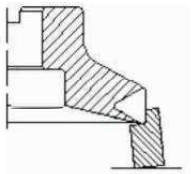
•Characteristics of Different Rake Angles Combined

		Double positive rake angle	Double negative rake angle	Positive and negative negative rake angle
Negative rake angle				
0° rake angle				
Positive rake angle				
Axial rake angle γ_f		+	−	+
Radial rake angle rp γ_p		+	−	−

Applicable material machined	P	√		√
	M	√		√
	K		√	√
	N	√		
	S	√		√

❷ Selection of Approach Angle

•Selection Method of Cutting Tools

Designation	Schematic diagram	Instruction
45°		Axial force is the largest, it will bend when machining thin-wall workpiece, reducing the precision of workpiece. It can help avoid fringe brekage of workpiece when machining cast iron
75°		The main force is radial cutting force, in is often used in general face milling
90°		The main force is radial cutting force, in is often used in general face milling

Technical Information

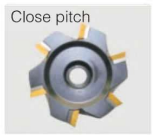
❸ Selection of Approach Angle :

The approach angle is formed by insert and tool body. It affects chip thickness. Cutting forces and tool-life. Decreasing the approach angle reduces chip thickness and expands the cutting area between cutting edge and workpiece at a given feed rate. A Smaller approach angle also ensures stable entry into or exiting workpiece, protecting the cutting edge and extending tool life. However, this will increase axial cutting forces on the workpiece, thus is not suitable for machining thin workpiece Such as thin plate.

Approach angle	Feed rate per tooth f_z	Maximum chip stickiness h_{ex}
90°	f_z	$h_{ex} = f_z \times sinKr$
75°	f_z	$h_{ex} = 0.96 \times f_z$
60°	f_z	$h_{ex} = 0.86 \times f_z$
45°	f_z	$h_{ex} = 0.707 \times f_z$
Circular Blade	f_z	$h_{ex} = \frac{\sqrt{iC^2 \times (iC - 2a_p)^2}}{iC} \times f_z$

❹ Pitch Selection

Pitch is the distance between one point on one cutting edge and the same point on the next edge.

Optimized stability		
L (Low)	M (Medium)	H (High)
Coarse pitch 	Close pitch 	Extra close pitch 
When the milling width is equal to diamete of cutter, the machining system is stable and main power of machine is sufficient, the use of coarse pitch can achieve high productive efficiency.	Used in general milling and multiple mixed productions.	When the milling width is less than diameter of cutter, cutting by maximum edges can achieve high productive effciency.

Milling Calculation

❶ General Formula

Vc : cutting speed (m/mi)
D_C : nominal diameter of milling tool (mm)
n : spindle speed (rev/min)
z_n : number of teeth
Q : metal removal rate(cm^3/min)
V_f : feed rate of worktable (feed speed) (mm/min)
f_z : feed rate per tooth (mm/z)
π : circumference ratio=3.14
T_c : machining time (min)
f_n : feed rate per revolution (mm/rev)
L : Actual working distance (mm)

● Cutting speed

$$Vc = \frac{\pi \times D_C \times n}{1000} \text{ (m/min)}$$

● Spindle speed

$$n = \frac{1000 \times V_c}{\pi \times D_C} \text{ (rev/min)}$$

● Feed rate of worktable(feed speed)

$$V_f = f_z \times n \times z_n \text{ (mm/min)}$$

● Feed rate per tooth

$$f_z = \frac{V_f}{n \times z_n} \text{ (mm/z)}$$

● Feed rate per revolution

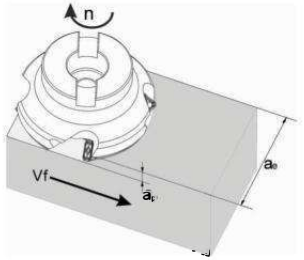
$$f_n = \frac{V_f}{n} \text{ (mm/rev)}$$

