DTR is a World Leader in Gear Hobs and Milling Cutters.

- *Unparalleled Quality*
- *Excellent Value*
- *Fast Delivery*
- *Superior Customer Service*




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PERFECTION MOVES US

DTR Offers More Advanced Technologies to Ensure Your Finished Product Delivers the Best Performance Possible.

PRODUCTS

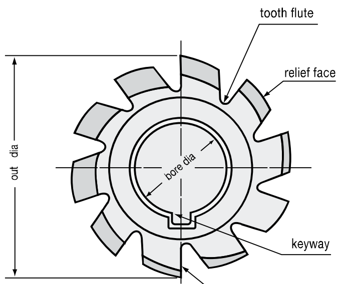
- STANDARD HOB
- PRE-SHAVING HOB
- SERRATION HOB
- SPECIAL HOB
- BUILT-UP HOB
- STUB HOB
- PRE-GRINDING HOB
- SPROCKET HOB
- TIMING HOB
- CARBIDE HOB
- FELLOW STUB HOB
- INVOLUTE SPLINE HOB
- WORM HOB
- PARALLEL SPLINE HOB

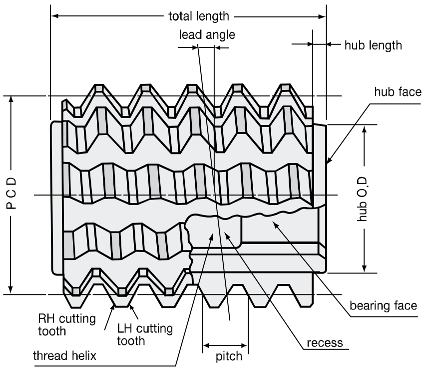
Company History

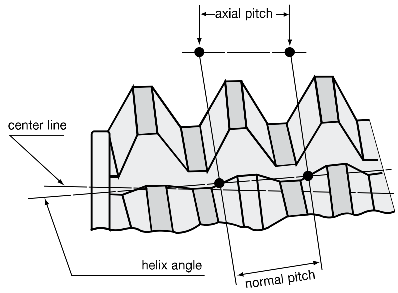
Mar	16.	1976	Dragon Precision Tools Co., Ltd. established. (Representative Director:Yong Bae Chun)
Jul	21,	1986	Awarded prize of successful case study by Maeil Economic Daily
Sep	11,	1987	Awarded prize of excellent domestic machinery development from the Ministry of Commerce&Industry of Korea (No.2299)
Jan	4,	1991	The headquarters and factory moved to new location in Namdong Industrial complex.
Oct	6,	1993	Appointed as an advanced technology company by the Production Technology Research Institute under the Ministry of Commerce, Industry and Energy
Mar	26.	1996	Opened an on-site research institute.
Aug	10.	1996	Established a branch office in Nagoya, Japan
Nov	25.	1998	Won the bronze prize at the Convention for Promotion of Precision Industry (Accuracy technology specific) which was hosted by the Korea Institute of Industrial Technology
Jul	1.	1999	Opened a branch office in Osaka, Japan.
Nov	28.	2001	Appointed as a leading company for parts and materials export by the Ministry of Commerce, Industry and Energy
Aug	19.	2003	Appointed as a Venture Business (research and development business/ 1999 Korean Government)
May	17.	2004	Awarded Gold Statue order of Industry
Aug	11.	2004	Appointed as Promising Export Firm in 2002 and 2002 (the Small and Medium Business Administration)
Oct	26,	2005	Awarded Excellent Capital Based Products Development Company (the Minister of Commerce, Industry and Energy)
Jun	23,	2006	Appointed as Technological innovated small and medium business (INNO-BIZ / the Small and Medium Business Administration)
Jan	5.	2007	Obtained ISO9001/14001(Korea Testing Laboratory)
Nov.		2007	Appointed the best person in small and medium company (Yong Bae Chun, Korean SMEs)
Mar	17,	2008	Changed name to DTR CORPORATION
Jul	17,	2008	Opened a branch office in Chicago, IL U.S.A
Aug	21,	2008	Awarded Monthly Trade Executive for contribution to South Korea exports – Yong-Bae Chun, Chairman
Oct	27,	2009	Awarded Excellent Capital Based Products Development Company (The Ministry of Knowledge Economy Minister)
Nov	30,	2009	Awarded for engaging in trade business (President Jong-Youn Chun, the Ministry of Economic Knowledge)
Mar	3,	2010	Awarded for Excellent Taxpayer at 44th Tax-player's day (Prime Minister) - Yong-Bae Chun, Chairman
May	25,	2010	Established DTR USA Corporation in Chicago, IL U.S.A.
Sep	1,	2010	Appointed as outstanding entrepreneur of district (President Jong-Youn Chun)
Nov	14,	2011	Appointed as a Vision of Company in Incheon City
Feb	1,	2012	Established DTR Japan Co., LTD in Nagoya, Japan
Sep	6,	2012	Appointed as Inclined to be employed company 2012
Dec	10,	2012	Awarded World Best Products 2012(Ministry of Knowledge Economy Minister)
Jan	30,	2013	Appointed as Global Hidden Champion 2013(S&M-Sized Business administration)
Jun	20,	2013	Appointed Advanced Technology Center Business (ATC) support
Jul	31,	2014	Appointed KICOX Global Leading Company (Korea Industrial Complex Corporation)
Nov	30,	2015	Established DTR China Co., LTD in Jiang Jia Gang, China
Apr	30,	2016	Opened a branch office in Frankfurt, Germany
May	20,	2016	Awarded the 2016 Industrial Service Medal (President Jong-Youn Chun)

