The House of Gear Technology
CENTURY PRECISION CO., LTD.
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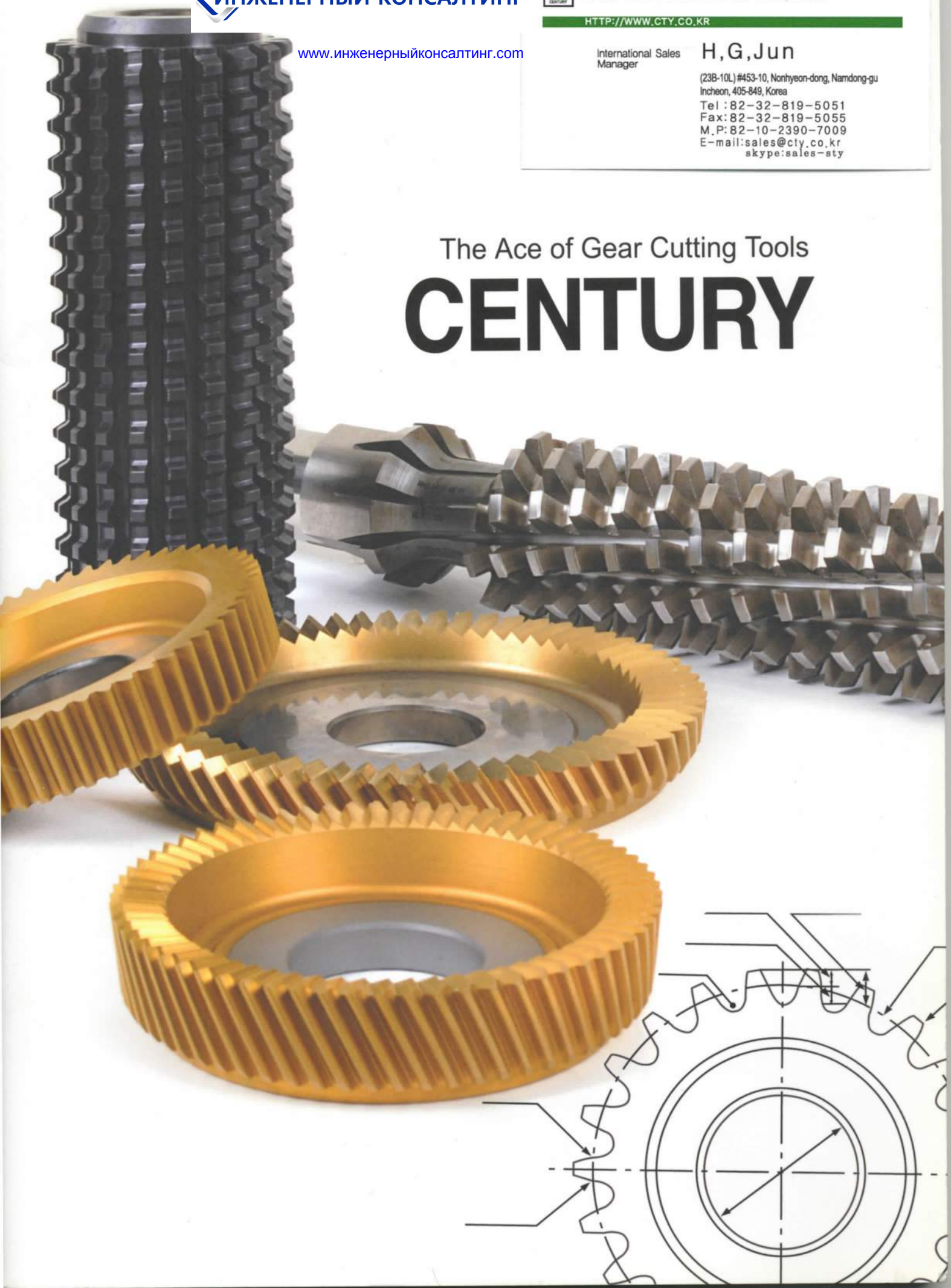
The Ace of Gear Cutting Tools

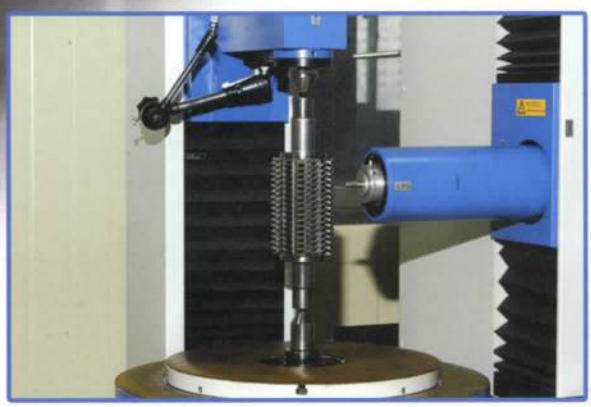
CENTURY



Century Precision puts emphasis on customer benefits, always!

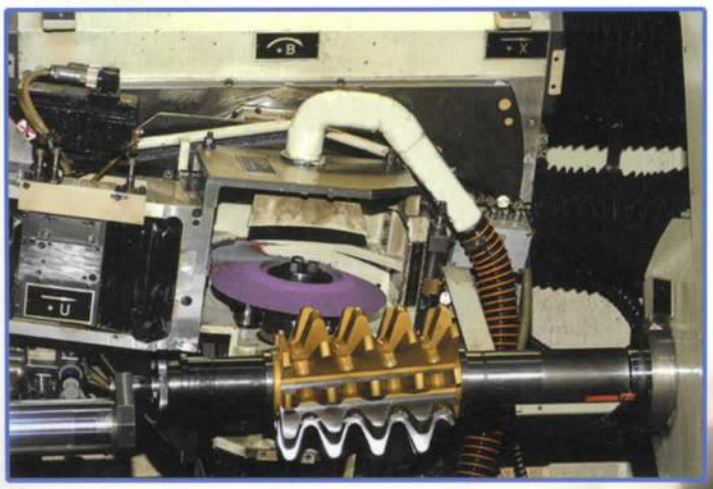
▲ CNC RELIEVING LATHE

▲ CNC GRINDING



▲ CNC HOB TESTER

▼ CNC SHARPENING



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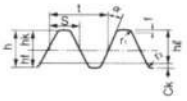
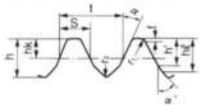
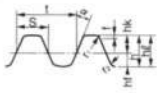
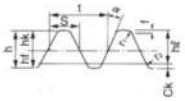
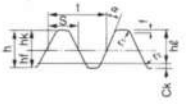
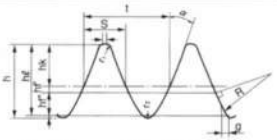
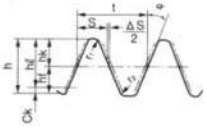
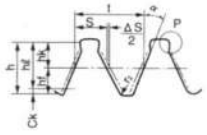
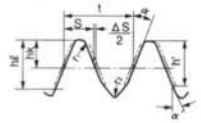
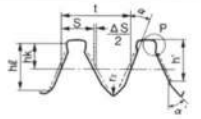
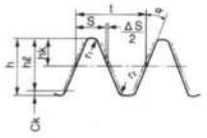
- SPECIAL FORMED BITE

TYPES OF TOOTH PROFILE

Shape of Tooth Profile according to Use of Cutting Tooth

	Symbol	Standard Tooth Profile
Tooth Profile for finishing cutting	N (Standard)	 α= 20° or 14.5° hk=1.25m hf=1.25m h=2.5m h *l* =2.25 $r_1=r_2$=0.375m(α= 20°) = 0.333m(α= 14.5°)
	S-TOP (Semi Topping)	 H', α', r_1 will be calculated according to specifications of the work piece. Except these, it will be in accordance with such tooth profiles as standard, topping, standard stub, and fellow stub.
	TOP (Topping)	 α= 20° or 14.5° hk=1.25m hf=1.0m h=2.5m h= h *l* =2.25 r_1=0.037m(α= 20°) =0.333m(α= 14.5°) r_2= 0.2m
	STB -N (Low tooth)	 α= 20° hk=1.0m hf=1.0m h=2.0m h *l* =1.8m r_1=0.3m
	STB-F (Fellow Stub)	 Module = "/m α= 20° hk=1.25m hf=1.25m h=2.5m h *l* =2.25m r_1=0.375m
	HF-B1 (S Type)	 α= 20° hk=1.25m hf'=0.507m $r_1=r_2$=0.375m h=2.5m hf=0.507m h *l* =2.25m' R=15.75m

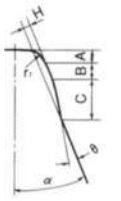
	Symbol	Standard Tooth Profile
Tooth profile for shaving or grinding	PRE-S PRE-G (Higher Tooth)	 α= 20° or 14.5° h≧2.6m hk=1.35m hf≦1.25m h *l* =2.35 $r_1=r_2$=0.3m Completion Value =△S
	PP PGP (ProtuBerance)	 α= 20° or 14.5° h≧2.6m hk=1.35m hf≦1.25m h *l* =2.35 $r_1=r_2$=0.3m Completion Value =△S
	PS PGS (Semi Topping)	 H', α', r_1 will be calculated according to each and every factors of the work piece. α= 20° or 14.5° hk=1.35m h *l* =2.35 r_1=0.3m Completion Value =△S
	PSP PGSP (ProtuBerance with Semi Topping)	 α= 20° or 14.5° hk=1.35m h *l* =2.35 Completion Value =△S H', α', r_1 will be calculated according to each and every factors of the work piece.
	RGH (Rough cutting)	 α= 20° or 14.5° hk=1.25m h≧2.4m h *l* =2.25m r_1=0.3m or Total radius r_1=0.2m Completion Value =△S

GRINDING STOCK

M	AMOUNT STOCK
Less than M1.25	0.15
1.5~1.75	0.2
2~2.75	0.25
3~5.5	0.3
6~12	0.4
13~18	0.5
20~25	0.6

STANDARD SHAVING STOCK

M	AMOUNT STOCK
M1~1.75	0.04
2~2.75	0.05
3~4.5	0.06
5~5.5	0.07
6~9	0.08
10~12	0.10



A=r_1(1−sinα)

C=Hcos(α−θ) /sinθ

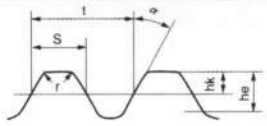
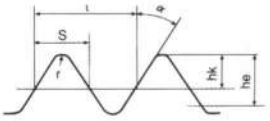
Shape of Protuberance

Mark \ Tooth Profile	Tooth Profile of PP, PSP		Tooth Profile of PGP, PGSP	
α	20°	14.5°	20°	14.5°
A	0.1974m	0.2249m	0.1974m	0.2249m
B	0.1m	0.1m	0.08m	0.06m
C	11.0828H	16.0795H	7.0283H	9.4617H
θ	5°	3.5°	8°	6°
H	0.75△S	0.75△S	0.7△S	0.7△S
r_1	0.3m	0.3m	0.3m	0.3m

INVOLUTE SPLINE, SERRATION TOOTH PROFILE

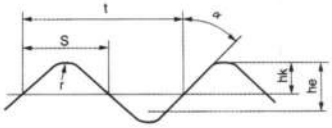
Involute Spline and Serration Tooth Profile have been specified in JIS D2001, JIS B1603, ANSI B92.2 and DIN5480.

Hob Tooth Profile for Involute Spline (Standard Tooth Profile)

Tooth Profile / Item	KS JIS D2001		DIN5480 JIS B1603		ANSI SAE within the limit of inch thread,(B92.1~1970)				Standard Tooth Profile
	Flat Bottom	Rounded Bottom	Flat Bottom	Rounded Bottom	Flat Bottom	Rounded Bottom	Flat Bottom	Rounded Bottom: More than DP16	Rounded Bottom: Less than DP12	
Module or DP	m		m		m		DP/DPS			 Flat Bottom Type (Flat Bottom Tooth)  Rounded Bottom Type (Rounded Bottom Tooth)
Standard Pressure Angle(α)	20°		30°		30°		30°			
Addendum(hk)	1.0m	1.146m	0.75m	0.9m	0.75m	0.9m	1.35/DPS (1.2/DPS +0.002)	2.0/DPS	1.8/DPS	
Working Depth(he)	1.2m	1.346m	1.25m	1.4m	1.25m	1.4m	2.35/DPS (2.2/DPS +0.002)	3.0/DPS	2.8/DPS	
Edge of Tooth Top(R)	0.3m	0.526m	0.2m	0.4m	1.2m	0.4m	0.075/DPS	0.36/DPS	0.46/DPS	
Pitch(t)	πm		πm		πm		πm			
Thickness of Tooth(s)	t/2		t/2		t/2		t/2			

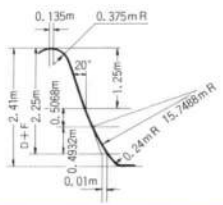
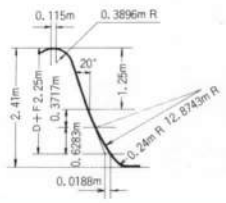
*In case of custom order for a large diameter gear, top of cutting edge should be chamfered.

Hob Tooth Profile for Involute Serration(Standard Tooth Profile)

Tooth Profile / Item	JIS Tooth Profile	ANSI (SAE) Tooth Profile				Standard Tooth Profile
		Metric Thread		Inch Thread (Unit: Inch)		
Module or DP	m	m		DP/DPS		
Standard Pressure Angle(α)	45°	37.5°	45°	37.5°	45°	
Addendum(hk)	0.5m	0.7m	0.6m	1.53/DPS	1.1/DPS	
Working Depth(he)	1.0m°	1.15m	1.0m	2.53/DPS +0.005	2.1/DPS	
Edge of Tooth Top(R)	0.4476m	0.3m	0.25m	0.4/DP	0.327/DP	
Pitch(t)	πm	πm		πm		
Thickness of Tooth(s)	1.3708m	t/2		t/2	1.3708/DP	

TOOTH PROFILE MODIFICATION

Since there are impacts, including elastic deformation, etc. when gear is being pressured, we have adopted modified tooth profile to protect gear from any interventions in conjugate giving some modification. For standard tooth profiles beyond m2 (D.P.12), B.S. A2; B class will be given, and B.S.C; D class is only for larger modules. But this only falls on the case when there is a separate instruction.

	A_2 ; B Tooth Profile Modification		C ; D Tooth Profile Modification
B. S (Basic Rock) [1.25m]		B. S (Basic Rock) [1.25m]	

TOLERANCES FOR HOBS WITH SPECIAL CLASS

Unit : ㎛

No.	Item	Standard Dimension (mm) / Grade	Tolerance					
			22	27	32	40	50	
			22.275	26.988	31.75	38.1		50.8
1	Hob Caliber	0	+9 (H5) 0	+9 (H5) 0	+11 (H5) 0	+11 (H5) 0	+11 (H5) 0	+13 (H5) 0
		1						
		2				+16 (H6) 0	+16 (H6) 0	+19 (H6) 0
		3	+13 (H6) 0	+13 (H6) 0	+16 (H6) 0			

No.	Item		Module (m) / Grade	Error Range and Tolerance						
				More than 1 Less than 1.6	More than 1.6 Less than 2.5	More than 2.5 Less than 4	More than 4 Less than 6.3	More than 6.3 Less than 10	More than 10 Less than 16	More than 16 Less than 25
2	Hub	Shaking outer diameter	0	5	5	5	6	6	(8)	(8)
			1	5	5	6	8	10	12	16
			2	6	6	8	10	12	18	20
			3	10	10	12	16	20	25	32
3		Shaking side	0	3	3	4	5	5	(6)	(6)
			1	5	5	5	6	8	10	12
			2	6	6	6	8	10	12	16
			3	8	8	8	10	12	16	20
4	Hob outer diameter	Shaking tooth edge	0	16	16	20	25	32	(40)	(50)
			1	25	25	25	32	40	50	63
			2	32	32	40	50	63	80	100
			3	63	63	80	100	125	160	200
5	Groove	Single Division Error (±)	0	16	20	25	32	40	(50)	(63)
			1	25	32	40	50	63	80	100
			2	42	50	63	80	100	125	160
			3	63	80	100	125	160	200	250
6		Cumulated Division Error	0	32	40	50	63	80	(100)	(125)
			1	50	63	80	100	125	160	200
			2	80	100	125	160	200	250	315
			3	125	160	200	250	315	400	500
7		Shaking toward radius	0	10	12	16	20	25	(32)	(40)
			1	16	20	25	32	40	50	63
			2	25	32	40	50	63	80	100
			3	40	50	63	80	100	125	160
8		Lead Error	Refer to No. 8							
9	Pitch	Single Pitch Variation(±)	0	5	6	8	10	12	(16)	(20)
			1	8	10	12	16	20	25	32
			2	12	16	20	25	32	40	50
			3	25	32	40	50	63	80	100
10		3-pitch Variation(±)	0	10	10	12	16	20	(25)	(32)
			1	16	16	20	25	32	40	50
			2	25	25	32	40	50	63	80
			3	40	50	63	80	100	125	160
11	Tooth Trace	Adjacent Pitch Variation	0	5	5	6	8	10	(12)	(16)
			1	8	8	10	12	16	20	25
			2	12	12	16	20	25	32	40
			3	(25)	(25)	(32)	(40)	(50)	(63)	(80)
12		One-turn Accumulated error	0	8	8	10	12	16	(20)	(25)
			1	12	12	16	20	25	32	40
			2	20	20	25	32	40	50	63
			3	(32)	(30)	(50)	(63)	(80)	(100)	(125)
13		3-turn Accumulated error	0	12	12	16	20	25	(32)	(40)
			1	20	20	25	32	40	50	63
			2	32	32	40	50	63	80	100
			3	(50)	(63)	(80)	(100)	(125)	(160)	(200)
14	Tooth Profile	Profile Variation	0	5	6	8	10	14	(22)	(36)
			1	8	10	12	16	22	36	56
			2	12	16	20	25	36	56	90
			3	20	25	32	40	56	90	140
15		Tooth Thickness Error	0	20	20	25	25	32	(40)	(50)
			1	20	20	25	32	40	50	63
			2	32	32	40	50	63	80	100
			3	50	50	63	80	100	125	160