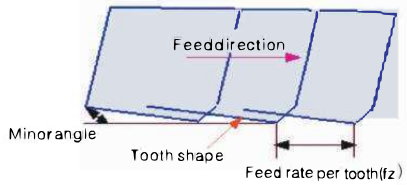
● Machining time

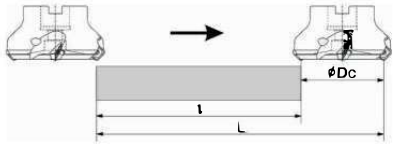
$$T_c = \frac{L}{v_f} \text{ (min)}$$

● Metal removal rate

$$Q = \frac{a_p \times a_e \times V_f}{1000} \ cm^3/\text{min}$$





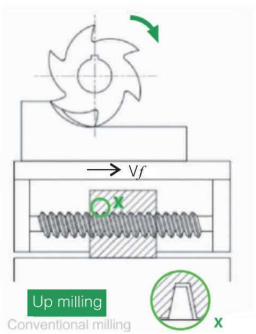


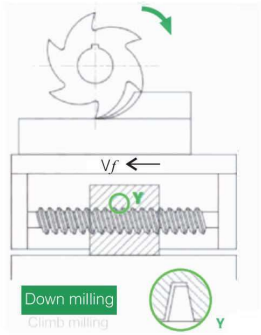
D Technical Information

Difference and Selection Between Down Milling and Up Milling

Climb milling (also called down milling): the feed direction of workpiece is the same as that of the milling rotation at the connecting position.

Conventional milling (also called up milling): the feed direction of workpiece is opposite to that of the milling rotation at the connecting position.





In down milling, the major force of cutting edge is the compressive stress, while in up milling is the tensile stress. The compressive strength of cemented carbide material is much larger than its tensile strength. In down milling, as chips become thin from thick gradually, cutting edge and workpiece press against each other. The friction between edge and workpiece is small, thus reducing the abrasion of edge, the hardening of workpiece surface and the surface roughness (Ra). In up milling, chips become thick from thin gradually. When the insert is cutting into the workpiece, it produces strong friction and more heat than in down milling, and make workpiece surface hardened.

In up milling, because horizontal direction of cutting force milling cutter conducting on workpiece is opposite to the feed direction of workpiece, the lead screw of worktable joints closely with one side of the screw nut. In down milling, the direction of cutting force is the same as the feed direction. When edge's radial force on workpiece is large enough, the worktable will bounce left and right, thus make the gap fall behind. The gap will return to the front side with the continuing rotation of lead screw. At this moment the worktable stops motion, however, it will bounce left and right again when the radial cutting force is large enough again. The periodical bounce of worktable will cause poor surface quality of workpiece and tool breakage.

When using end mills for down milling, the edges always starts cutting at the workpiece surface, therefore end mills are not suitable for machining workpiece with hardened surface

Up milling is recommended for milling thin-wall components or square milling with high requirement for precision.

CVD Grades Comparison Table

ISO	SHOSAI	SANDVIK	KENNAMETAL	SecoTool	ISCAR	TaeguTec	Walter	TUNGALOY	KYOCERA	KORLOY	SUMTOMO	MITSUBISHI	ZCC-CT
P10	SHP1015	GC4315	KCP10 KC9110	TP1500	IC5005 IC8150	TT8115	WPP05S WPP10S	T9115	CA4505 CA4515	NC3215	AC810P AC820P	UE6110 MY5015	YBC151 YBC152
P20	SHP1025	GC4325	KCP25 KC9125 KC9225	TP2500	IC8150 IC8250	TT5100 TT8125	WKP25S WPP20S WMP20S	T5026 T9125	CA4515 CA4525	NC3225 NC3120 NC3330	AC2000 AC820P	UE6020 MC6025 F7030	YBC251 YBC252
P30	SHP1035	GC4325 GC4335	KCP30 KCP40	TP3020	IC8250 IC8350	TT8125 TT5100	WKP35S WPP30S WMP20S	T9135 T9035	CA4525 CA4535	NC3030 NC5340 NC500H	AC630M AC830P	UE6020U E6035U 6400	YBC252 YBC351
M10		GC2015	KCM15		IC6015 IC8150	TT9215	WMP20S		CA4515 CA4015	NC9115	AC610M AC630M	US7020 MC7015	YBM251 YBM153
M20		GC2015 GC2025	KCM15 KC9225	TM2000	IC6025 IC8150 IC8250	TT9225	WMP20S	T5020 T6130	CA4515 CA4525	NC9115 NC9125 NC5330	AC630M AC830P	US7020 C7015 MC7025	YBM251 YBM253
M30		GC2035 GC2025	KCM25 KC9230	TM4000	IC6025 IC8250 IC8350	TT5100	WSM45X	T6130	CA4525	NC5340 NC5350 NC9135	AC630M	MC7025 US735 F7030	YBM351
K10	SH3020K	GC3210 GC3215	KCK05 KCK15	TK1000	IC5005 IC5010	TT1300	WAK15 WPP01	T5010 T1115	CA4505 CA4010	NC6315	AC410K	UC5115 MY5015	YBD102 YBD152
K20	SH3015K	GC3215	KCK15 KCK20	TK2000	IC5005 IC5010	TT7105 TT7310	WKP25S WPP10S	T5115 T5125	CA4515 CA4115	NC6315 NC5330	AC410K AC420K	UC5115 UE6110 MC5020	YBD152
K30	SH3040K	GC3225	KC9325		IC5010		WKP35S WPP20S	T5125		NC5340	AC820P	UE6110	YBD252