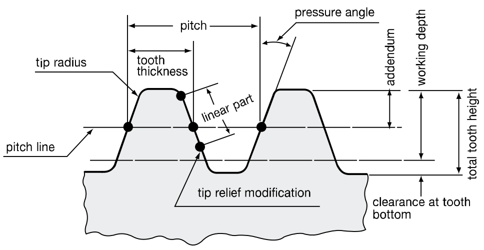
Gear Hob

Hob Nomenclature









Clearance of tooth bottom	CK=0.25m
Tip radius	r=Full-R, 0.3m
Pitch	nP=π·m
Tooth thickness	Sn=nP/2
Module	m
Pressure angle	PA=20°
Addendum	1.25m
Working depth	D+F=2.25m
Total tooth height	h=2.5m

Standard Gear Hob

DTR

Specifications

Unit: mm

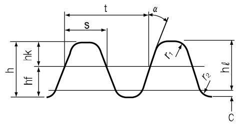
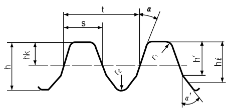
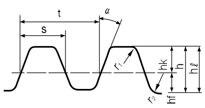
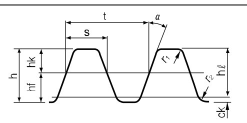
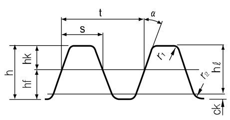
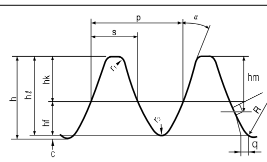
Module M	Diametral Pitch DP	Standard Hob						
		Out dia	Total Length	Bore dia	Hub dia	Hub Width	Bearing Face	N.T
1	24-22	50	50		34		(12)	
1.25	20	50	50		34		(12)	
1.5	18-16	55	55		36		(14)	
1.75	14	55	55	22(22.225)	36		(14)	
2	12	60	60		38		(15)	
2.25	11	60	60		38		(15)	
2.5	10	65	65		38		(16)	
2.75	9	65	65		38	4	(16)	12
3		70	70		42		18	
3.25	8	70	70		42		18	
3.5		75	75		45		20	
3.75	7	80	75	27(25.4)	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		58		24	
6		105	100		60		25	
6.5	4	110	110		60	5	28	
7	3.5	115	115	32(31.75)	60		28	
8	3	120	130		60		32	10
9	2.65	125	145		60		36	
10	2.5	130	160		60	6	40	
11	2.25	150	175		60		44	
12		160	190		60	7	48	
13	2	170	200	40(38.1)	70		50	
14	1.75	180	210		70	8	52	
15		190	220		74		54	
16	1.5	200	230		84	9	58	
18		220	250		94		62	9
20	1.25	240	270		94	10	65	
22		250	300	50(50.8)	94	12	68	
24		260	320		100	15	75	
25	1	270	320		100		80	
26		280	340			18		
28		300	360	60				
30		310	380					
32		320	410					
34		360	410			20		
35		370	420	80				8
36		380	440					
38		390	460					
40		400	480					

▶ For 32 Module and above, consult sales department.

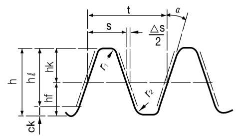
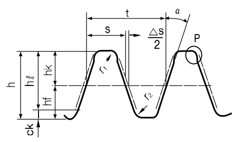
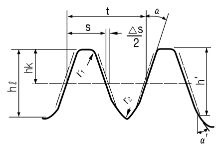
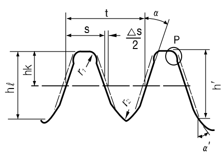
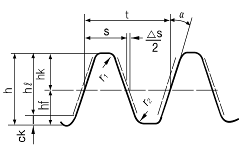
STD Tooth Profile of Hob

Standard Hob Tooth Profile

Finishing HOB Profile

Designation	Symbol	Specification
	STD	 α = 20° or 14.5° hk = 1.25m hf = 1.25m h = 2.5m $h\ell$ = 2.25m r_1 = r_2 = 0.375m (α = 20°) = 0.333m (α = 14.5°) C = 0.25m For a standard gear
Semi-topping Tooth	S-TOP	 α = 20° or 14.5° hk = 1.25m $h\ell$ = 2.25m r_1 = 0.375m • h', α', r_2 *are calulated by work gear data* Tooth Profile for reducing a noise with chamfer on out-diameter of a gear.
Topping Tooth	TOP	 α = 20° or 14.5° hk = 1.25m hf = 1.0m h = $h\ell$ = 2.25m r_1 = 0.375m (α = 20°) = 0.333m (α = 14.5°) r_2 = 0.2m To control both out-diameter on the bottom side of gear tooth and tooth thickness when producing a small size gear.
Stub Tooth	STUB	 α = 20° hk = 1.0m hf = 1.0m h = 2.0m $h\ell$ = 1.8m r_1 = r_2 = 0.3m ck = 0.2m For making a strong gear or distance of an axle use the lower tooth height.
Fellows Stub Tooth		 m/m' α = 20° hk = 1.25m' hf = 1.25m' h = 2.5m' $h\ell$ = 2.25m' r_1 = r_2 = 0.375m' ck = 0.25m' Use the same specification or double module with difference between the tooth thickness and tooth height, to make a strong tooth with the appropriate width.
Modified Tooth (BS Standard)	BS-1, BS-2, BS-W	 α = 20° h = 2.5m hf = hk = 1.25m C = 0.25m hm = 1.757m (1.622m) $h\ell$ = 2.25m r_1 = r_2 = 0.39m R = 15.75m (12.87m) q = 0.009m (0.019m) s = 0.5p The involute curve is modified in order to avoid interference on the side of the gear out-diameter, and is called the modification of tooth profile.