No.	Item		Length of Hob mm / Hob Grade	Tolerance				
				Less than 50	More than 50 Less than 100	More than 100 Less than 150	More than 150 Less than 200	More than 200
8	Groove	Lead Error (±)	Entire Grade	40	60	80	100	120

PRECISION OF GEAR AND HOB GRADE TABLE

Comparison of Each Nation' s Precision Grade of Gear

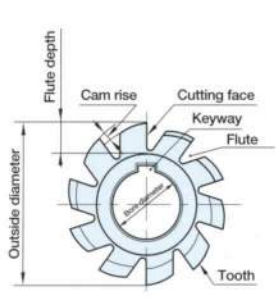
Specification	Confidence Level and Precision Grade											
KS (Korea)				0	1	2	3	4	5	6	7	8
DIN (Germany)	1	2	3	4	5	6	7	8	9	10	11	12
ANSI (America)					4	3	2	1				
BS (England)					A_1	A_2	B	C	D			
FN (France)				A	B	C	D	E				
AGMA (America)				14	13	12	11	10	9	8	7	6

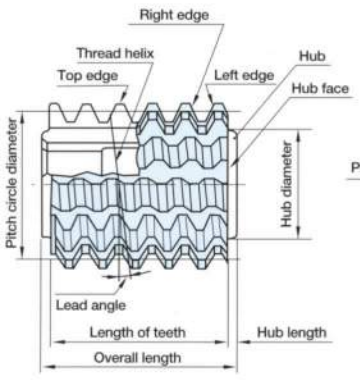
Comparison of Each Nation' s Precision grade of hob

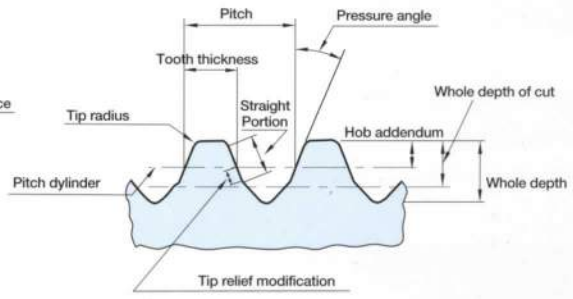
Classification		KS and JIS	DIN	AG/MA	BS
Grade	Grinding			AA	AA
		0	AA	A	A
		1	A	B	B
		2	B	C	
	Non-grinding	3	C	D	D
			D		

Note: AGMA, Grade "G" is non-grinding.

HOB-VOCABULARY







Normal section of hob tooth profile

Cutting Condition (Standardized Condition of Module 2-2.5)

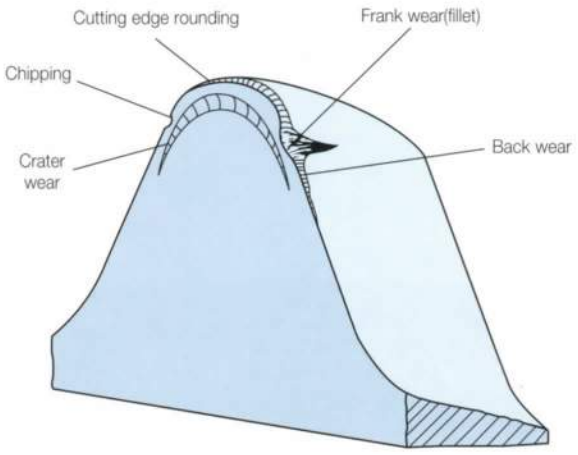
Item	Range of Use			
	Subject Material to be machined	Cutting Speed (m/min)	Climb cut Feed (mm/rev)	
			Number of Conditions 1-2	Number of Conditions 3-5
Cutting Speed and Up Milling	More than S45C	40-70	1.5 - 2.5	1.0 - 2.0
	SCM440	50-80	2.0 - 3.0	1.5 - 2.5
	SCM420 SCr 420	60-110	2.5 - 3.5	2.0 - 3.0
	FID 70	40-50	2.0 - 3.0	1.5 - 2.5
Conventional cut	As it causes to bring an damage on Hob rapidly, please avoid this job as much as possible. (Applying to a large module)			
Work Speed	Hob RPM : Q Number of Conditions of Hob: Work Speed as = TH $\times \frac{Q}{Z}$ (min-1) Work Dimension: Z			
Depth of Grinding	This will be depended upon all requirements of the subject gear that will machined.			
Amount of Shift	0.1m - 0.5m(m: module)			

Sharpening

Damages of cutter caused by hob cutting can largely be divided into flank wear and crater wear depending upon the damaged part.
Economical timing for Sharpening job will be -

- When the wear has reached up to the point of 0.2 mm from the width of frank wear.
- When the wear has reached up to the point of 0.1 mm from the depth crater wear.
- We recommend the amount of sharpening, as of (amount of wear + 0.1 mm).
- And it is important to choose a grinding wheel that has been Sharp, and at the same time you need to be careful about heat that makes the edge of hob cutter dull, and occurrence of cracks during grinding works.

Particularly, we suggest that you avoid creep feed grinding with powder metal involving with high-alloy steel, instead we commend you to do it by light cutting and grinding with high transmitting speed.



Types of wear on a hob tooth

For an example; S-31, SNC-30

Material of Hob	Diameter of Grinding Wheel	Number of Revolutions of Grinding Wheel	Transmitting Speed	Amount of Cutting		Grinding Liquid
HSS	200mm	2200-3000/min	300-600/min	Rough	0.10-0.15mm	Liquid exclusively for grinding purpose
				Completion	0.02-0.05mm	
Powder metal	200mm	2200-3000/min	300-600/min	Rough	0.05-0.10mm	
				Completion	0.01-0.02mm	

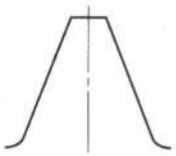
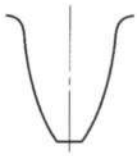
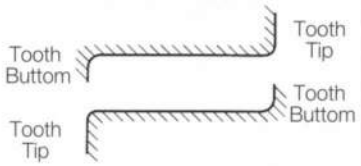
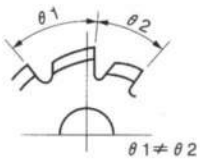
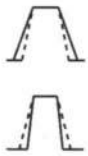
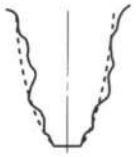
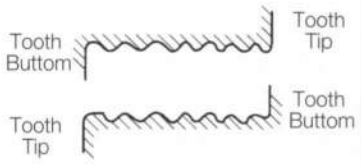
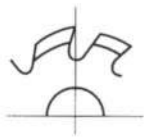
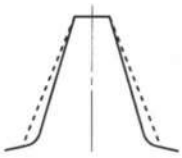
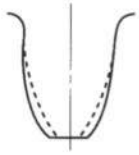
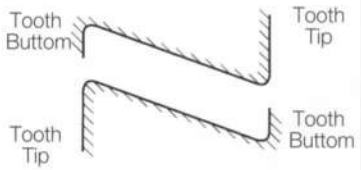
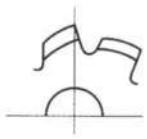
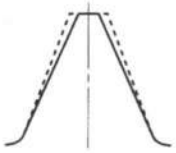
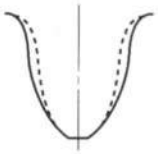
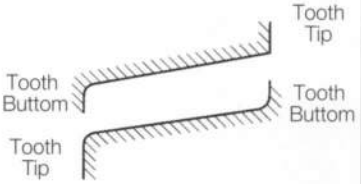
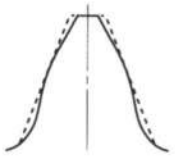
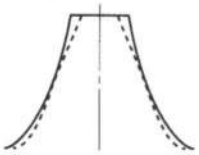
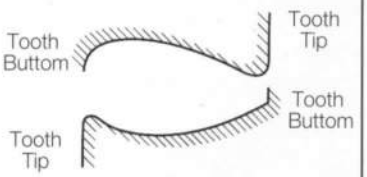
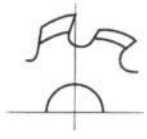
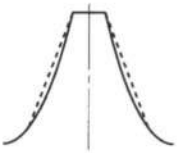
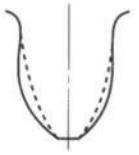
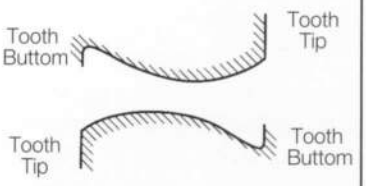
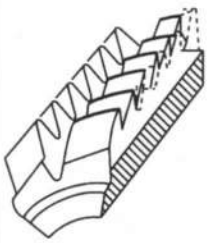
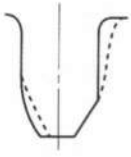
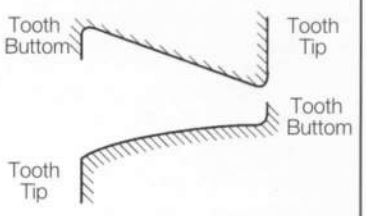
Grinding Wheel now in use	CB 100-R 100B90T
Abrasive Grain	CBN(Retinoid)
Particle Intensity	100
Concentration	100
Coherence	R

Point of sharpening

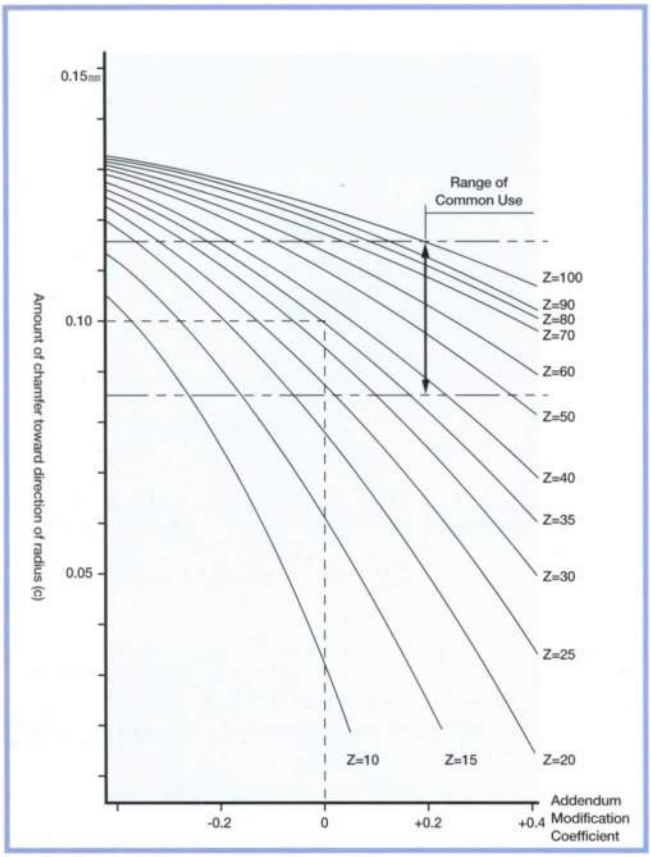
- To decide an economical timing for sharpening, please regard it as standard when the wear has been approached to the point of about 0.2 mm from the width of wear of clearance space.
- Be careful about occurrence of plastic deformation during grinding works.
- Please sharpen the edge of cutter often using white stone.
- Please change grinding fluid regularly, two times a year.

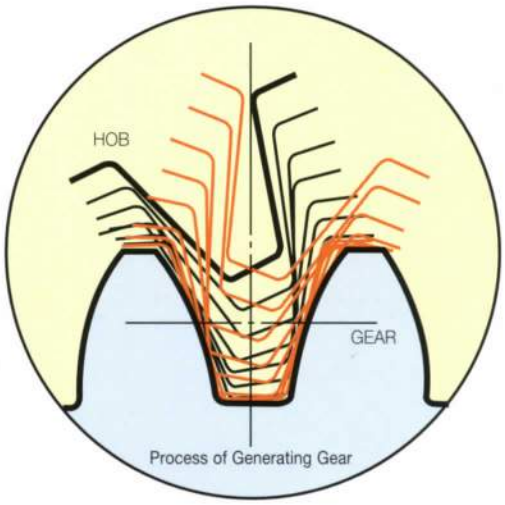
SHARPENING ERROR

Side effects of Sharpening error

Item	State of Hob		Impact toward machining workplece	
	Angle of Cutte	Tooth Profile	Tooth Profile	Tooth Profile Chart
Normal State				
In case there is groove division error				
In case there is groove division error				
In case cutting angle is small				
In case cutting surface is convex				
In case cutting surface is concave				
In case there is an error in the lead of groove				

ADDENDUM MODIFICATION COEFFICIENT AND AMOUNT OF CHAMFER





PRESSING TOOL[HOB] INTO GROOVE WHEN CUTTING GEAR

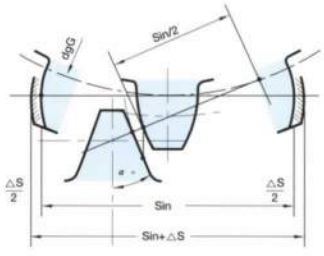
Conversion Table for Adding or Subtracting Thickness of Tooth when cutting gear

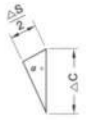
Input Value $\alpha = 20°$

△S	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0		0.015	0.025	0.044	0.059	0.073	0.088	0.102	0.117	0.132
0.1	0.146	0.161	0.175	0.190	0.205	0.219	0.234	0.249	0.263	0.278
0.2	0.292	0.307	0.322	0.336	0.351	0.366	0.330	0.395	0.409	0.242
0.3	0.439	0.453	0.468	0.483	0.497	0.512	0.526	0.541	0.556	0.570
0.4	0.585	0.599	0.614	0.629	0.643	0.658	0.673	0.687	0.702	0.716
0.5	0.731	0.746	0.760	0.775	0.790	0.804	0.819	0.883	0.848	0.863
0.6	0.899	0.892	0.906	0.921	0.936	0.950	0.965	0.980	0.994	1.009
0.7	1.023	1.038	1.053	1.067	1.082	1.097	1.111	1.126	1.140	1.155
0.8	1.170	1.184	1.199	1.214	1.228	1.243	1.257	1.272	1.287	1.301

Input Value $\alpha = 14.5°$

△S	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0		0.020	0.040	0.060	0.080	0.100	0.120	0.140	0.160	0.180
0.1	0.200	0.220	0.240	0.260	0.280	0.300	0.320	0.340	0.360	0.379
0.2	0.399	0.419	0.439	0.459	0.497	0.499	0.519	0.539	0.559	0.579
0.3	0.599	0.619	0.639	0.659	0.679	0.699	0.719	0.739	0.759	0.779
0.4	0.779	0.819	0.839	0.859	0.879	0.899	0.919	0.939	0.959	0.979
0.5	0.999	1.019	1.038	1.058	1.078	1.098	1.118	1.138	1.158	1.178
0.6	1.198	1.218	1.238	1.258	1.278	1.298	1.318	1.338	1.358	1.378
0.7	1.398	1.418	1.438	1.458	1.478	1.498	1.518	1.538	1.558	1.578
0.8	1.598	1.618	1.638	1.658	1.677	1.697	1.717	1.737	1.757	1.777



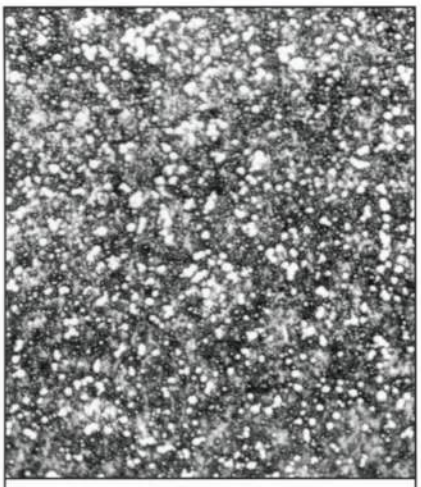


When cutting gear, if the thickness of tooth to be laid across is as much larger as $\triangle_s$ than that of drawing, then press the tool (HOB shaving cutter or grindstone) into the direction toward radius as much as $\triangle_c$.