PVD Grades Comparison Table

ISO	SHOSAI	SANDVIK	KENNAMETAL	SecoTool	ISCAR	TaeguTec	Walter	TUNGALOY	KYOCERA	KORLOY	SUMITOMO	MITSUBISHI	ZCC.CT
P10	SH1115	GC1010 GC1025	KC715		IC807 IC907	TT7030 TT7080	WXM15 WSM10 WSM10S		PR730 PR830 PR1225		ACP100 ACP200	VP10MF	YBG102 YBG105
P20	SH2025+ SHM525 SH1125	GC1010 GC1025 GC2030	KC522M KC525M	CP200	IC807 IC907 IC3028	TT7030 TT9030 TT9080	WSM20 WSM2 S WSM21	AH725 AH120 GH330	PR730 PR830 PR1225	PC3600	ACP200	VP15 F VP20RT VP20MF	YBG202 YBG205
P30	SH1125	GC1025 GC1030	KC725M KC530M	CP500	IC807 IC808 IC3028	TT8080 TT9030 TT9080	WSP45S WSP46 WSM30S	AH730 GH130 AH130	PR660 PR1230	PC3600 PC3500 PC5300	ACZ300 ACZ350 ACZ200	VP15TF VP30RT VP20MF	YBG302
M10	SH824	GC1025 GC1030	KC715M	CP200	IC807		WSM10 WSM10S		PR630 PR730 PR1225	PC8105 PC8110	ACP200	VP10MF	YBG202 YBG205
M20	SH824 SHM525 SH2025M	GC1025 GC1030	KC5025 KC715M	CP200 TS2500 CP500	IC354 IC807 IC3028	TT9030 TT9080	WSM20 WSM20S WSM21	GH120 AH120 AH725	PR660 PR730 PR1225	PC8110 PC8115 PC5300	ACZ310 AC520U ACP300	VP15TF VP20RT VP20MF	YBG202 YBG205 YB9320
M30	SH2025M	GC1030 GC1040 GC2030	KC725M KC5525	CP500 F30M	IC808 IC908	TT8080 TT9030 TT9080	WSP35S WSP36 WSM30S	AH130 GH130 AH730	PR660 PR730	PC5300 PC9530 PC5400	ACZ330 AC520U ACZ350	VP15TF VP30RT MP7030	YBG302 YBG402
K10	SH1015K	GC1210	KC5010 KC510M	CP200	IC910		WHH15 WXM15	AH110 GH110	PR510 PR905 PR1210	PC8110 PC6510	ACZ310 ACK200	VP10RT	YBG102 YBG105
K20	SH2025+ SHM525 SH1125	GC102 GC122	KC5025 KC520M KC525M	CP200 CP500	IC808 IC908	TT6080	WKK25S	AH120 GH110 AH330	PR905 PR1210	PC5300	ACZ310 ACK200	VP15TF VP20RT	YBG202
K30	SH1125	GC1020	KC735M KU25T	CP500	IC808 IC908		WKK25S	GH130		PC5400	ACZ330 ACK300	VP15TF VP20RT	YBG205 YBG302
S10	SSH605 SRH610	GC1025	KC510M KC5510 KCS10B	CP200 TS2000	IC806	TT9030	WSM10 WSM10S	AH905 AH110 SH730	PR660 PR905	PC8105 PC8110	EH520Z EH20Z AC510U	VP10R VP20RT	YBS103
S20	SHM525 SRH520 SRH525	GC1025 GC2030	KC522M KC525M KC5525	CP250 TS2500 CP500	IC806 IC807 IC808	TT9030 TT9080	WSM20 WSM20S WSM21	AH120 AH725	PR1225 PR905	PC8115 PC5300	EH520Z EH20Z AC520U	VP15TF VP20RT MP9130	YBS203
S30	SRH029 SRH030	GC2030 S30T	KC725M	F40M	IC8350	TT8080 TT9030 TT9080	WSM45S WSP46 WSM30S	AH725	PR905	PC5400	ACK300 AC520U	VP15TF	YBS303