Roughing HOB Profile

Designation		Symbol	Specification
Semi-Topping Tooth	Pre-S/PreG	Pre-S/Pre-G/Pre-H	 α = 20° or 14.5° h ≥ 2.6m hk = 1.35m hf ≥ 1.25m $h\ell$ = 2.35m r_1 = r_2 = 0.3m ck = 0.25m *finishing stock* = △S When the gear manufacturing process is at the finishing stage and ready to be shaved or grinded, the gear grinding value is a negative amount, which should be used to grind down by using a shaving or a grinding cutter.
Semi-Topping Tooth	Protuberance Tooth	PP/PGP/PHP	 α = 20° or 14.5° h ≥ 2.6m hk = 1.35m hf ≥ 1.25m $h\ell$ = 2.35m r_2 = 0.3m ck = 0.25m *finishing stock* = △S r_1 *is calculated by work gear data* When the gear manufacturing process is at the finishing stage and ready to be shaved or grinded, under-cut on the bottom of gear tooth is made by the hob protuberance.
Semi-Topping Tooth	Semi-Topping Tooth	PS/PGS/PHS	 α = 20° or 14.5° hk = 1.35m $h\ell$ = 2.35m r_1 = 0.3m *finishing stock* = △S h', α', r_2 *are calculated by work gear data* When finishing by shaving or grinding, the semi-topping hob makes a chamfered gear tooth.
Semi-Topping Tooth	Pre-Shaving-Grinding Tooth	PSP/PGSP/PHSP	 α = 20° or 14.5° hk = 1.35m $h\ell$ = 2.35m *finishing stock* = △S h', α', r_1, r_2 *are calculated by work gear data* When finishing by shaving or grinding, a chamfered gear tooth and an under-cut on the automobile and ground gear are made by the semi-topping hob with protuberance.
Roughing Tooth			 α = 20° or 14.5° hk = 1.25m h ≥ 2.4m $h\ell$ = 2.25m hf = 1.15m r_1 = 0.3m or *FULL-R* r_2 = 0.2m ck = 0.15m *finishing stock* = △S When finishing by shaving or grinding, the gear grinding value is a negative amount which should be used to grind down by using a shaving or a grinding cutter.

The way to produce gear	Uses
1. HOB FINISHING	STD, S-TOP, TOP HOB
2. HOB + SHAVING CUTTER + H.T	P, PSP, PP, PS HOB
3. HOB + (SHAVING CUTTER) + H.T + HON	PHP, PP, PH, PHSP, PHP, PHS, PH
4. HOB + H.T + GRINDING	PG, PGSP, PGP, PGS

Roller Chain Sprocket Hob

DTR

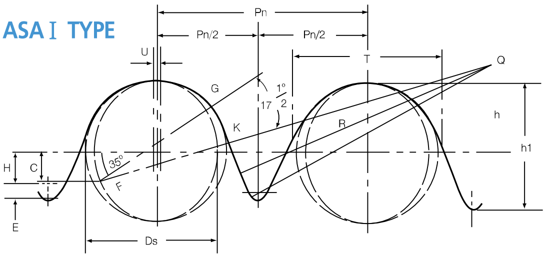
Ordering Specifications

1. Standard for chain(ASA-1, ASA-2, JUS-S, JIS-U, DIN, BS)
2. Pitch for chain
3. Roll diameter
4. No of chain
5. Specification for arbor which uses customer's machine.

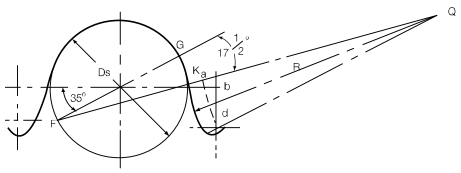
Note: The measurement for standard DIN/BS (8180, 8187, 8188) is different so it needs to be specified when you order.

Tooth Profile

ASA Ⅰ TYPE



ASA Ⅱ TYPE



Unit: mm

Dimension of chain sprocket			Hob dimension			
CP	RD	KS, ASA I, II Chain No.	OD	Total Length	Bore dia	
					A type	B type
6.35 (1/4")	3.30	RS25	60	60	22	22.225
9.525 (3/8")	5.08	35	65	65		
9.525 (3/8")	6.35	35	65	65		
12.7 (1/2")	7.77 (Agricultural M/C)	41	75	75	27	25.4 (26.988)
12.7 (1/2")	7.95 (Standard Industry)	40	75	75		
12.7 (1/2")	8.5(Autobicycle)	40	75	75		
15.875 (5/8")	10.16	50	85	90		
19.05 (3/4")	11.907	60	90	105		
25.4 (1")	15.875	80	110	125	32	31.75
31.75 (1 1/4")	19.05	100	120	140		
38.1 (1 1/2")	22.225	120	130	170		
44.45 (1 3/4")	25.4	140	160	190	40	38.1
50.8 (2")	28.575	160	170	210		
57.15 (2 1/4")	35.72	180	190	240		
63.5 (2 1/2")	39.688	200	210	260	50	50.8
76.2 (3")	47.625	240	240	310		
88.9 (3.5")	53.98	56B	280	310	60	63.5
101.60 (4")	63.5	64B	300	350		
114.30 (4.5")	72.39	72B	320	390		

Timing Pulley Hob

Ordering Specifications

1. Belt specification (Pitch & Belt Type)
2. Belt maker's instructions
3. NT of pulley
4. Pulley profile (Detail View)
5. Hob dimensions (OD X L X d)

Note: When you order please provide the name of the belt maker because each manufacturer's tooth profile varies.
Even if the standard for the timing hob you request is the same tooth profile, it may be different according to the belt maker.