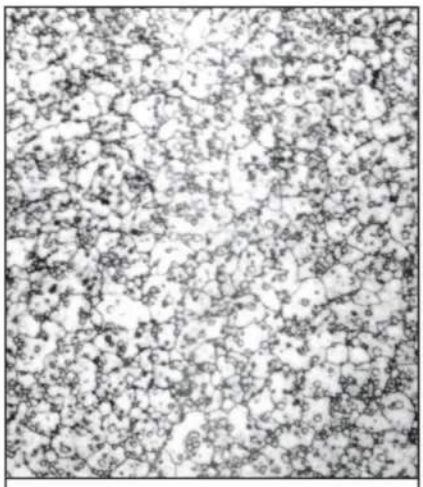
$$\triangle C = \frac{\triangle S}{\triangle C = 2 \sin \alpha_o}$$

In case α_o is 14.5°,
$\triangle C = 1.997$, $\triangle S \fallingdotseq 2\triangle C$
In case α_o is 20°,
$\triangle C = 1.462$, $\triangle S \fallingdotseq 1.5\triangle C$

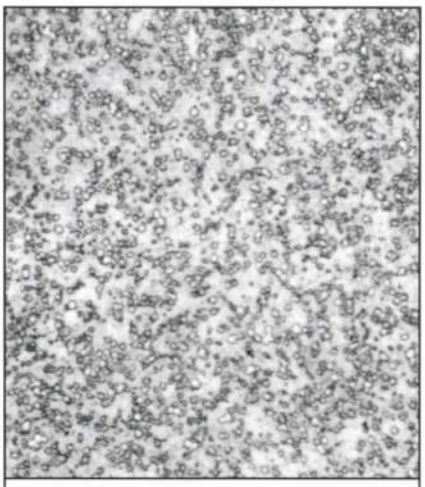
Microstructure after heat treatment



MATERIAL × 400



QUENCHING × 400



TEMPERING × 400

Material Components

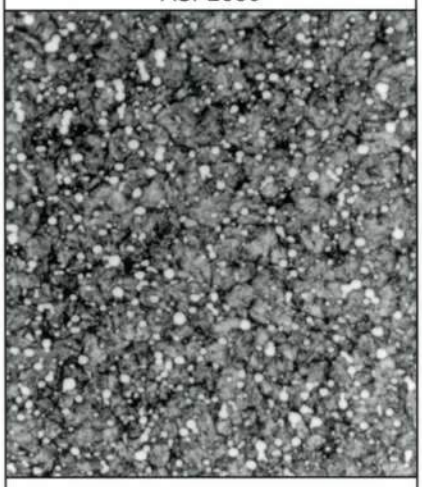
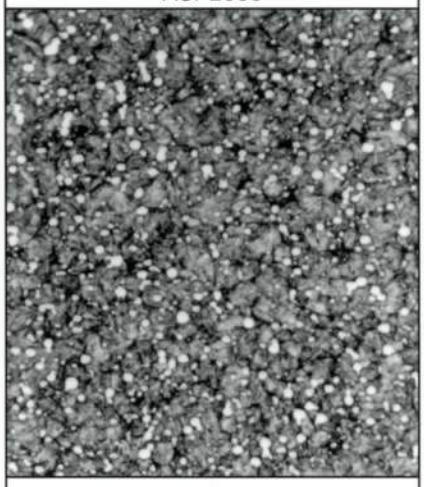
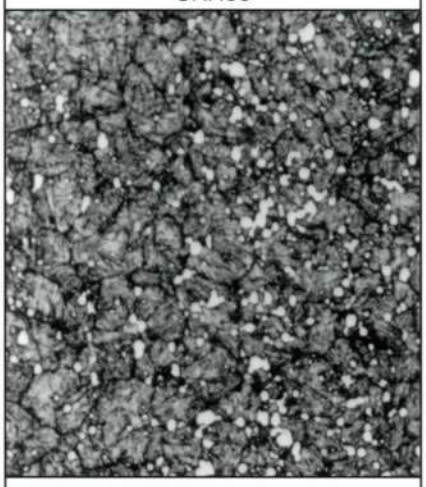
AISI / KS / Component (%)		C	Si	Mn	P	S	Cr	Ni	Cu	Mo	W	V	Co
M2	SKH51 (SKH9)	0.8 0.9	Below 0.4	Below 0.4	Below 0.03	Below 0.03	3.8 4.5	Below 0.25	Below 0.25	4.5 5.5	5.5 6.7	1.6 2.2	
M35	SKH55	0.8 0.9	〃	〃	〃	〃	〃	〃	〃	4.8 6.2	5.5 6.7	1.7 2.3	4.5 5.5
M36	SKH56	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	7.0 9.0
M42	SKH59	1.0 1.15	Below 0.5	〃	〃	〃	3.5 4.5	〃	〃	9.0 10.0	1.2 1.9	0.9 1.4	7.5 8.5
ASP2030		1.27	Below 0.3	Below 0.3			4.2			5.0	6.4	3.1	8.5
ASP2060		2.30	Below 0.55	Below 0.4			4.2			7.0	6.5	6.5	10.5
CPM45		1.3	Below 0.5	Below 0.4		Below 0.3	4.05			5.0	6.25	3.05	8.25
HAP50		1.6					4.0			6.0	8.0	4.0	8.0
HS30		1.27	Below 0.25	Below 0.3	0.03	0.03	4.2			5.0	6.25	3.1	8.5

Types of High-Speed Tool Steel and Application

Symbol		Hardness	Characteristics	Application
M1		63-65	A standard high-speed tool steel belonging to molybdenum(Mo) system. It displays a high-quality of non-machinability.	Tap and various cutters
M2	SKH51	64-66	A standard high-speed tool steel of Mo system. It has an excellent tenacity.	Drill, TAP, Reamer, Broach, Various Cutters and Saws, Cold Punch and Die, and Various Molding Products
M35	SKH55	65-67	A standard high-speed tool steel of mo-co system. It has an outstanding quality of heat-resistance	HOB, Drill, Reamer, Chaser, Various Cutters, Stainless Valves to adjust high pressure, and various cutting machines and tools
M36	SKH56	65-67	A high-speed tool steel having enforced heat-resistant feature of M35	End Mill, Drill, HOB
M42	SKH59	66-68	A standard high-speed tool steel in M40 series. It displays excellent characteristics of endurance of cutting and of machinability	End Mill, Drill, RAP, Broach
PM(POWDER METAL)		66-68	This is powdered HSS steel having excellent characteristics of wear resistance, tenacity, heat-resistance and machinablity	HOB, End Mill, Drill, Cutter, Broach, Cutting Tool

HEAT TREATMENT

Microstructure of hob materials

ASP2030	ASP2060	SKH55
		
Hardening 1180℃ Tempering 3x1h 560℃ Hardness HRC 67,0	Hardening 1180℃ Tempering 3x1h 560℃ Hardness HRC 67,5	Hardening 1220℃ Tempering 3x1h 560℃ Hardness HRC 66,5

Heat Treatment

Material	Bottom Temperature	Annearing	Hardeing	Tempering	Annearing HB	Tempering HRC	Applications
SKH 2	900-1150 Annealing	820-880 Annealing	1260°-1300° Oil Quenching	550°-580° Air-Cooling	Less than 248	More than 62	General cutting tool
SKH 3	900-1150 Annealing	820-880 Annealing	1260°-1300° Oil Quenching	550°-580° Air-Cooling	Less than 262	More than 63	High speed cutting tool
SKH 51	900-1150 Annealing	820-880 Annealing	1260°-1300° Oil Quenching	550°-580° Air-Cooling	Less than 255	More than 62	Cutting tool required for tenacity
SKH 55	900-1150 Annealing	820-880 Annealing	1260°-1300° Oil Quenching	550°-580° Air-Cooling	Less than 277	More than 63	High speed cutting tool

Classification of Heat Treatment

Steel Quality	Capacity	Hardness	Types of Steel
High-Speed Steel	350×350×450	HRC56-68	SKH51, SKH55, SKH59 CPM REX15, REX41, REX45 ASP23, ASP30, HAP40, HAP50 SKH4A, YXM60
Alloy Steel	〃	HRC40-63	SKD11, SKD12, SKD61, SKD5, SUS410, SUS416, SUS420, SUS440, 8407, QRO90, DC53, STAVAX, XW41
Structural Steel	〃	HRC20-60	S45C, S55C, SCM4, SNCM8, SK3, SK5, SKS3, SUJ2, SUP SCM420, 430, 440, SNC836, SNCM439, STD4
SUS Solution Treatment	〃	Less than HB210	SUS303, SUS304, SUS310, SUS316, SUS630

COATING

■ Coating of tools is mainly done by titanium metal including TiN and TiCN, etc.

As coating method, TiN is turned to a state of plasma in vacuum furnace and it is deposited on tool by Physical Vapour Deposition (PVD).

TiN Coating Effect

- Increasing life cycle of tool
  - With high surface hardness on TiN coating surface (above HRC 83) and strong anchor forces for PVD, it enables to prolong life cycle of tool 3 to 8 times more.

- Increasing productivity
  - Cutting speed and its depth is to be increased on account of improved hardness of TiN coating surface and wear resistance, it leads to increasing productivity.

- Improving Surface Roughness
  - It improves surface roughness by lubricating activity on TiN coating surface.

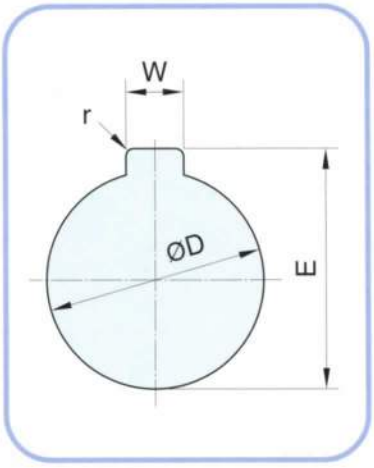
- Sharpening and Reducing Exchange Time

- Increasing anticorrosive life cycle
  - Since TiN coating surface itself has anticorrosive effect, it prolongs life for preservation.

COATING CHARACTERISTICS TABLE

Coating Material	TiN	TiCN TiCN+TiN	WC/C	CrN	CrN	CrC	TiAlN Multiple Layer	TiAlN NANO Structure	TiAlN Single Layer	TiAlN Single Layer	TiAlN + WC/C	Polycrist. Diamond
Microhardness (HV 0.05)	2,300	3,000	1,000 1,500	1,750	1,750	1,850	3,000	3,300	3,500	3,300	3,000	8,000 ~10,000
Fractional Coefficient against steel (Dry Type)	0.4	0.4	0.1~0.2	0.5	0.5	0.4	0.4	0.3~0.35	0.4	0.4	0.15~0.2	
Coating Thickness (㎛)	1~4	1~4	1~4	1~6	1~6	1~6	1~5	1~5	1~3	1~3	2~6	6~30
Coating Internal Stress (GPa)	-2.5	-4.0	-1.0	-1.5 -2.0	-1.5 -2.0	-1.5 -2.0	-1.7 -2.0	-1.3 -1.5	-4.0	-3.0 -3.5	-1.3 -1.5	
Coating Temperature (℃)	〈500	〈500	〈250	〈500	〈250	〈500	〈500	〈500	〈500	〈550	〈500	〈800
Maximum Applicable Temperature (℃)	600	400	300	700	700	700	800	900	800	900	800	600
Coating Color	Gold	Bluish gray Gold	Darkish gray	Silver gray	Silver gray	Silver gray	Purplish gray	Purplish gray	Purplish-red gray	Bluish gray	Darkish gray	Darkish gray
Wear Resistance	++	+++	+ ++	++	++	++	+++	+++	+++	+++	+++	++++
Welding wear resistance	++	++	+++	++	++	++	++	++	++	++	+++	++
Corrosion Resistance	+	+	+	+++	+++	+++	+	+	+	+	+	+
Oxidation Resistance	++	++	++	++	++	++	++	++	++	++	++	+
Surface Fatigue Resistance			++ +									

HOB KEY



A Type (By Meter)

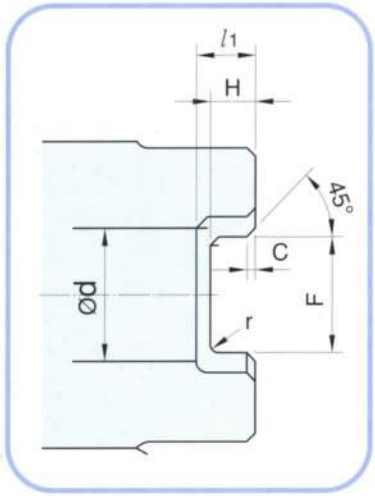
(mm)

Size	D		E		W		Remark
	Standard Dimension	Tolerance	Standard Dimension	Tolerance	Standard Dimension	Tolerance	r
8	8	H5	8.9	+0.25 0	2	+0.16 +0.06	0.4
10	10		11.5		3		0.6
13	13		14.6				
16	16		17.7		4	+0.19 +0.07	1
19	19		21.1		5		
22	22		24.1		6		
27	27		29.8		7	+0.23 +0.08	1.2
32	32		34.8		8		
40	40		43.5	+0.3 0	10		
50	50		53.5		12	+0.275 +0.095	1.6
60	60		64.2		14		
70	70		75.0		16		2
80	80		85.5		18		
100	100		107.0		24	+0.32/+0.11	2.5

B Type (By Inch)

(mm)

Size	D		E		W		Remark
	Standard Dimension	Tolerance	Standard Dimension	Tolerance	Standard Dimension	Tolerance	r
12.7	12.7	H5	14.2	+0.25 0	2.39	+0.31 +0.13	0.5
15.875	15.875		17.7		3.18		0.8
19.05	19.05		20.9				
22.225	22.225		24.1				
25.4	25.4		28.0		6.35		1.2
26.988	26.988		29.8		7	+0.23/+0.08	
31.75	31.75		35.2		7.92	+0.32/+0.14	1.6
38.1	38.1		42.3		9.52	+0.89 +0.25	
44.45	44.45		49.5		11.12		
50.8	50.8		55.8		12.7		
63.5	63.5		69.4		15.87		
76.2	76.2		82.9		19.05		2.4
88.9	88.9		98.8		22.22		
101.6	101.6		111.5		25.4		
114.3	114.3		125.8		28.58		3.2
127	127		140.1		31.75		



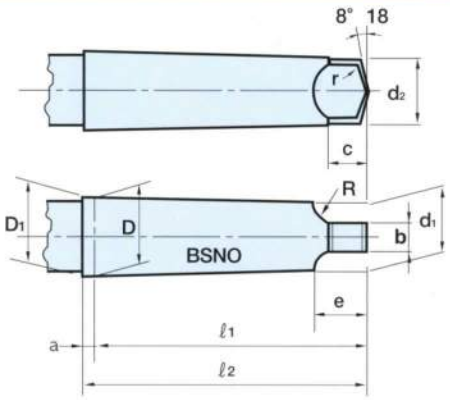
SIDE Type (One-sided Style)

(mm)

Internal Diameter d		F		H		r	$\epsilon_{(1)}$	l_1	c
A Type	B Type	Standard Dimension	Tolerance (H11)	Standard Dimension	Tolerance (H13)				
22	22.225	10.4	+0.11 0	6.3	+0.220 0	$1.2^{0}_{-0.3}$	0.100	7	$0.6^{+0.2}_{0}$
27	26.988	12.4		7.0				8	$0.8^{+0.2}_{0}$
32	31.75	14.4		8.0		$1.6^{0}_{-0.4}$		9	
40	38.1	16.4		9.0		$2.0^{0}_{-0.5}$		10	$1.0^{+0.3}_{0}$
50	50.8	18.4	+0.130 0	10.0				11	
60	63.5	20.5		11.0	+0.270 0		0.125	12	
80	76.2	24.5		14.0		$2.5^{0}_{-0.5}$		15	$1.2^{+0.3}_{0}$

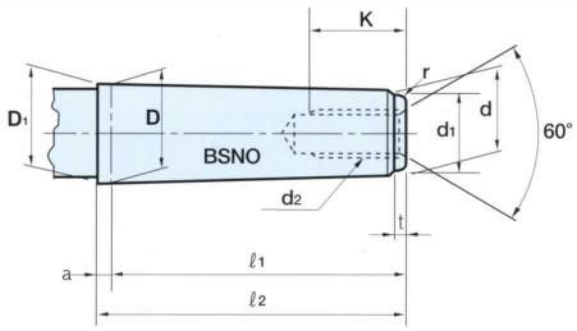
(1) : ϵ is maximum tolerance between the center of axis of d, internal diameter and midline of F.

Brown & Sharpe Taper



(mm)

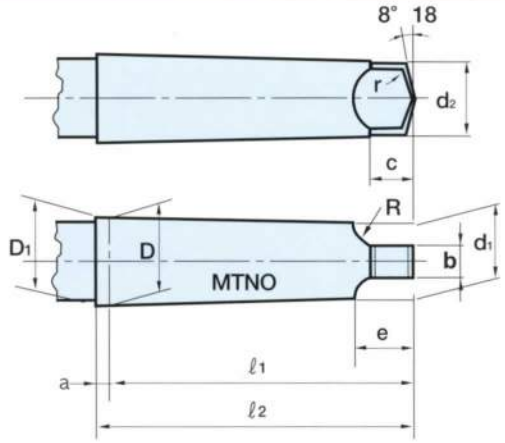
B&SNO.	D	a	D1	d1	d2	ℓ 1	ℓ 2	b	c	e	R	r
4	10.221	2.4	10.321	8.458	8.1	42.1	44.5	5.5	8.7	14.4	7.9	1.3
5	13.286	2.4	13.386	10.962	10.7	55.6	58.0	6.3	9.5	16.2	7.9	1.5
6	15.229	2.4	15.330	12.167	11.7	73.0	75.4	7.1	11.1	18.0	7.9	1.5
7	18.424	2.4	18.524	14.675	14.2	89.7	92.1	7.9	11.9	20.3	9.5	1.8
8	22.828	3.2	22.962	18.453	18.0	104.8	108.0	8.7	12.7	22.0	9.5	2.0
9	28.104	3.2	27.238	22.200	21.8	117.5	120.7	9.5	14.3	25.4	11.1	2.8
10	32.749	3.2	32.887	25.751	25.7	162.7	165.9	11.1	16.7	28.1	11.1	2.8
11	38.905	3.2	39.039	30.985	30.7	189.7	192.9	11.1	16.7	30.0	12.7	3.3
12	45.641	3.2	45.774	37.246	37.1	201.6	204.8	12.7	19.0	32.5	12.7	3.8
13	52.654	3.2	52.787	43.589	43.4	217.5	220.7	12.7	19.0	35.7	15.9	4.2
14	59.533	3.2	59.666	49.841	49.8	232.6	235.8	14.2	21.4	41.2	19.0	4.8
15	66.408	3.2	66.541	56.186	56.1	245.3	428.5	14.2	21.4	44.4	22.2	5.3
16	73.292	3.2	73.425	62.441	62.2	260.4	263.6	15.8	23.8	50.0	25.4	5.8



(mm)

B&SNO.	D	a	D1	d	d1	ℓ 1	ℓ 2	t	r	d2	K
4	10.221	2.4	10.321	8.890	8.0	31.8	34.2	2	0.2	-	-
5	13.286	2.4	13.386	11.430	10.0	44.4	46.8	3	0.2	-	-
6	15.229	2.4	15.330	12.700	11.0	60.3	62.7	3	0.2	M8(1/4)	20
7	18.424	2.4	18.524	15.240	14.0	76.2	78.6	4	0.2	M10(3/8)	24
8	22.828	3.2	22.962	19.050	17.0	90.5	93.7	4	0.6	M12(1/2)	28
9	28.104	3.2	27.238	22.863	21.0	101.6	104.8	4	0.6	M12(1/2)	28
10	32.749	3.2	32.887	26.534	24.0	144.5	147.7	5	1.0	M16(5/8)	32
11	38.905	3.2	39.039	31.749	29.0	171.4	174.6	5	1.0	M16(5/8)	32
12	45.641	3.2	45.774	38.103	35.0	181.0	184.2	6	2.5	M20(3/4)	40
13	52.654	3.2	52.787	44.451	41.0	196.8	200.0	6	3.0	M20(3/4)	40
14	59.533	3.2	59.666	50.800	47.0	209.6	212.8	7	4.0	M24(1)	40
15	66.408	3.2	66.541	57.150	53.0	222.2	225.4	7	4.0	M24(1)	50
16	73.292	3.2	73.425	63.500	59.0	235.0	238.2	8	5.0	M30(1/6)	60

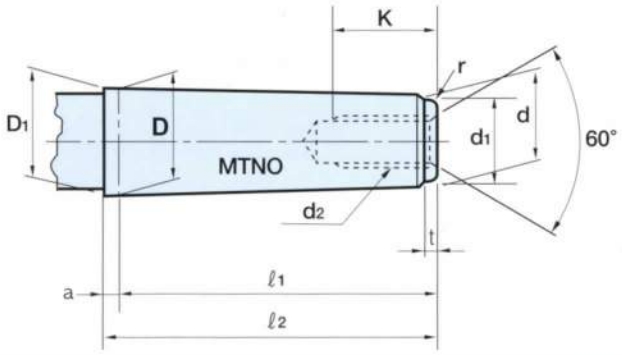
Morse Taper



(mm)

MT NO.	Taper	Taper Angle(α)	D	a	D1	d1	ℓ1	ℓ2	d2	b	c	e	R	r
0	1/19.212	1°29′27″	9.045	3	9.201	6.104	56.5	59.5	6.0	3.9	6.5	10.5	4	1
1	1/20.047	1°25′43″	12.065	3.5	12.240	8.972	62.0	65.5	8.7	5.2	8.5	13.5	5	1.2
2	1/20.020	1°25′50″	17.780	5	18.030	14.034	75.0	80.0	13.5	6.3	10	16	6	1.6
3	1/19.922	1°26′16″	23.825	5	24.076	19.107	94.0	99.0	18.5	7.9	13	20	7	2
4	1/19.254	1°29′15″	31.267	6.5	31.605	25.164	117.5	124.0	24.5	11.9	16	24	8	2.5
5	1/19.002	1°30′26″	44.399	6.5	44.741	36.531	149.5	156.0	35.7	15.9	19	29	10	3
6	1/19.180	1°29′36″	63.348	8	63.765	52.399	210.0	218.0	51.0	19.0	27	40	13	4
7	1/19.231	1°29′22″	83.058	10	83.578	68.186	286.0	296.0	66.8	28.6	35	56	19	5

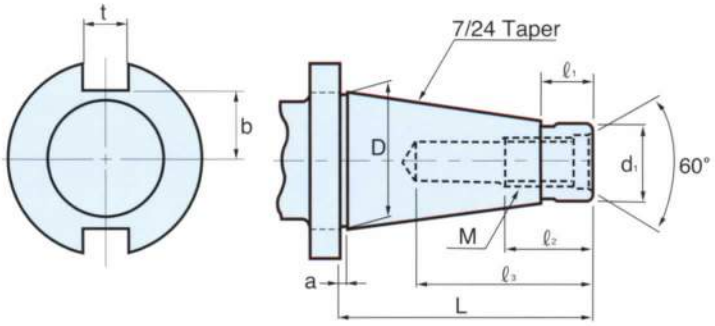
Morse taper



(mm)

MT NO.	Taper	Taper Angle(α)	D	a	D1	d	ℓ1	ℓ2	d1	d2	k	t	r
0	1/19.212	1°29′27″	9.045	3	9.201	6.442	50	53	6	-		4	0.2
1	1/20.047	1°25′43″	12.065	3.5	12.230	9.396	53.5	57	9	M6	8.5	5	0.2
2	1/20.020	1°25′50″	17.780	5	18.030	14.583	64	69	14	M10	10	5	0.2
3	1/19.922	1°26′16″	23.825	5	24.076	19.759	81	86	19	M12	13	7	0.6
4	1/19.254	1°29′15″	31.267	6.5	31.605	25.943	102.5	109	25	M16	16	9	1
5	1/19.002	1°30′26″	44.399	6.5	44.741	37.584	129.5	136	35.7	M20	19	9	2.5
6	1/19.180	1°29′36″	63.348	8	63.765	53.859	182	190	51	M24	27	12	4
7	1/19.231	1°29′22″	83.058	10	83.578	70.058	250	260	65	M33	35	18.5	5

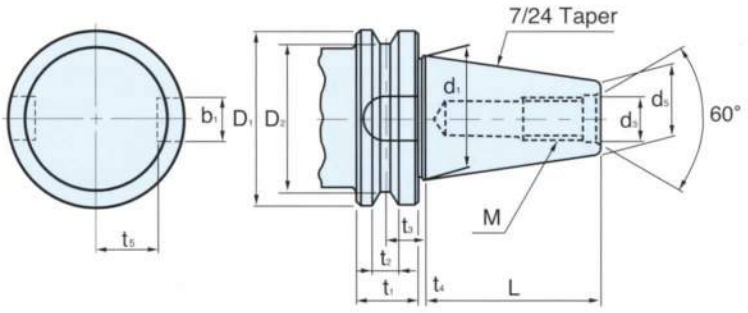
National Taper



(mm)

NT NO.	Nominal Dimension	D	d1	L	ℓ1	M	ℓ2	ℓ3	a	t	b
30	1 1/4"	31.750	17.40 -29 -0.36	70	20	UNC 1/2"	24	50	1.6	15.9	16
40	1 3/4"	44.450	25.32 -0.30 -0.384	95	25	UNC 5/8"	30	60	1.6	15.9	22.5
50	2 3/4"	69.850	17.40 -0.31 -0.41	130	25	UNC 1"	45	90	3.2	25.4	35
60	4 1/4"	107.950	17.40 -0.34 -0.46	210	45	UNC1 1/4"	56	110	3.2	25.4	60

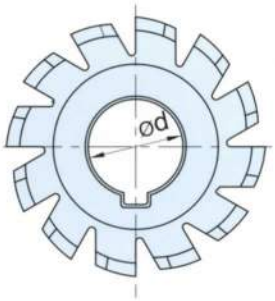
Bottle clip taper

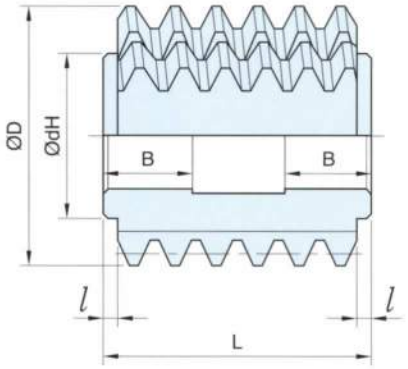


(mm)

BT NO.	D1	D2	T1	T2	T3	T4	d1	d3	L	M	b1	t5	d5
35	56	43	22	10	14.6	2	38.1	13	56.5	M12 X 1.75	16.1	19.6	21.62
40	63	53	25	10	16.6	2	44.45	17	65.4	M16 X 2	16.1	22.6	25.3
45	85	73	30	12	21.2	3	57.15	21	82.8	M20 X 2.5	19.3	29.1	33.1
50	100	85	35	15	23.2	3	69.85	25	101.8	M24 X 3	25.7	35.4	40.1
60	155	135	45	20	28.2	3	107.95	31	161.8	M30 X 3.5	25.7	60.1	60.7

STANDARD HOB

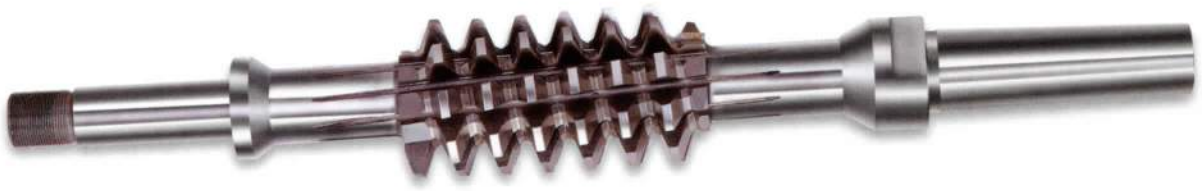


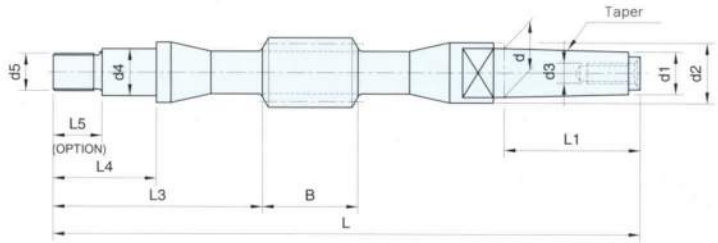


(Unit : mm)

Module (M)	Diametral Pitch (DP)	Standard Hob						
		Out Diameter(D)	Full Length(L)	Inside Diameter(d)	HOB Diameter	HOB Width	Width of Inner Diameter	Number of Flute (N)
1	24-22	50	50	22 (22.225)	34	4	12	12
1.25	20	50	50		34		12	
1.5	18-16	55	55		36		14	
1.75	14	55	55		36		14	
2	12	60	60		38		15	
2.25	11	60	60		38		15	
2.5	10	65	65		38		16	
2.75	9	65	65		38		16	
3	8	70	70	27 (25.4)	42		18	
3.25		70	70		42		18	
3.5		75	75		45		20	
3.75	7	80	75		50		20	
4	6	85	80		52		20	
4.5	5.5	90	85		52		22	
5	5	95	90		52		22	
5.5	4.5	100	95	32 (31.75)	58	5	24	12
6		105	100		60		25	
6.5	4	110	110		60		28	
7	3.5	115	115		60		28	
8	3	120	130		60		32	
9	2.65	125	145		60		36	
10	2.5	130	160		60		40	
11	2.25	140	175	40 (38.1)	60		44	
12		150	190		60	10	48	
13	2	160	200		70		50	9
14	1.75	170	210		70		52	
15		180	220		74		54	
16	1.5	190	230		84		58	
18		210	250	50 (50.8)	94		62	
20	1.25	220	270		94		65	
22		230	300		94		68	
24		250	320		100		75	
25	1	250	320		100		80	
26		280	340	60	100		85	
28		300	360		110		90	
30		310	380		110		95	

WORM GEAR HOB





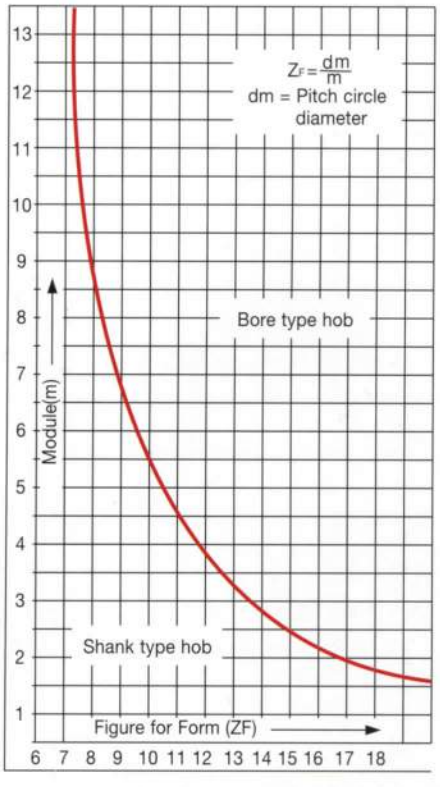
◈ Worm Data is mostly influential on designing Worm Hob, so that when ordering worm hob, you need data of worm.

◈ At the time you order, please choose your type, profile and data among the following options, and present it to us with Worm Data (drawing).

- Select either BORE TYPE or SHANK TYPE
  - In case of SHANK TYPE, present specification of SHANK
- Select standard of tooth profile; ZE, ZK, ZN, ZA, and others
  - In general, worm hob is manufactured by the standard profile of "ZK and ZI."
- WORM DATA
  - Axial or Normal module
  - Pressure angle
  - Worm out diameter and pitch circle diameter
  - Lead angle and direction
  - Number of worm threads

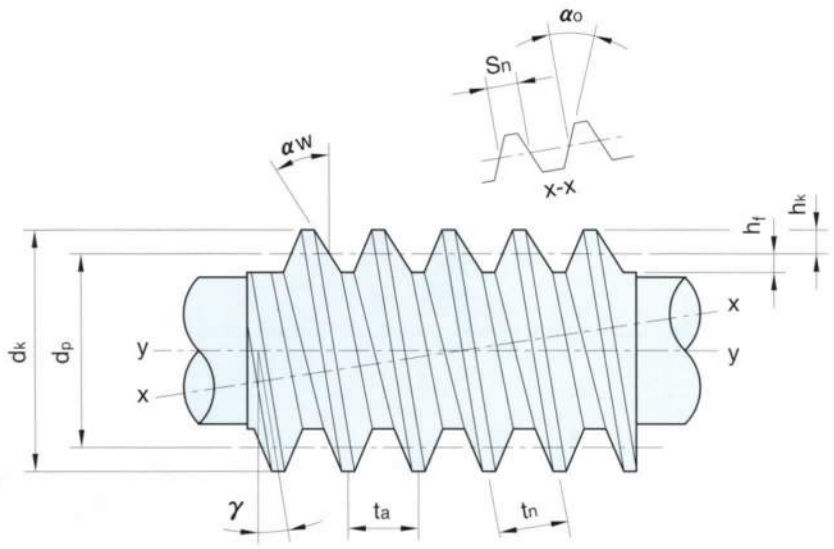
◈ For general bore type and shank type of HOB, please refer to the graph at the right.