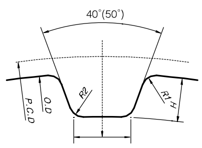
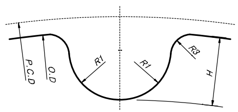
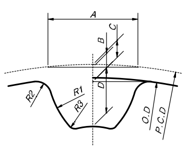
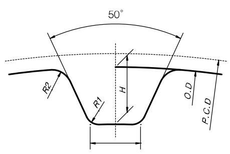
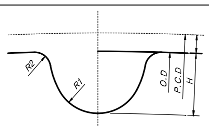
▶ Standard formula for pulley gear

$m = CP \div \pi$

$PCD = m \times Z$

$OD = PCD - (CK \times 2)$

Timing Pulley Profile

Timing Belt Profile		Belt Type	Common Use Ranges
S.T.D		MXL(2.032)	10-23T, 24-R
		XL(5.08)	10-R
		L(9.525)	10-R
		H(12.7)	14-19T, 20-R
		XH(22.225)	18-R
		XXH(31.75)	18-R
H.T.D		2M	
		3M	9-15T, 16-25T, 26-80T, 81-R
		5M	11-16T, 17-31T, 32-79T, 80-200T
		8M	18-27T, 28-40T, 41-89T, 90-200T
		14M	28-40T, 41-89T, 90-R
		20M	28-40T, 41-R
S.T.S		2M	
		3M	16-25T, 26-80T
		5M	19-22T, 23-28T, 29-39T, 40-69T
		8M	18-23, 24-69, 49-120
		14M	28-36T, 37-51T, 52-100T, 100-200T
		20M	
(A.T)D.T		AT5	10-14T, 15-20T, 21-R
		AT10	12-15T, 16-20T, 21-R
		AT20	15-20T, 21-R
		(D) T5	13-17T, 18-25T, 26-40T, 41-R
		(D)T10	12-15T, 16-20T, 21-45T, 46-114T
		(D)T20	15-20T, 21-R
G.T		2GT	16-25T, 26-80T
		3GT	16-25T, 26-50T
		5GT	17-31T, 32-79T
		8GT	18-28T, 29-89T

Parallel Side Spline Hob

DTR

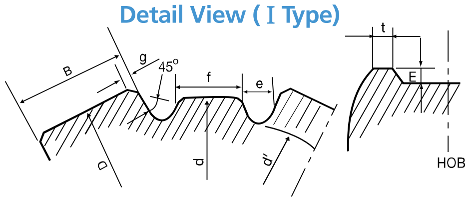
Ordering Specifications (D×d×B×N)

1. Out-diameter and tolerance for Parallel Side Spline(D)
2. Root-diameter and tolerance for Parallel Side Spline(d)
3. The width and tolerance for Parallel Side Spline(B)
4. No of tooth for Parallel Side Spline(N)
5. Amount of chamfer, grinding and LUG for Parallel Side Spline hob
6. Amount of grinding when it grinds during the process
7. Standard and type for Hob

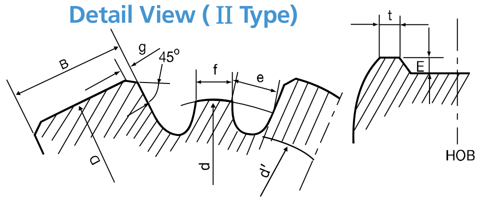
Parallel Side Spline Hob can be divided into 1 type and 2 type. ex. As shown in the table below, it is divided into MAJ dia. and MIN dia.

Parallel Side Spline Hob Dimensions

Detail View (I Type)



Detail View (II Type)



Unit: mm

Disignation	Dimension: Out dia	Dimension: Total Length (L)	Dimension: Bore dia (D)	I Type: NT N	I Type: MIN dia d	I Type: MAJ dia D	I Type: width B	I Type: chamfer amount g	II Type: NT N	II Type: MIN dia d	II Type: MAJ dia D	II Type: width B	II Type: chamfer amount g
11	60	60	22 (22.225)	6				0.3	6	11	14	3	0.3
13										13	16	3.5	
16										16	20	4	
18										18	22	5	
21	75	75	27 (25.4)							21	25	5	
23					23	26	6			23	28	6	
26					26	30	6			26	32	6	0.4
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	12	0.5
52					58	14	0.4	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)		78	18	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	36	6	6		8	32	32	6	0.4
36					36	40	7			36	42	7	
42					42	46	8			42	48	8	
46	95	90	32 (31.75)		50	9	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					72	78	12		10	10	72	82	
82	115	115		10	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	

Involute Spline Hob

DTR

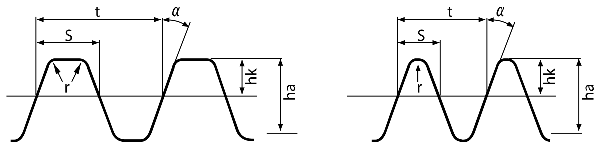
Tooth Profile for Involute Spline Hob

A Spline gear is used when the power transmits in the same rotating direction. The tooth profile is an involute profile. The specification is needed when ordering, as each country has a standard which follows their module value.