Selection Table for Worm Hob Type



DATA REQUIRED TO DESIGN WORM GEAR HOB

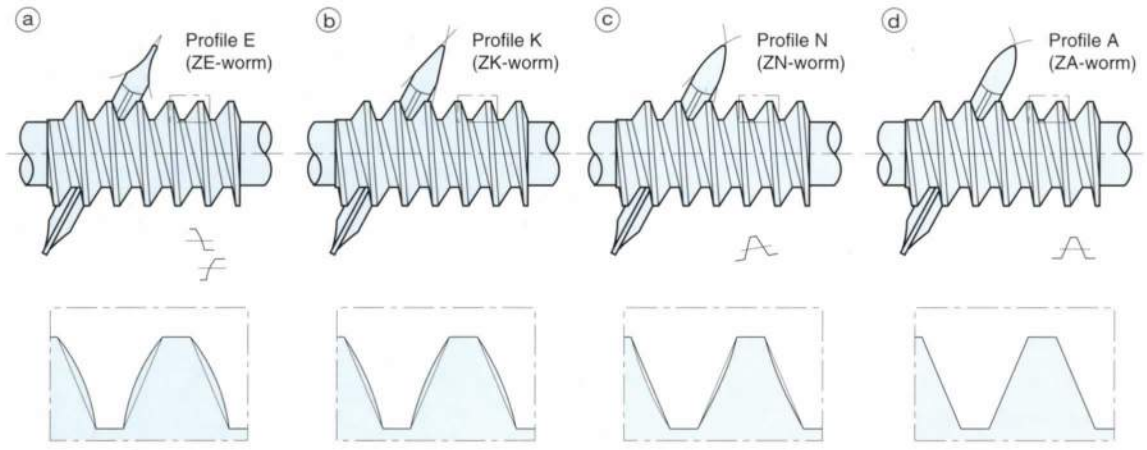
Worm hob - Vocabulary



x-x : Normal Section
y-y : Axial Section
d_p : Pitch Diameter
d_k : Outer Diameter
t_n : Normal Pitch
t_a : Axial Pitch
S_n : Normal Tooth Thickness
γ : Helix Angle (Right/Left)

α_o : Normal Pressure Angle
α_w : Axial Pressure Angle
h_k : Addendum
h_f : Dedendum
m_n : Normal Module
m_s : Axial Module
z_w : Number of Threads
z_2 : Number of Teeth of Worm Gear

Flank forms



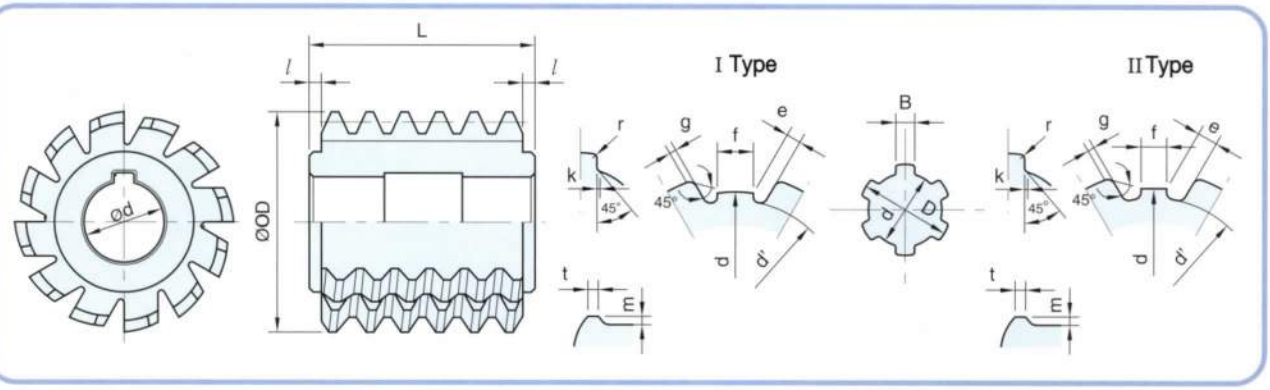
ZE Tooth Profile (ZI)
Tooth profile of worm shaft is involute wave.

ZK Tooth Profile
A tooth profile grinded by giving standard pressure angle.

ZN Tooth Profile
A tooth profile having made normal profile straight line.

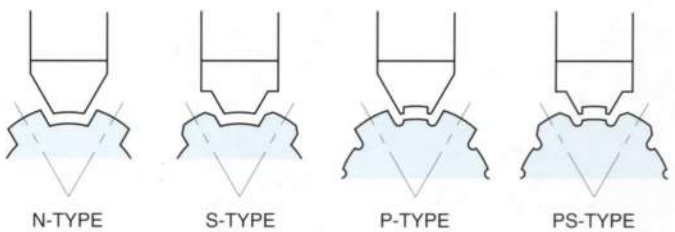
ZA Tooth Profile
A tooth profile having made axial profile straight line

PARALLEL SIDE SPLINE HOB

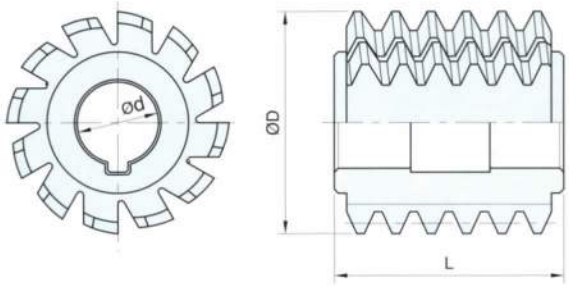


Unit : mm

Title of Spline d	Specification of HOB			Dimension of Each Spline Type									
				I Type					II Type				
	Outer Diameter (OD)	Full Length (L)	Inner Diameter	Number of Splines N	Minor Diameter d	Major Diameter D	Width B	Chamfering g	Number of Splines N	Minor Diameter d	Major Diameter D	Width B	Chamfering g
11	60	60	22 (22.225)							11	14	3	0.3
13										13	16	3.5	
16										16	20	4	
18										18	22	5	
21										21	25	5	
23	75	75	27 (25.4)	6	23	26	6	0.3	6	23	28	6	0.4
26					26	30	6			26	32	6	
28					28	32	7			28	34	7	
32					32	36	8			32	38	8	
36					36	40	8			36	42	8	
42					42	46	10			42	48	10	
46	95	95	32 (31.75)		46	50	12			46	54	11	0.5
52					52	58	14	0.4		52	60	14	
56	115	115			56	62	14			56	65	14	
62					62	68	16			62	72	16	
72	135	175	40 (38.1)		72	78	18			72	82	18	
82					82	88	20			82	92	20	
92	145	190			92	98	22			92	102	22	
32	75	75	27 (26.988)	8	32	36	6		8	32	38	6	0.4
36					36	40	7			36	42	7	
42					42	46	8			42	48	8	
46	95	90	32 (31.75)		46	50	9			46	54	9	0.5
52					52	58	10	0.5		52	60	10	
56					56	62	10			56	65	10	
62					62	68	12			62	72	12	
72				10	72	78	12		10	72	82	12	
82	115	115			82	88	12			82	92	12	
92					92	98	14			92	102	14	
102					102	108	16			102	112	16	
112					112	120	18			112	125	18	



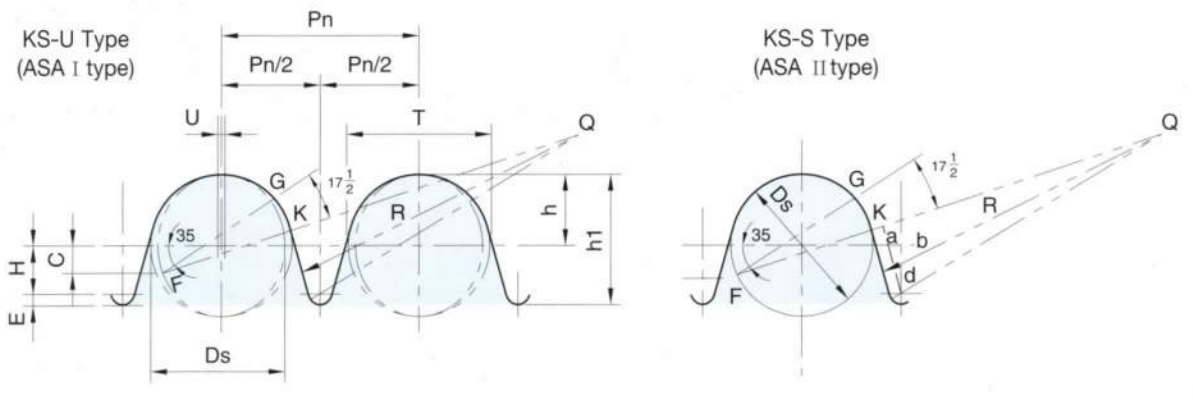
ROLLER CHAIN SPROCKET HOB



(mm)

Types of Chain Sprocket			HOB Dimensions			
KS, ASA Ⅰ & Ⅱ	C P	R D	Outer Diameter (ϕ D)	Full Length (L)	Inner Diameter (ϕ d)	
					A (meter)	B (inch)
RS25	6.35 (1/4″)	3.30	60	60	22	22.225
35	9.525 (3/8″)	5.08	65	65		
35	9.525 (3/8″)	6.35	65	65		
40	12.7 (1/2″)	7.77	75	75	27	25.4 (26.988)
40	12.7 (1/2″)	7.95	75	75		
40	12.7 (1/2″)	8.5	75	75		
50	15.875 (5/8″)	10.16	85	90		
60	19.05 (3/4″)	11.907	90	105		
80	25.4 (1″)	15.875	110	125	32	31.75
100	31.75 (1 1/4″)	19.05	120	140		
120	38.1 (1 1/2″)	22.225	130	170		
140	44.45 (1 3/4″)	25.4	160	190	40	38.1
160	50.8 (2″)	28.575	170	210		
180	57.15 (2 1/4″)	35.72	190	240		
200	63.5 (2 1/2″)	39.688	210	260	50	50.8
240	76.2 (3″)	47.625	240	310		

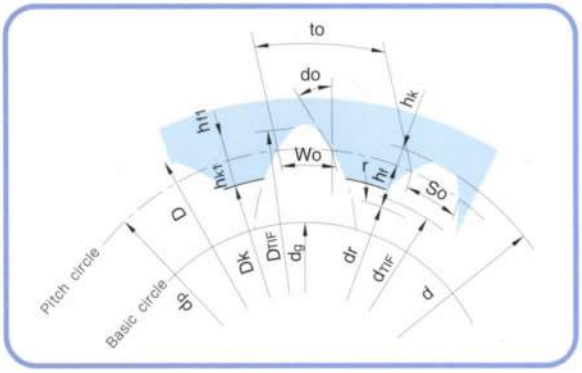
Chain and HOB Tooth Profile (normal angle)



- KS-U Type
  Pn = Normal Pitch of HOB = 1.011 X Chain Pitch
  Ds= Minimum diameter of basic coverture of tooth bottom
  = 1.005 x Roller+0.08
  U = 0.07(Chain Pitch-Roller diameter)+0.051
- KS-S Type
  U=0

INVOLUTE SERRATION HOB

Following is standard tooth profile of KS-B-2007 Involute Serration.



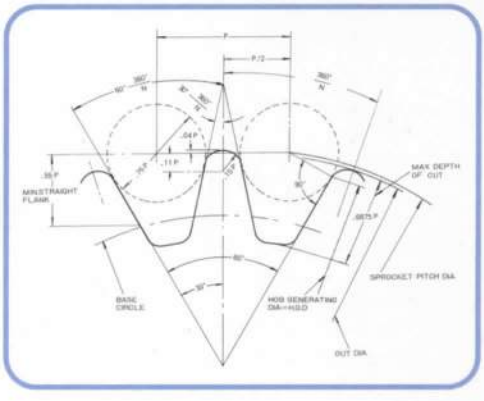
Order specifications for Involute Serration Hob will be the same as that of standard gear hob, and for exterior look, please refer to standard gear HOB described in the fore front page. Basic formulas of each part are as follows:

Item		Symbol	Calculation Formula of Serration Part
	Module	m	6 kinds; 0.5, 075, 1.0, 1.5, 2.0, 2.5
	Teeth	z	10~60
	Pressure Angle	α_o	Pressure Angle on pitch circle $\alpha_o = 45°$
	Tooth Height	h_f	0.8m
	Shift	x	0.1m
	Major Diameter	d	$d = (z + 0.8 + 2x)m = (z+1)m$
	Pitch	t_o	$to = \pi \cdot m$
	Pitch Diameter (Pitch Circle Diameter)	d_p	$dp = z \cdot m$
Inner Diameter Serration	Major Diameta	D	$D = (z + 1.4)m = d + 0.4m$
	Minor Diameta	D_k	$D_k = (z-0.6)m = d-1.6m$
	Limit Diameter of Involute	D_{TIF}	$D_{TIF} = (z + 1.1)m$
	Addendum	h_{k1}	$h_{k1} = (0.4-x)m = 0.3m$
	deddendum	h_{f1}	$h_{f1} = (0.6-x)m = 0.7m$
	Width of Arc of Groove on PCD	W_o	$W_o = (\frac{\pi}{2} + 2x\tan\alpha_o)m = (0.5\pi + 0.2)m$
Outer Diameter Serration	Major Diameter	d	$d = (z + 0.8 + 2x)m = (z+1)m$
	Minor Diameta	d_r	$d_r = (z-1)m = d-2m$
	Limit Diameter of Involute	d_{TIF}	$d_{TIF} = (z-0.7)m$
	Addendum	h_k	$h_k = (0.4 + x)m = 0.5m$
	deddendum	h_f	$h_f = (0.6-x)m = 0.5m$
	Thickness of Arc of Tooth on PCD	S_o	$S_o = (\frac{\pi}{2} + 2x\tan\alpha_o)m = (0.5\pi + 0.2)m$

SILENT CHAIN SPROCKET HOB

It has been manufactured for the use of tooth profile ; ASA B29.2-1950 and UDC NO.621.855

Chain Pitch	Hob Number	Standard Number of Teeth	Range of Tooth Profile of Hob
SC3 = .375"	1	20	17-23
SC4 = .500"	2	28	24-32
SC5 = .625"	3	38	33-43
SC6 = .750"	4	51	44-58
SC8 = 1.000"	5	69	59-79
SC10 = 1.250"	6	95	80-110
SC12 = 1.500"	7	100	111-150
SC16 = 2.000"			



TIMING PULLEY HOB

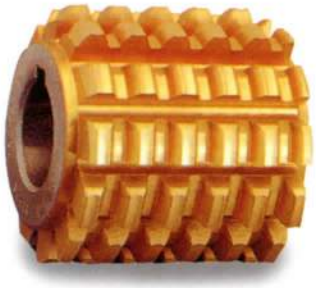
◈ Order Specification

Timing belt will be varied in its tooth profile depending upon manufacturer, so we need your tooth profile data along with your order specification.

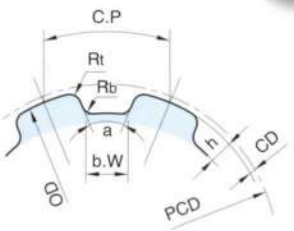
- ▶ Belt Specification (Model Type and Pitch)
- ▶ Belt Manufacturer ▶ Pulley Teeth
- ▶ Detailed Descriptions and Drawing of Pulley Teeth
- ▶ Size of Exterior Look of Hob ordered (outer diameter x inner diameter x full length, etc.)
- ▶ There is no limit in designing pulley hob beyond 24T for using it for common purpose in the industry in general.

◈ Common Dimension Table

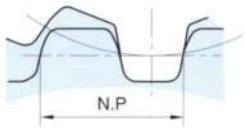
Hob Number	Number of Pulley Teeth	Standard Teeth for Design
1	More than 40	40
2	25~39	25
3	17~24	17
4	12~16	12
5	9~11	9



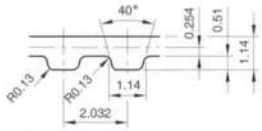
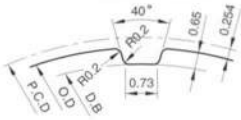
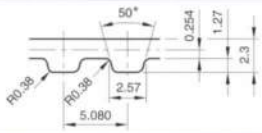
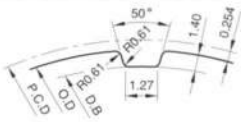
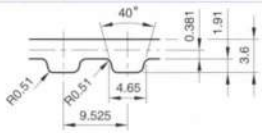
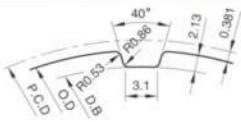
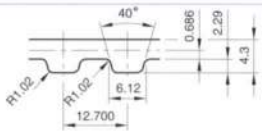
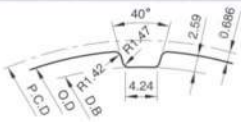
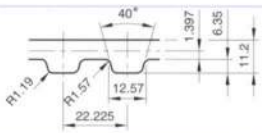
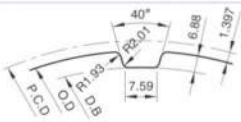
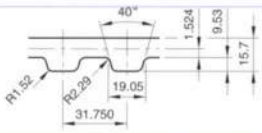
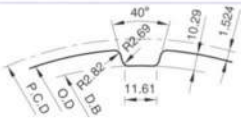
Shape of Pulley



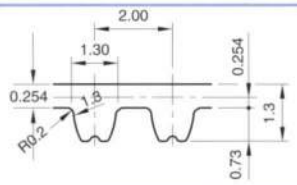
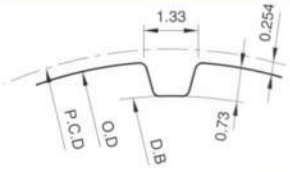
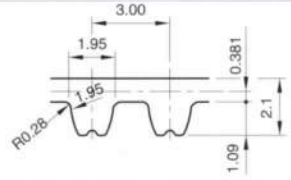
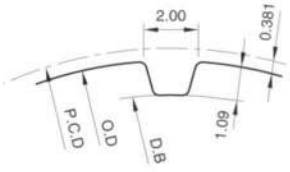
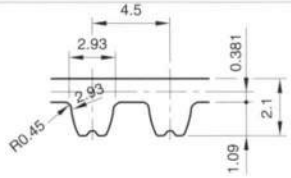
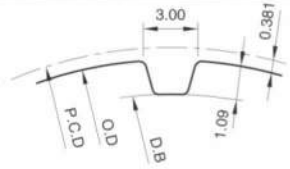
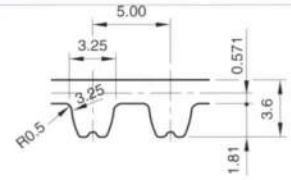
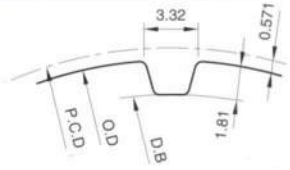
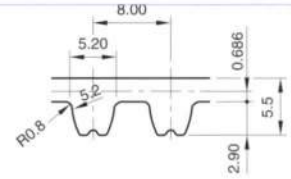
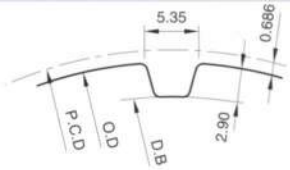
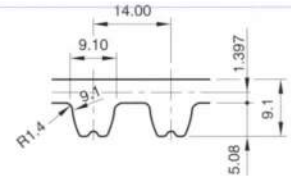
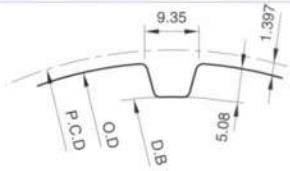
Shape of Hob



TIMING BELT PROFILE

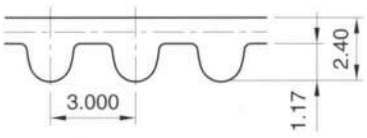
	Timing Belt Profile	Timing Pulley Profile
MXL		
XL		
L		
H		
XH		
XXH		

TIMING BELT PROFILE

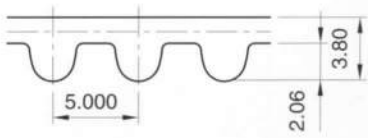
	Timing Belt Profile	Timing Pulley Profile
STS 2M		
STS 3M		
STS 4.5M		
STS 5M		
STS 8M		
STS 14M		

Timing Belt Profile of HTD Type

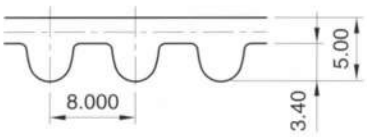
HTD 3M



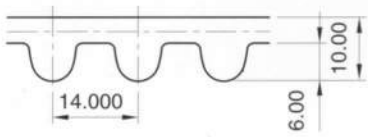
HTD 5M



HTD 8M



HTD 14M



RATCHET HOB

■ Ratchet, in general, is being treated lightly on many occasions, however, we should recognize the importance of designing ratchet considering its indispensable functions.

■ Followings are things to consider in designing ratchet.

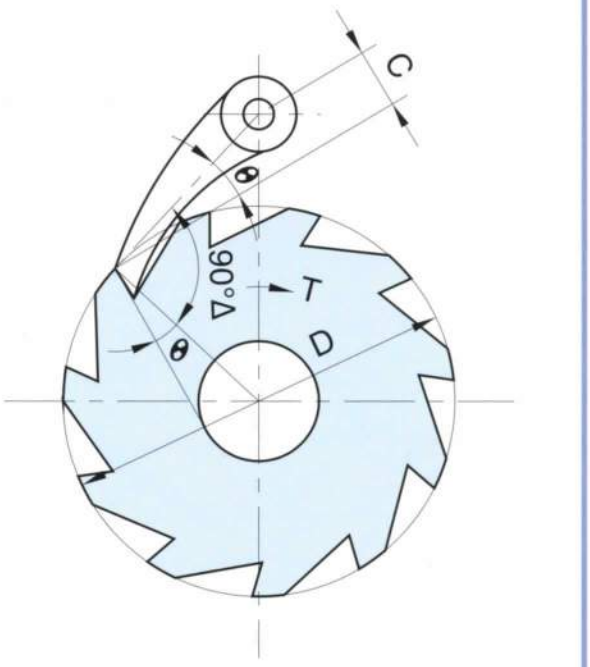
- Force that impacted on the sustaining point of the pawl must be minimal.
- Angle (θ) of contacting side of pawl when it stops must be larger than fractional angle.

Under an ambience of normal dry θ=12~20°
Under a state of lubrication θ=10~15°

■ Things to accompany with Order

When ordering RATCHET HOB, please present following information

- Detailed Drawing of Ratchet Profile
- Exterior Look of Hob (Outer Diameter x Inner Diameter x Length)
- Specification of Hob
  -Number of Threads and Blades, etc.



RATCHET HOBS

CLASSIFICATION OF SHAPER CUTTER

Classification of Shaper cutter

Shaper Cutter is used when hobbing is not passible due to accessibility problem

Classification according to Torsion of Saw Thread

Name of Cutter	Use
Shaper cutter (Straight)	Flat Gear Use
Shaper cutter for Curved Gear Use	Curved Gear Use

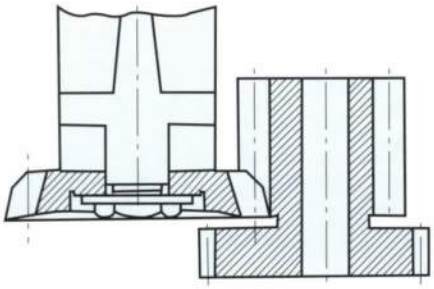
Classification according to Structure

Name of Cutter
Pinion Gear (Directional)
Pinion Gear (Fabricable)
Braze Shaper cutter

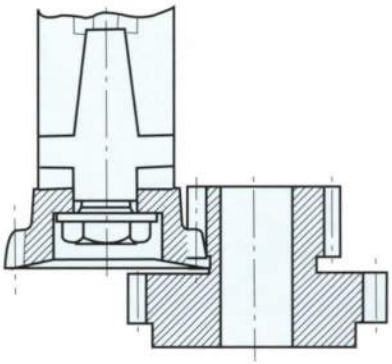
Tooth Profile and Its Molding

Molding Method	Tooth Profile	Use
Generating Gearing	Involute	Gear, Spline, Serration, Timing Belt Pulley, Steering Rack
Molding	Straight Line	Spline, Serration, Ratchet, Timing Bet Pulley
	Circular Arc	Sprocket, Pin Gear, Timing Belt Pulley
	Special	Cam, Cycroid Gear

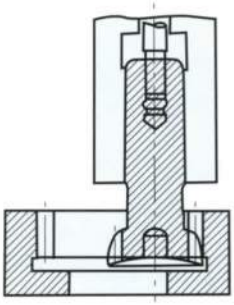
Shape of the Subject Gear to be machined and Cutter



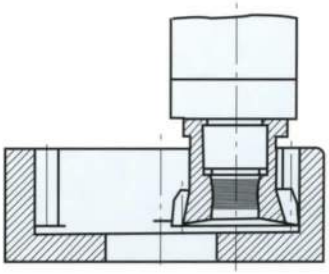
Disk Type ···, Use for gear shouldered single rod



Bell Type··· Use for preventing it from interruptions of nut

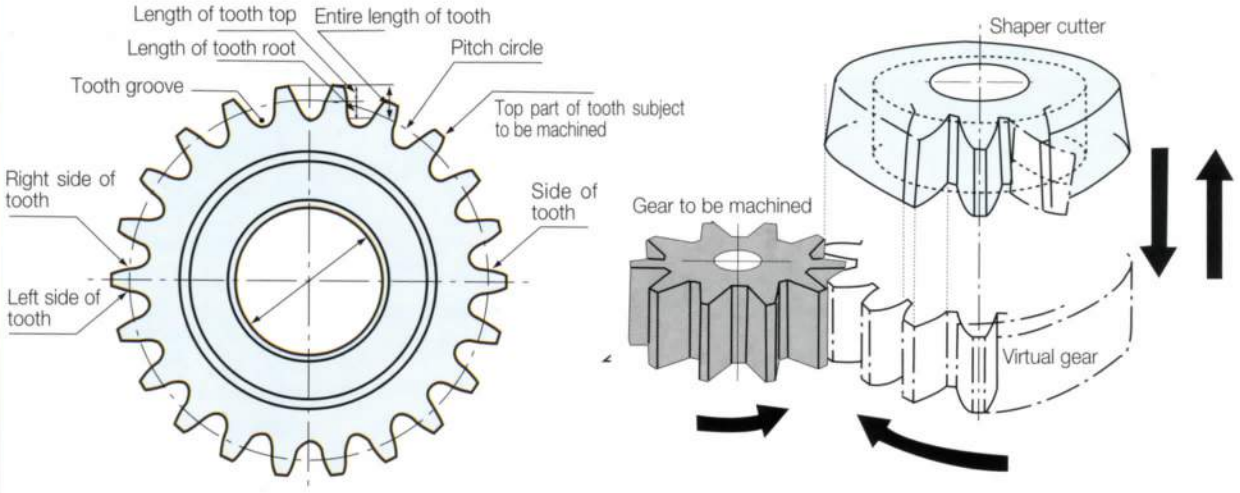


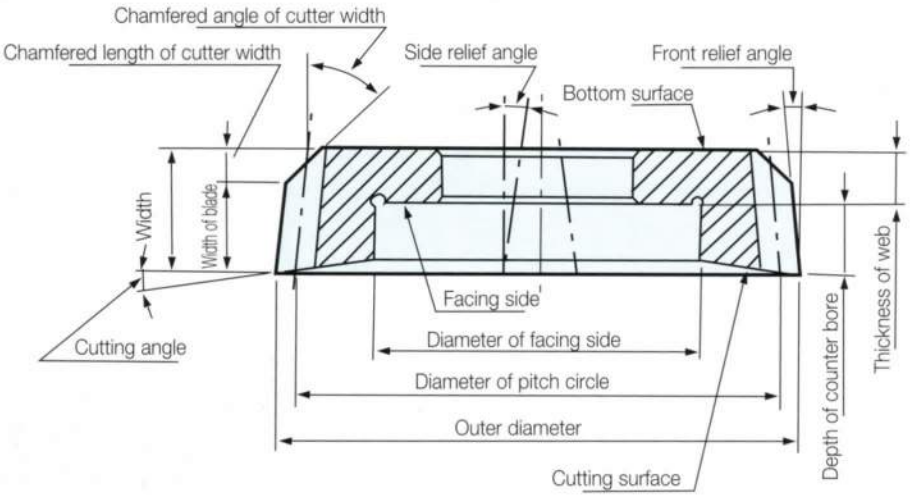
Shank Type··· Use for cutting inside of minor diameter



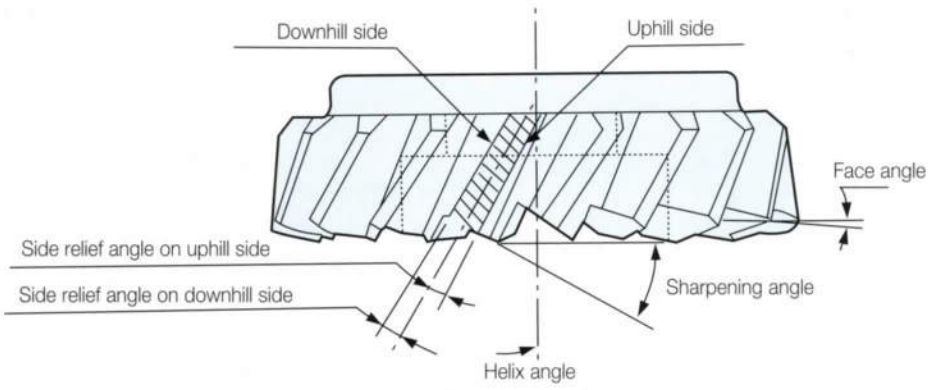
Hub Type

SHAPER CUTTER - VOCABURALY





SPUR GEAR SHAPER CUTTER

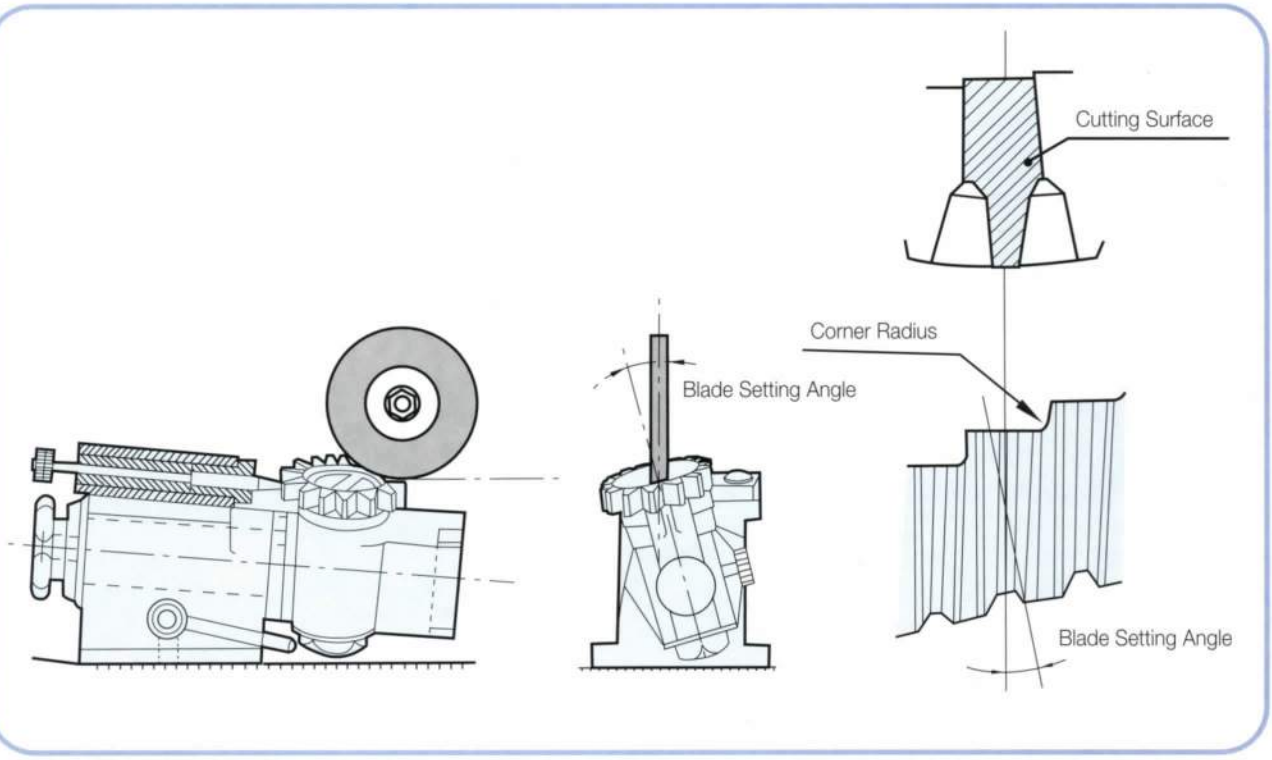


HELICAL GEAR SHAPER CUTTER

SHARPENING OF HELICAL TYPE CUTTER

Sharpening of Cutter for the use of Curved Gear Tooth

Cutting surface of this cutter will be turned to a staircase shape depending upon blade setting angle, and cutter does surface grinding by separating blades one by one. At this time, if there leaves a large corner radius behind at the corner of material being machined, you will see some variations on the machining dimensions, therefore, you' ll have be more careful about wear of cross section of grinding wheel.



For reference, e.g. MICO-COLETTE

Material of Cutter	Diameter of Grinding Wheel	Wheel Speed	Shaft Speed of Wheel	Amount of Cutting		Grinding Fluid
HSS	220mm	2500-3000m/min	1800m/min	Rough	0.05-0.10mm	Liquid exclusively for grinding purpose
				Phase	0.01-0.02mm	
Powder metal	220mm	2500-3000m/min	1800m/min	Rough	0.02-0.05mm	
				Phase	0.005-0.01mm	

Grinding wheel now in use	N3A80K8VBE
Abrasive Grain	A
Grain Size	80
Texture	8
Coherence	K

Point of Sharpening

- Be careful not to result a large radius in the corner of metal being machined.
- To decide an economical timing for Sharpening, please regard it as standard when the wear has been reached to the point of 0.2 mm from the width of wear of clearance space.
- Make cutter grind well by sharpening its edge, and be careful about occurrence of plastic deformation during grinding works.
- Please change grinding fluid regularly, two times a year.