▲Fitted surface of tooth ▲Fitted major-diameter

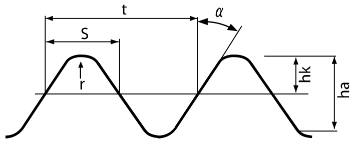
ex) Germany's industrial spline standard (pressure angle 30° ANSI B92.2: USA, inch system standard JIS/KS: D2001, B1603 standard)

Involute Spline Hob Tooth Profile



Flat Root Fillet Root

Involute Serration Tooth Profile



Unit: mm

Terms \ Standard	Old JIS Tooth Profile D2001-1959	New JIS Tooth Profile B1603-1995 ANSI B92.2M-1980 (meter system)		ANSI B92.2-1980 (inch system)			DIN Tooth Profile DIN 5480-1964
	Flat Root	Flat Root	Fillet Root	Flat Root	Fillet Root DP≧16	Fillet Root DP≦12	Flat Root
Module/DP	m	m		DP/DPS			m
Standard Pressure Angle(α)	20°	30°		30°			30°
Tooth Height(hk)	1.0m	0.75m	0.9m	1.35/DPS	2.0/DPS	1.8/DPS	0.6m
Cutting Length(WD)	1.2m	1.25m	1.4m	2.35/DPS	3.0/DPS	2.8/DPS	1.2m
Edge of Tooth(r)	0.3m	0.2m	0.4m	0.075/DPS	0.36/DPS	0.46/DPS	0.16m
Pitch(t)	πm	πm		25.4π/DP			πm
Tooth Thickness(s)	t/2	t/2		t/2			t/2

Tooth Profile for Involute Serration

Unit: mm

Terms \ Standard	Old JIS Tooth Profile D1602–1960	New JIS Tooth Profile B1603–1995 ANSI B92.2M (meter system)		ANSI B92.2-1980 (inch system)	
Module/DP	m			DP/DPS	
Standard Pressure Angle(α)	45°	37.5°	45°	37.5°	4.5°
Tooth Height(hk)	0.5m	0.7m	0.6m	1.53/DPS	1.1/DPS
Cutting Length(WD)	1.0m	1.15m	1.0m	2.53/DPS	2.1/DPS
Edge of Tooth(r)	0.4476m	0.3m	0.25m	0.4/DP	0.327/Dp
Pitch(t)	πm	πm		25.4π/DP	
Tooth Thickness(s)	1.3708m	t/2		t/2	1.3708/DP

Dry Cutting Hob

DTR

Features

Characteristics

- Increased productivity: Special HSS and multi layer coating increases cutting ability by more than 2 times, compared to a conventional Hob
- Cost savings: Increased tool life and reduced cycle time lead to cost savings
- Environmentally friendly: Cutting oil is not used

Successful Results Require

- a quality Hobbing M/C for Turbo cutting.

Application

- Mass production of gears(high volume)

Comparison of Results in a Hobbing Test between PFAUTER and MITSUBISHI

1. Machine Used : PFAUTER & MITSUBISHI
2. Work Data
   ① Material : CM818H
   ② Gear Specification : M2.95 X PA20° NT62 HA33° width 28mm

Specification		Conventional Hob	Dry Hob
Hob (PGS)	No of Start	4RH	4RH
	No of Teeth	NT16	NT16
	GL	∞	∞
	RA	8°	8°
	Material	PM	DHS2
	Coating	TiN	T.V.C
	OD	90	90
	OAL	150L	150L
	Bore	31.75	31.75
Cutting Condition	Rev	353	530
	Speed(M/Min)	Max. 100	170
	Feed	2	3.2
	Cutting Method	Climb Cutting	Climb Cutting
	Shift	1.5	1.5
	Cutting Oil	Yes	No
	Cycle Time	90.78sec	37.79sec
Cutting Amount		350ea	1,000ea
Wear Amount		Wear : 0.15	Wear : VB 0.29
		Crater : 0.20	Crater : 0.18

▶Climb cutting method should be used if possible.

Worm Gear Hob

DTR

Ordering Specifications

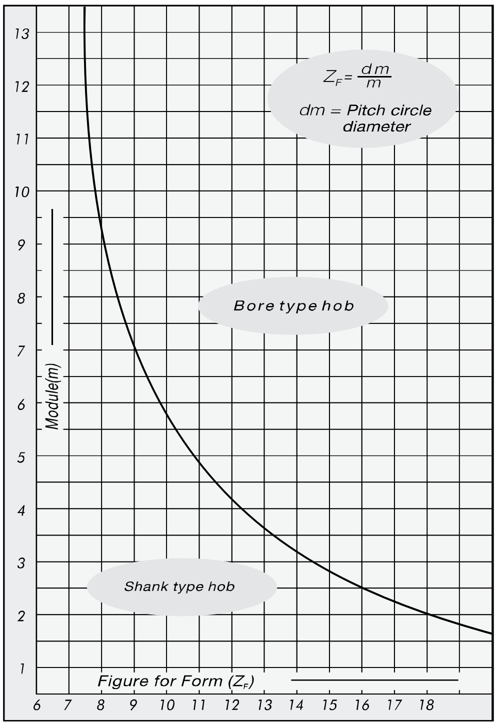
A worm hob is designed based on the worm shaft specification. There are no standards for worm gear hobs.
Generally this hob is manufactured as 'ZK' type. Since the overall dimensions of the hob are determined by the worm shaft and worm wheel data, please specify the following data when ordering:

1. Normal or axial module, DP
2. Out dia or pitch dia of worm
3. Worm lead angle
4. Number of threads and hand of thread
5. In case of shank type, shank standard
6. Contact ratio (Non-Standard): Standard contact ratio is generally 20~30%, and users can select either hole or shank type.