SHARPENING OF SPUR TYPE CUTTER

Cutting Conditions (Premises according to hard anodizing treatment)

Item	Range of Use note2)
Cutting Speed note1)	Carburized Steel 40-80m/min
	More than S45C 30-50m/min
	FCD70 20-40m/min
Rotary Feed	0.2-0.3mm/stroke
Radial Feed	0.002-0.1mm/stroke
Back-off	0.2-0.8mm
Off-set	Adjustments made by various causes relating to rotating direction and contact
Amount of Cutting	It is due to various causes relating to the gear subject to be machined.

Note 1) Cutting speed will be determined by the length of cutting surface of the subject to be cut and number of cutter stroke set.

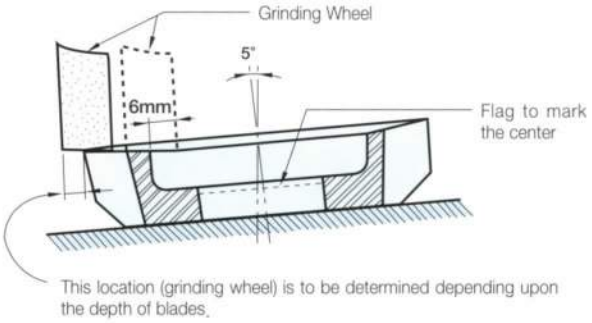
B : Width of gear to be machined(mm)
Wc: Number of strokes(str/mm)
V : Cutting speed(m/mm)

$$V = \frac{Wc \cdot (b+6) \cdot \pi}{1000}$$

Note 2) Since the range of possible selections changes so much according to the kinds of gear shaver (saw thread cutting plate) that you are required to review it sufficiently.

Sharpening of Shaper cutter

sharpening jobs for disk type and bell type Shaper cutter is to be done by rotary surface grinder. When doing sharpening, you need to attach cutter to magnetic chuck adjusting it to the center of table, (if it is shank type, then you need to attach it to by inserting into taper shank cutter holder.) then next, you tilt the upper part of magnetic chuck as much as the angle equivalent to cutting angle (generally, 5°), and you start sharpening as described in the drawing.



Grinding Method of Shaper cutter

For reference, e.g. SPUR M/C

Material of Cutter	Diameter of Grinding Wheel	Wheel Speed	Shaft Speed of Grinding Wheel	Amount of Cutting		Grinding Liquid
HSS	305mm	1500/min	1500m/min	Rough	0.02-0.05mm	Liquid exclusively for grinding purpose
				Phase	0.02mm	
Powder metal	305mm	1500/min	1500m/min	Rough	0.02mm	
				Phase	0.01-0.02mm	

Grinding wheel now in use	C220HE9V81R
Abrasive Grain	C
Grain Size	220
Texture	9
Coherence	H

Point of sharpening

- To decide an economical timing for sharpening, please regard it as standard when the wear has been reached to the point of 0.2 mm from the width of wear of clearance space.
- Make cutter grind well by sharpening its edge, and be careful about occurrence of plastic deformation during grinding works.
- Please change grinding fluid regularly, two times a year.

TOLERANCE

No.	Item		Tolerance or Allowance		
			Grade		
			AA Grade	A Grade	B Grade
1	Hole diameter, d (mm)	19.050	+4 0	+6 0	+9 0
		31.742		+7 0	+11 0
		44.450			
	Run-out of shank (value exceeded a limit)		3	4	5
2	Run-out of circumference		7	10	15
3	Run-out of bottom surface		3	4	6
4	Run-out of contacting surface		5	5	7
5	Run-out of cutting face		10	16	25
6	Cutting Angle (Portion)		± 1	± 14	± 20
7	Side Relief Angle (Portion)				
8	Front Relief Angle (Portion)				

Comparison Table of Precision Grade

CENTURY	JIS
AA	0
A	1
B	2

* Principally shank type, AA grade, is not produced.

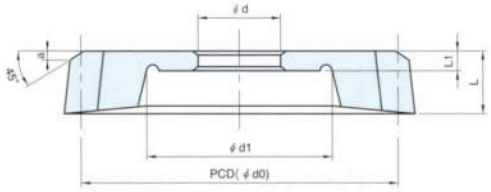
Remark 1) In case of number 1, if it is disk type or bell type, hole diameter is applied to, and if is shank type, then shank run-out is to be applied to.

2) In case of number 3 and 4, it will be applied only to disk type and bell type.

No.	Item	Grade	No.	Tolerance or Allowance						
				Module m						
				More than 0.75 Less than 1	More than 1 Less than 1.6	More than 1.6 Less than 2.5	More than 2.5 Less than 4	More than 4 Less than 6	More than 6 Less than 10	More than 10 Less than 12
9	Run-out of tooth groove	AA	25, 38, 50	15	15	11	11	-	-	-
			75, 100	16	16	12	13	14	17	-
			125, 150, 175	-	16	13	14	15	18	23
		A	25, 38, 50	19	18	17	16	-	-	-
			75, 100	19	19	18	18	20	24	-
			125, 150, 175	-	20	19	20	22	26	32
		B	25, 38, 50	28	28	30	33	-	-	-
			75, 100	31	31	33	36	40	48	-
			125, 150, 175	-	35	37	40	45	52	65
10	Adjacent pitch error	AA	25, 38, 50	3	3	4	4	-	-	-
			75, 100	4	4	4	4	5	6	-
			125, 150, 175	-	4	5	5	6	7	9
		A	25, 38, 50	5	5	6	6	-	-	-
			75, 100	6	6	6	7	8	9	-
			125, 150, 175	-	7	7	8	8	10	13
		B	25, 38, 50	10	10	12	13	-	-	-
			75, 100	12	12	13	14	16	19	-
			125, 150, 175	-	14	15	16	18	21	27
11	Cumulated pitch error	AA	25, 38, 50	11	12	12	12	-	-	-
			75, 100	12	13	13	14	15	18	-
			125, 150, 175	-	14	15	15	17	20	24
		A	25, 38, 50	18	19	21	23	-	-	-
			75, 100	21	22	23	25	28	34	-
			125, 150, 175	-	25	26	28	32	37	46
		B	25, 38, 50	26	28	30	33	-	-	-
			75, 100	30	31	33	36	40	48	-
			125, 150, 175	-	35	37	40	45	52	65
12	Tooth profile variation (1)	AA	-	6	6	7	9	10	11	16
		A	-	8	9	10	13	16	22	32
		B	-	16	19	21	25	32	43	63
13	Thickness of Tooth (-)	AA	-	13	13	17	21	27	33	43
		A	-	21	21	27	33	43	53	67
		B	-	33	33	43	53	67	80	95

SHAPER CUTTER

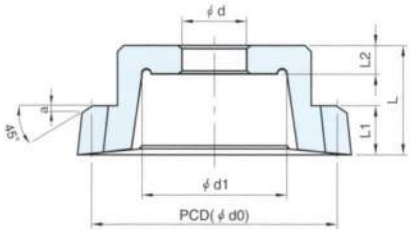
HELICAL & DISK TYPE



(mm)

Nominal diameter	Module (m)			PCD (d)	d	L	L1	d1	a
75	0,75	-	1	75	31,742	16	8	50	3
	1,25	-	2	75	31,742	18	8	50	3
	2,25	-	3,5	75	31,742	20	8	50	3
	3,75	-	5	75	31,742	22	10	50	3
100	1	-		100	31,742	18	10	65	4,5
	1,25	-	2	100		20	10	65	4,5
	2,25	-	3,5	100	44,450	22	10	65	4,5
	3,25	-	6	100		24	10	65	4,5
	6,5	-	7	100		28	12	65	4,5
125	1,5	-	2	125	44,450	22	10	85	4,5
	2,25	-	3,5	125	44,450	24	10	85	4,5
	3,75	-	6	125	44,450	26	12	85	4,5
	6,5	-	8	125	44,450	30	12	85	4,5
150	1,75	-	2	150	44,450	24	12	95	4,5
	2,25	-	3,5	150	44,450	26	12	95	4,5
	3,75	-	6	150	44,450	28	14	95	4,5
	6,5	-	10	150	44,450	32	14	95	4,5
175	2	-		175	44,450	26	14	110	4,5
	2,25	-	3,5	175	44,450	28	14	110	4,5
	3,75	-	6	175	44,450	30	14	110	4,5
	6,5	-	10	175	44,450	34	14	110	4,5
	11	-	12	175	44,450	36	16	110	4,5

BELL TYPE

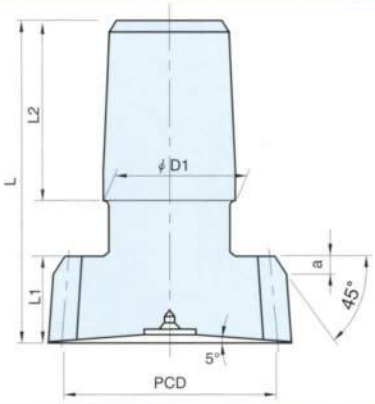


(mm)

Nominal diameter	Module (m)			PCD (d)	ø d	L	L1	d1	a
50	0,75	-	1	50	19,050	30	12	28	3
	1,25	-	2	50	19,050	32	14	28	3
	2,25	-	3,5	50	19,050	34	16	28	3
	3,75	-	4	60	19,050	38	18	28	3
75	0,75	-	1	75	31,742	34	16	50	3
	1,25	-	2	75	31,742	36	18	50	3
	2,25	-	3,5	75	31,742	38	20	50	3
	3,75	-	5	80	31,742	42	22	50	3
100	1	-		100	31,742 (44,450)	38	18	65	4,5
	1,25	-	2	100		40	20	65	4,5
	2,25	-	3,5	100		42	22	65	4,5
	3,75	-	6	105		44	24	65	4,5
	5,5	-	7	110		50	28	65	4,5

SHAPER CUTTER

SHANK TYPE

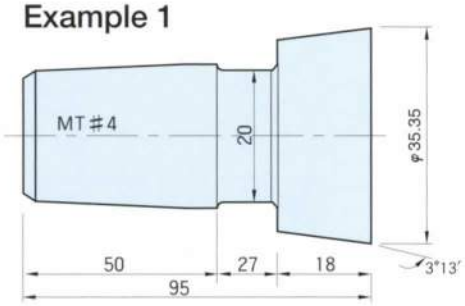


(mm)

Nominal diameter	Module (m)	PCD (d)	L	L1	L2	D1	Shank taper		a	Type of shank taper
25	0.75 ~ 0.9	25	80	10	40	18.0	1/20.020	0.049951	2	Morse
	1 ~ 1.5	25	80	12	40	18.0	1/20.020	0.049951	2	Taper
	1.75 ~ 2.5	25	80	15	40	18.0	1/20.020	0.049951	2	No.2
38	0.75 ~ 0.9	38	100	12	50	24.1	1/19.922	0.050196	2	Morse taper No.3
	0.75 ~ 0.9	38	100	12	50	27.0	1/19.185	0.052125	2	Fellows taper
	1 ~ 1.75	38	100	15	50	24.1	1/19.922	0.050196	2	Morse taper No.3
	1 ~ 1.75	38	100	15	50	27.0	1/19.185	0.052125	2	Fellows taper
	2 ~ 3	38	100	18	50	24.1	1/19.922	0.050196	3	Morse taper No.3
	2 ~ 3	38	100	18	50	27.0	1/19.185	0.052125	3	Fellows taper3
	3.25 ~ 4	38	125	18	50	24.1	1/19.922	0.050196	3	Morse taper No.4
	3.25 ~ 4	45	125	18	50	27.0	1/19.185	0.052125	3	Fellows taper

SHAPER DATA

Example 1



Example 2

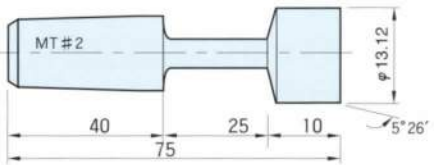
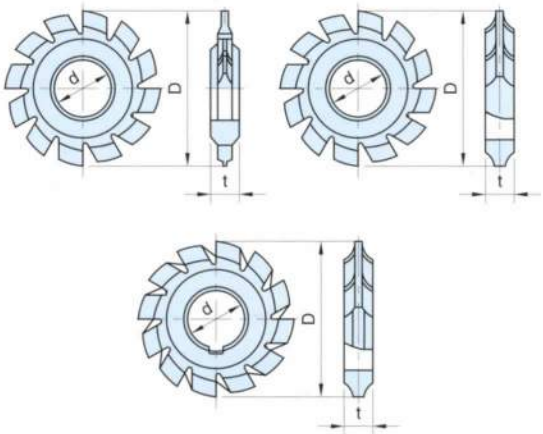


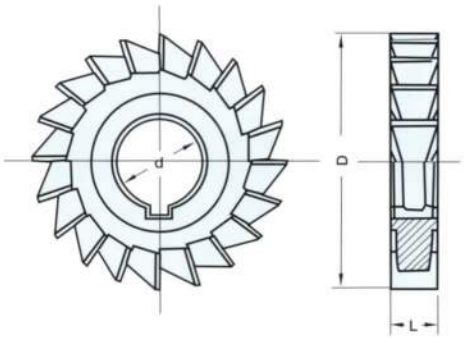
	Figure				
Specification	Module or DP	DP 20/40		M 1.5 Spur	
	Pressure angle	30°		20°	
	No.of teeth	26		6	
	Helix angle	Spur		Spur	
	PCD	33.020		9	
	Side angle	2°		2°	
	Material hardness	AISI-M2 HRC64.5		AISI-M2 HRC65	
	Accuracy standard & grade	JIS B4356-1964 Class O		JIS B4356-1964 Class O	
Accuracy		Value of permissible errors	Value of actual reading	Value of permissible errors	Value of actual reading
	Adjacent pitch error	Within 0.003	0.002	Within 0.003	0.002
	Accumalated pitch error	0.012	0.005	0.012	0.008
	Tooth space runout	0.010	0.006	0.010	0.006
	Tooth profile error	0.006	0.004	0.006	0.005

INVOLUTE GEAR CUTTER



Module M Series			D	d	CUTTER Specification (t)							
					NUMBER OF GEAR CUTTER							
					8	7	6	5	4	3	2	1
1	2	3			NUMBER OF GEAR TEETH							
					12~13	14~16	17~20	21~25	26~34	35~54	55~134	More than 135
0,5			55	22 (22,235)	4,4	4,4	4	4	4	3,6	3,6	3,6
0,6			55		4,4	4,4	4	4	4	3,6	3,6	3,6
	0,7		55		4,4	4,4	4	4	4	3,6	3,6	3,6
0,8			55		4,4	4,4	4	4	4	3,6	3,6	3,6
	0,9		55		4,8	4,8	4,4	4,4	4,4	4	4	4
1			55		4,8	4,8	4,4	4,4	4,4	4	4	4
1,25			55		5,5	5,5	5,2	5,2	5,2	4,8	4,8	4,8
1,5			60		6	6	5,5	5,5	5,5	5,2	5,2	5,2
	1,75		60		6,5	6,5	6	6	6	5,5	5,5	5,5
2			60		7,5	7	6,5	6,5	6,5	6	5,5	5,5
	2,25		65		8	8	7,5	7	7	6,5	6,5	6,5
2,5			65	27 (25,4)	9	8,5	8,5	8	8	7,5	7	7
	2,75		70		10	9,5	9,5	9	8,5	8	8	7,5
3			70		11	10,5	10	9,5	9,5	9	8,5	8,5
	3,25		75		12	11,5	11	10,5	10	10	9,5	9
	3,5		75		12,5	12	12	11,5	11	10,5	10	10
		3,75	80		13,5	13	12,5	12	11,5	11	11	10,5
4			80		14,5	14	13,5	13	12,5	12	11,5	11
	4,5		85		16,5	15,5	15	14,5	14	13,5	13	12,5
5			90	32 (31,75)	18	17,5	17	16	15,5	15	14,5	14
	5,5		95		20	19,5	18,5	17,5	17	16,5	16	15
6			100		22	21	20	19,5	18,5	18	17,5	17
	7		110		25,5	24,5	23,5	22,5	22	21	20	19
8			115		29	28	27	26	25	24	23	22
	9		120		32,5	31,5	30,5	29	28	27	26	24,5
10			125		37	35	34	32	31	30	29	28
	11		130	40 (38,1)	40	39	37	36	35	33	32	30
12			140		44	42	41	39	38	36	35	33
		13	150		48	46	44	42	41	39	38	36
	14		160		51	49	47	45	44	42	40	39
		15	170		55	53	51	48	47	45	43	41
16			180		58	56	54	52	50	48	46	44
20	18		190	50 (50,8)	66	63	61	58	56	54	52	50
23			205		73	70	67	65	62	60	58	55
25			220		80	77	74	71	69	66	64	60
			235		91	88	84	81	78	75	72	69

SIDE MILLING CUTTERS



(mm)