- CAVEX WORM - It's different based on the tooth maker. Please discuss when you order.
- The out-diameter of hob is decided with out-diameter of worm and sometimes it's impossible to produce with an Arbor Type Hob.

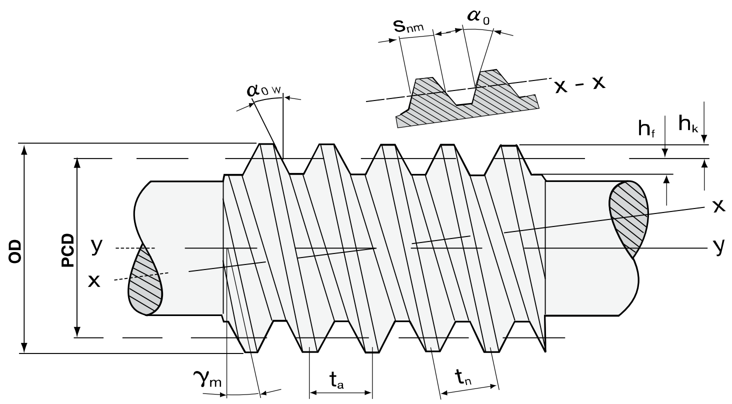
When ordering a combination worm hob and arbor, please provide the arbor specification, taper of the hobbing machine, setting bolt standard and hob rotating direction.
In addition specify whether the contact of the arbor is right or left.

Selection Graph for Worm Hob



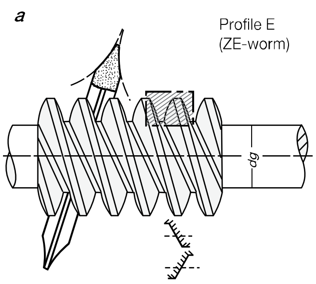
Worm Wheel & Shaft

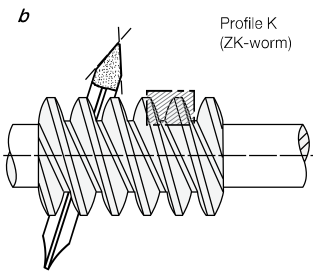
Worm Wheel & Shaft

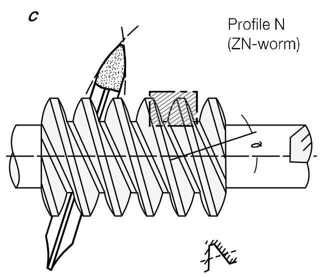


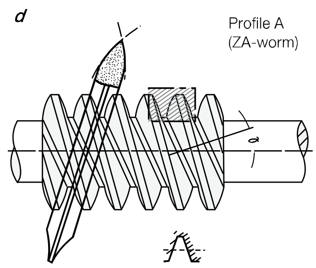
x-x	normal section
y-y	axial section
PCD	pitch diameter
OD	outside diameter
t_n-t_a	normal & axial pitch
s_{nm}	normal tooth thickness on the pitch circle
γ_m	helix angle
α_0- α_0w	normal & axial pressure angle
h_k	addendum
hf	dedendum
m_n-m_s	normal & axial module
Z_1	number of threads
R-L	hand of thread-right or left
Z_2	number of teeth in mating worm gear

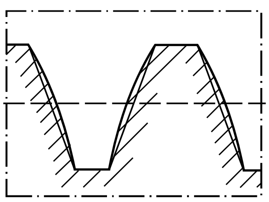
Profile of Worm Shaft





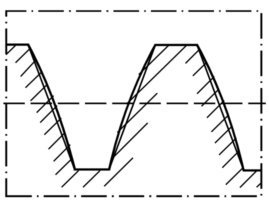






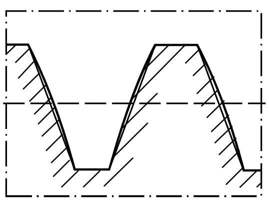
ZE-TYPE

Involute form profile of worm shaft profile



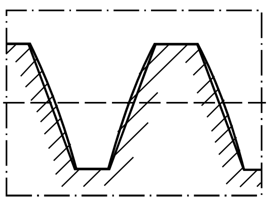
ZK-TYPE

The profile is generated by the pressure angle of grinding wheel



ZN-TYPE

A straight pressure angle in the normal plane



ZA-TYPE

A straight pressure angle in the axial plane

Heavy Cutting Hob

Ordering Specifications

Performance

- Reduction of cycle time: Faster cutting with more hob teeth
- Reduction of hob wear: Reduced hob tooth flank wear and overload because of doubled hob cutting edge compared to a conventional hob
- More savings: Increased productivity through increased tool life

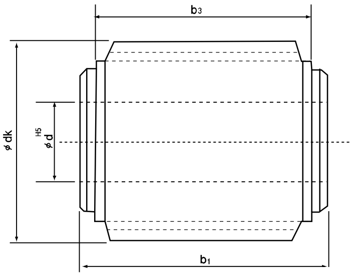
Use

Most effective when cutting large module gears and gears with many teeth

Applicable range

Module 6.0~Module 32 (A bigger module is more effective)

▶The above specification for the hob may be changed at the customer's request.