Outer Diameter (D)	Width of Flute (L)	Inner Diameter (d)	Number of Flute	
			Ordinary Flute	Roughing
50	4	15.875	18	-
50	6	15.875	18	-
50	6	15.875	18	10
50	8	15.875	18	10
50	10	15.875	18	10
60	4	22.225	20	-
60	5	22.225	20	-
60	6	22.225	20	10
60	8	22.225	20	10
60	10	22.225	20	10
60	12	22.225	20	10
60	14	22.225	20	10
75	4	25.4	22	-
75	5	25.4	22	-
75	6	25.4	22	-
75	8	25.4	22	12
75	10	25.4	22	12
75	12	25.4	22	12
75	14	25.4	22	12
75	16	25.4	22	12
75	18	25.4	22	-
75	20	25.4	22	-
100	5	25.4	26	-
100	6	25.4	26	-
100	8	25.4	26	-
100	10	25.4	26	-
100	12	25.4	26	12
100	14	25.4	26	12
100	16	25.4	26	12
100	18	25.4	26	12
100	20	25.4	26	12
100	22	25.4	26	-
125	6	31.75	28	-
125	8	31.75	28	-
125	10	31.75	28	-
125	12	31.75	28	-
125	14	31.75	28	
125	16	31.75	28	14
125	18	31.75	28	14

(mm)

Outer Diameter (D)	Width of Flute (L)	Inner Diameter (d)	Number of Flute	
			Ordinary Flute	Roughing
125	20	31.75	238	14
125	22	31.75	238	14
125	24	31.75	238	14
150	6	31.75	32	-
150	8	31.75	32	-
150	10	31.75	32	-
150	12	31.75	32	-
150	14	31.75	32	-
150	16	31.75	32	-
150	18	31.75	32	16
150	20	31.75	32	16
150	22	31.75	32	16
150	24	31.75	32	16
150	28	31.75	32	16
175	8	31.75	34	-
175	10	31.75	34	-
175	12	31.75	34	-
175	14	31.75	34	-
175	16	31.75	34	-
175	18	31.75	34	-
175	20	31.75	34	-
175	22	31.75	34	18
175	24	31.75	34	18
175	26	31.75	34	18
175	28	31.75	34	18
175	30	31.75	34	18
200	10	31.75	36	-
200	12	31.75	36	-
200	14	31.75	36	-
200	16	31.75	36	-
200	18	31.75	36	-
200	20	31.75	36	-
200	22	31.75	36	-
200	24	31.75	36	20
200	26	31.75	36	20
200	28	31.75	36	20
200	30	31.75	36	20
200	32	31.75	36	20

SHELL END MILLS

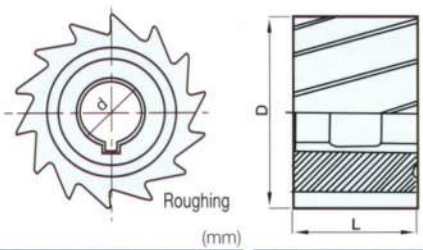
(mm)

Outer Diameter	Full Length	Inner Diameter	Number of Ordinary Flute	Number of Rough Cut Blades
30	30	12.7	10	8
32				
35		15.875	12	
38				
40				
42				
45	45	22.225		10
50				
55				

(mm)

Outer Diameter	Full Length	Inner Diameter	Number of Ordinary Flute	Number of Rough Cut Blades
60	60	25.4	14	10
65				
70			16	12
75				
90			18	14
100		31.75		
125			20	16

PLAIN MILLING CUTTER



(mm)

Outer Diameter (D)	Width of Flute (L)	Inner Diameter (d)	Number of Flute		
			Ordinary Flute	Roughing 1	Roughing 2
50	25	22.225	12	8	6
50	30	22.225	12	8	6
50	40	22.225	12	8	6
50	50	22.225	12	8	6
50	60	22.225	12	8	6
50	75	22.225	12	8	6
60	30	25.4	14	8	6
60	40	25.4	14	8	6
60	50	25.4	14	8	6
60	60	25.4	14	8	6
60	75	25.4	14	8	6
60	100	25.4	14	8	6
75	40	31.75	14	10	8
75	50	31.75	14	10	8

(mm)

Outer Diameter (D)	Width of Flute (L)	Inner Diameter (d)	Number of Flute		
			Ordinary Flute	Roughing 1	Roughing 2
75	60	31.75	14	10	8
75	75	31.75	14	10	8
75	100	31.75	14	10	8
100	50	38.1	16	12	10
100	75	38.1	16	12	10
100	100	38.1	16	12	10
100	125	38.1	16	12	10
100	150	38.1	16	12	10
125	60	38.1	18	12	10
125	75	38.1	18	12	10
125	100	38.1	18	12	10
125	125	50.8	18	12	10
125	150	50.8	18	12	10

SINGLE ANGLE MILLING CUTTERS

(mm)

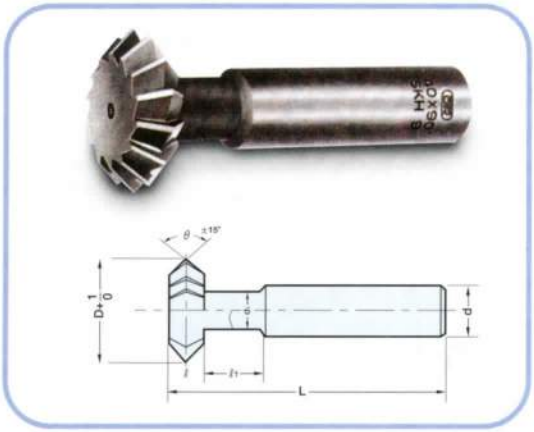
Outer Diameter	Inner Diameter	Width	α°	Number of Flute
65	25.4 31.75	13	30° 45° 60° 90°	18
		16		
70		13		20
		16		
75		16		22
		18		
		20		
100		20		26
		25		

DOUBLE ANGLE MILLING CUTTERS

(mm)

Outer Diameter	Inner Diameter	Width	α°	Number of Flute
70	25.4 31.75	10	30° 45° 60° 90°	20
75		10		20
100		16		22
70		13		22
75		13		22
100		16		26
		20		
70		13		20
		16		
75		16		22
		20		
100		20		26
		25		

DOUBLE ANGLE CUTTERS

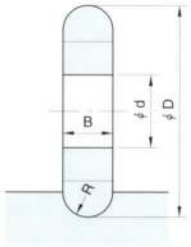


(mm)

Outer Diameter (D)	Width of Flute (ℓ)		Full Length (L)	Diameter of Shank (d)	Number of Flute (N)
	60	45			
10	5.2	3	50	8	6
12	6	3.5	52		
15	6.9	4	59	10	8
20	10.4	6	64		
25	13	7.5	68	12	
30	13.8	8	76	16	10
35	17.1	10	82		
40	18	11	88	23	
45	24.1	11	88		
50	28	15	100	25	12
55	28.6	16.5	110		
60	32.9	19	115		
65			130	32	14
70	36.4		140		16
75	39		150		18
80	43.3		160		20
90				42	
100	52.0		170		

MILLING CUTTERS

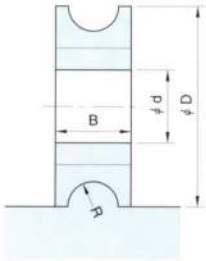
CONVEX MILLING CUTTER



(mm)

TYPE	R	φ D	B	φ d	Number of Flute
75	0.5	75	1	25.4	14
	1	75	2	25.4	14
	1.5	75	3	25.4	12
	2	75	4	25.4	12
	2.5	75	5	25.4	12
	3	75	6	25.4	12
	3.5	75	7	25.4	12
	4	75	8	25.4	12
	5	75	8	25.4	12
	6	75	12	25.4	10
	7	75	14	25.4	10
	8	75	16	25.4	10
	9	75	18	25.4	10
	10	75	20	25.4	10
100	1	100	2	25.4	16
	2	100	4	25.4	16
	3	100	6	25.4	16
	4	100	8	25.4	16
	5	100	10	25.4	16
	6	100	12	25.4	12
	7	100	14	25.4	12
	8	100	16	25.4	12
	9	100	18	25.4	12
	10	100	20	25.4	10

CONEAVE MILLING CUTTER



(mm)

TYPE	R	φ D	B	φ d	Number of Flute
75	0.5	75	6	25.4	14
	1	75	8	25.4	14
	1.5	75	8	25.4	12
	2	75	8	25.4	12
	2.5	75	10	25.4	12
	3	75	12	25.4	12
	3.5	75	14	25.4	12
	4	75	16	25.4	12
	5	75	20	25.4	12
	6	75	24	25.4	10
	7	75	28	25.4	10
	8	75	32	25.4	10
	9	75	36	25.4	10
	10	75	40	25.4	10
100	1	100	8	25.4	16
	2	100	9	25.4	16
	3	100	12	25.4	14
	4	100	16	25.4	14
	5	100	16	25.4	12
	6	100	24	25.4	21
	7	100	28	25.4	12
	8	100	32	25.4	12
	9	100	36	25.4	12
	10	100	40	25.4	10

FORMED MILLING CUTTER

■ Types of Formed Milling Cutters, as for manual tools

- Manual work tools, including spanner, plier wrench, pincers, etc.

■ Formed milling cutters for auto and aircraft accessory works

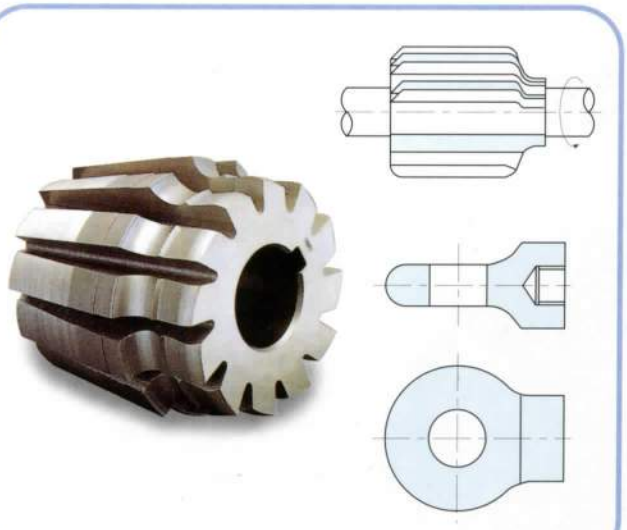
- Working tools including Rod End and Connecting Joint, etc.
- Other working tools, including Universal Joint, etc.

■ Formed milling cutters for light industry use

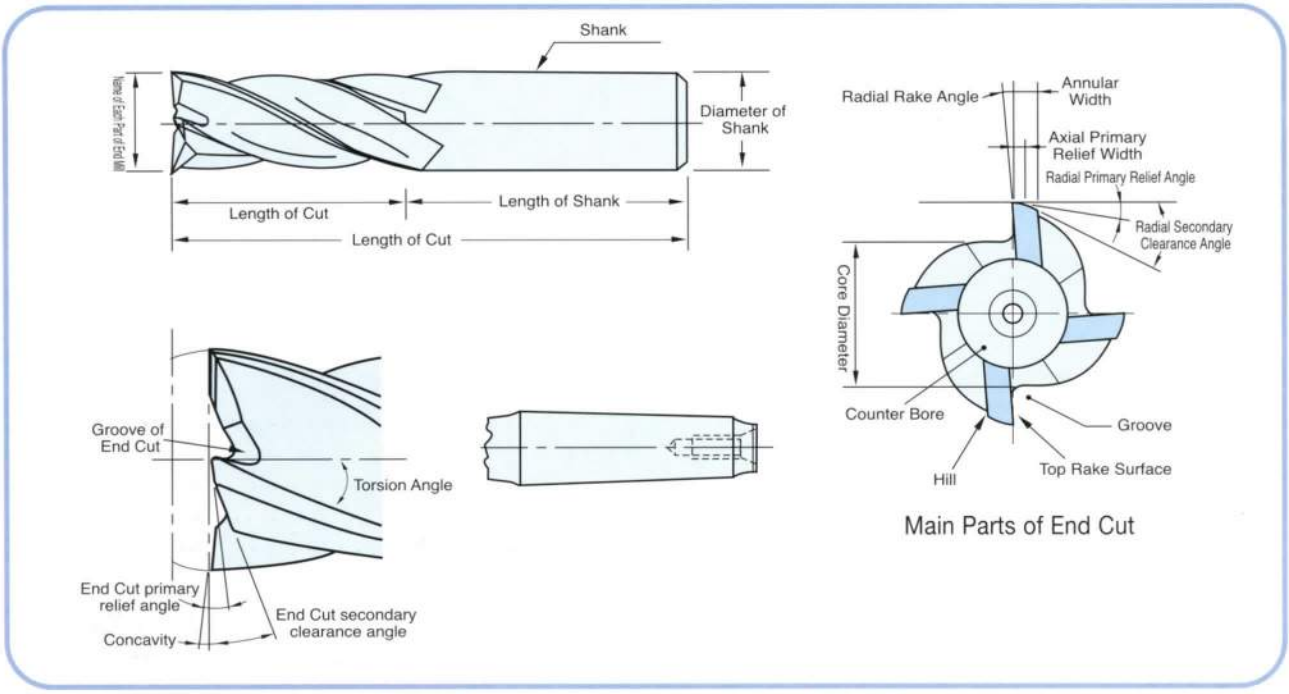
- Tooth Pick Cutter
- Shoe Cutter
- Chair Sheet Cutter

■ For Placing Order

When ordering formed milling cutters, you are required to present us drawing for material and conditions for mounting of such working tools.



Name of Each Part of End Mill



Main Parts of End Cut

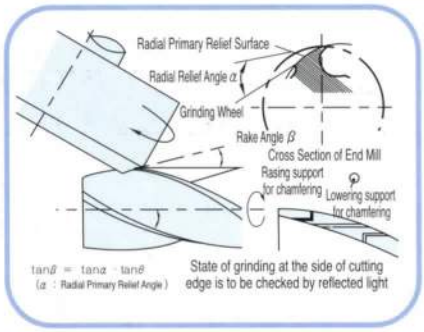


Figure 1 Eccentric Type

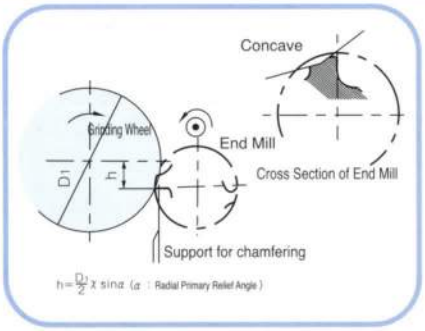


Figure 2 Concave Type

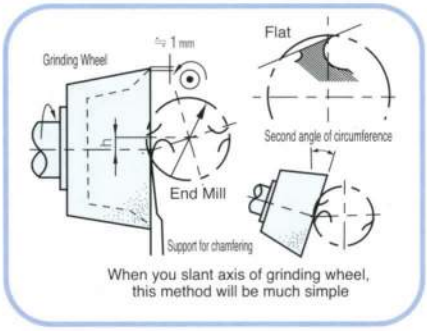
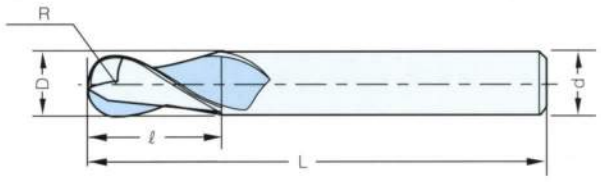


Figure 3 Flat Type

BALL END MILL



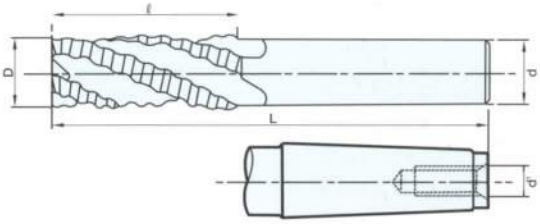
(mm)

R	D	ℓ	L	d
3	6	30	90	6
3.5	7	35	100	8
4	8			
4.5	9	40	115	10
5	10			
5.5	11	45	120	12
6	12			
6.5	13	50	125	
7	14			
7.5	15			
8	16	55	135	16
8.5	17	60	145	
9	18			

(mm)

R	D	ℓ	L	d
9.5	19	65	150	20
10	20			
11	21			
12	24	70	160	25
12.5	25			
13	26			
14	28	75	165	
15	30			
16	32	80	180	32
17	34	85		
18	36			
19	38	90		36

ROUGHING END MILL



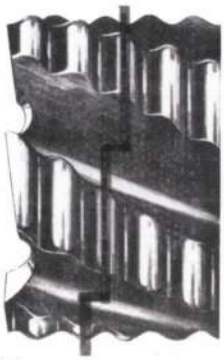
Specification

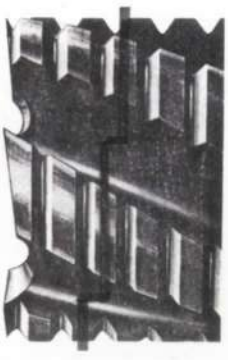
(mm)

Straight Shank					Morse Taper Shank			L
D	l	L	d	teeth	L	MT · NO	d_1	
15	35	90	16	4	125	2	M10	135
16								
18	40	100			130			140
20	45	110	20		135			145
22	45	110		5	140			150
25	50	125	25		170	3	M12	190
28	50	125						195
30	55	130			205	4	M16	200
32	65	150	32					
35	65	150		6	215			210
40	70	160			225			220
45	75	175	42		265	5	M20	280
50	80	180			280			330

Screw Type

Rack Type





Russia:

Italian — Verzorano

Germany - Fette; Ingersoll

TNT

DHL

The House of Gear Technology

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