Unit: mm

Module	Pressure Angle	Out Dia (dk)	Use Total Length (b_3)	Total Length (b_1)	Inner Diameter	No of Tooth
5	20°	150	210	220	32	16
6.5	20°	150	210	220	32	16
7	20°	160	210	220	32	16
7.5	20°	160	210	220	32	16
8	20°	160	210	220	32	16
8.5	20°	160	210	220	32	16
9	20°	170	230	240	32	16
9.5	20°	170	230	240	32	16
10	20°	170	230	240	40	16
11	20°	170	230	240	40	16
12	20°	190	252	262	40	16
13	20°	190	252	262	40	16
14	20°	210	252	262	40	16
15	20°	210	252	262	40	16
16	20°	240	288	288	40	16
17	20°	240	288	288	50	16
18	20°	260	318	318	50	16
19	20°	260	318	318	50	16
20	20°	290	360	360	50	16
22	20°	300	396	396	50	16
24	20°	320	400	400	50	16
25	20°	320	400	420	50	16
26	20°	320	400	420	60	16
28	20°	330	420	440	60	16
30	20°	330	420	450	60	16
32	20°	330	420	450	70	16

▶The above indicated specification for hob might be changed with customer's request.

Built-up Hob / Carbide Hob

DTR

Built-up Hob

The teeth and body are assembled separately and with different materials.

Advantages

1) The cutting condition is efficient controlled relief angle.
2) Cost effective with lower material price for body.
3) Useful for high speed cutting with controlled arbor.

Disadvantages

1) The manufacturing process is complex.
2) The out-diameter of built-up hob increases more than that of a standard gear hob.
3) It requires more flexible delivery terms than a standard gear hob.

Unit: mm

Module	Out Dia	Total Length	Bore Dia
10	205	220	60
11	215	235	60
12	220	240	60
14	235	260	60
16	250	280	60
18	265	300	60
20	280	320	60
22	315	335	80
25	330	350	80
28	345	365	80
30	360	385	80
32	375	405	80

▶The above indicated specification for hob might be changed with customer's request.

Carbide Hob

DTR newly developed carbide hobs can cut gears down powerfully at high speed which brings higher efficiency of production than conventional HSS hobbing.

Specification

module : m0.5~m6.0
accuracy class : DIN3968 , class A / AA / AAA

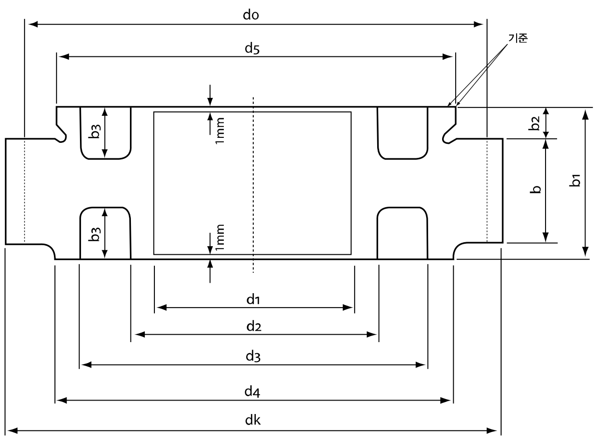
Characteristics

- high cutting speeds
- short machining times
- a longer tool life than conventional HSS cutter
- time saving per piece for gear manufacture
- high productivity
- machining precision
- improved working environment by employing dry cutting
- high suitability for dry machining
- lower gear generation costs

Master Gear

Master Gear Profile

The Master gear is used for checking the precision of the gear, especially in the automobile and aerospace industries. It features high precision, long tool life, and excellent efficiency. When the master gear engages with the gear on the rolling fixtures, the value of tooth is inspected by a variety of indicators, chart or other indicating devices, etc.



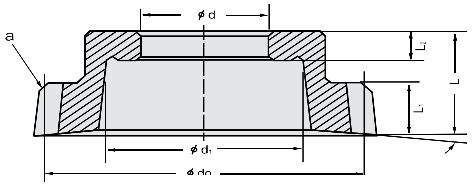
Unit: mm

Module m	No of Teeth	PCD Diameter d_0	Inner Diameter d_1	d_2	d_3	d_4, d_5	Tooth Thickness b	b_1	b_2	b_3	Out Diameter dk
1	48	48	22	-	-	40	12	17	4	-	50
1.25	64	80	32	-	-	70	20	25	4	-	82.5
1.5	54	81	32	-	-	70	20	25	4	-	84
1.75	46	80.5	32	-	-	70	20	25	4	-	84
2	40	80	32	-	-	70	20	25	4	-	84
2.25	36	81	32	-	-	70	20	25	4	-	85.5
2.5	32	80	32	-	-	70	20	25	4	-	85
2.75	42	115.5	32	-	-	95	30	36	5	-	121
3	38	114	32	-	-	95	30	36	5	-	120
3.25	36	117	32	-	-	95	30	36	5	-	123.5
3.5	32	112	32	-	-	95	30	36	5	-	119
3.75	30	112.5	32	-	-	95	30	36	5	-	120
4	28	112	32	-	-	95	30	36	5	-	120
4.5	34	153	40	70	110	130	40	46	5	10	162
5	30	150	40	70	110	130	40	46	5	10	160
5.5	28	154	40	70	110	130	40	46	5	10	165
6	26	156	40	70	110	130	40	46	5	10	168
7	28	196	60	90	110	170	60	66	5	12	210
8	24	192	60	90	110	170	60	66	5	12	208
9	22	198	60	90	110	170	60	66	5	12	216
10	20	200	60	90	110	170	60	66	5	12	220

Gear Shaper Cutter (Pinion Cutter)

DTR

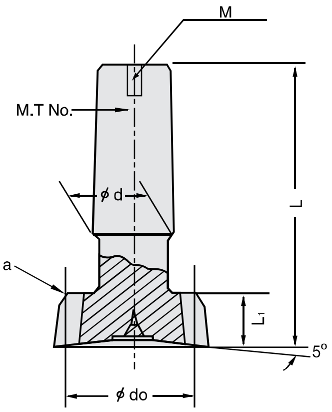
Bell Type



Unit: mm

Type	Module (M)			No. of Teeth(Z)	P.C.D do (M×z)	Hole Dia (d)	L	L₁	L₂	d₁	a
50		0.75		67	50.25	19.050	22	12	6.5	28	3
	0.8			63	50.4						
	0.9			56	50.4						
	1			50	50		28	15	8		
	1.25			40	50						
	1.5			34	51						
		1.75		29	50.75						
	2			25	50						
		2.25		23	51.75						
	2.5			24	60						
	2.75			22	60.5						
	3			20	60						
			3.25	19	61.75						
		3.5		18	63						
		3.75		16	60						
	4			15	60						
75		0.75		100	75	31.742	32	12	8	50	3
	0.8			94	75.2						
		0.9		84	75.8						
	1			75	75		38	15	10		
	1.25			60	75						
	1.5			50	75						
		1.75		43	75.25						
	2			38	76		38	18			
		2.25		34	76.5						
	2.5			30	75						
		2.75		28	77						
	3			28	78						
		3.25		24	78						
		3.5		23	80.5						
		3.75		21	78.75						
	4			20	80						
		4.5		18	81						
	5			16	80						
100	1			100	100	31.742 (44.450)	38	18	10	85	4.5
	1.25			80	100						
	1.5			67	100.5						
		1.75		58	101.5						
	2			50	100						
		2.25		45	101.25						
	2.5			40	100		40	22			
		2.75		37	101.75						
	3			34	102						
			3.25	31	100.75						
		3.5		29	101.5						
			3.75	27	101.25						
	4			25	100						
		4.5		23	103.5						
	5			21	105						
		5.5		19	104.5						
	6			18	108						
			6.5	17	110.5						
		7		18	112						

Shank Type



Please indicate a screw specification of "M" when you order.

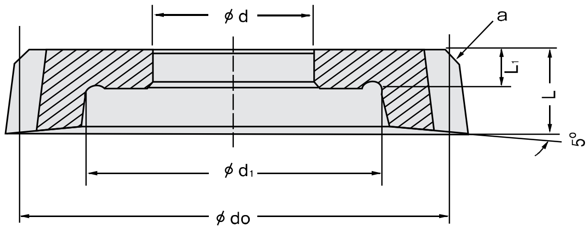
Unit: mm

Type	Module (M)			No. of Teeth(Z)	P.C.D do (M×z)	L	L₁	M.T Shank No.	a
25		0.75		34	25.5	63	10	MT.2 X M10	2
	0.8			32	25.8				
		0.9		28	25.2				
	1			25	25	80	12		
	1.25			20	25				
	1.5			17	25.5				
		1.75		15	26.25		15		
	2			13	26				
		2.25		12	27				
	2.5			10	25				
38		0.75		51	38.75	100	12	MT.3 X M12	5
	0.8			48	38.4				
		0.9		43	38.7				
	1			38	38		15		
	1.25			31	38.75				
	1.5			28	38				
		1.75		22	38.5				
	2			19	38		18		
		2.25		17	38.25				
	2.5			16	40				
		2.75		14	38.5				
	3			13	38				
			3.25	13	42.25	125		MT.4 X M16 Fellow Type M12	
		3.5		13	48.5				
			3.75	13	48.75				
	4			13	52				

Gear Shaper Cutter (Pinion Cutter)

DTR

Disk Type



*This cutter is for cutting a spur gear and the standard distance is indicated below.

Unit: mm

Type	Module (M)			No. of Teeth (Z)	P.C.D do (M×z)	Hole Dia (d)	L	L_1	d_1	a
75		0.75		100	75	31.742	12		50	3
	0.8			94	75.2					
		0.9		84	75.8					
	1			75	75		15	6.5		
		1.25		60	75					
	1.5			50	75					
		1.75		43	75.25					
	2			38	76		18	8		
		2.25		34	76.5					
	2.5			30	75					
		2.75		28	77					
	3			25	75					
			3.25	24	78					
		3.5		22	77					
			3.75	20	75					
	4			19	78					
		4.5		17	76.5					
	5			15	75					
100	1			100	100	31.742 (44.450)	18	10	6.5	4.5
	1.25			80	100					
	1.5			67	100.5					
		1.75		58	101.5					
	2			50	100					
		2.25		45	101.25					
	2.5			40	100		22			
		2.75		37	101.75					
	3			34	102					
			3.25	31	100.75					
		3.5		29	101.5					
			3.75	27	101.25					
	4			25	100					
		4.5		23	103.5					
	5			20	100					
		5.5		19	104.5					
	6			17	102					
				16	104					
		7		15	105					

Unit: mm

Type	Module (M)			No. of Teeth (Z)	P.C.D do (M×z)	Hole Dia (d)	L	L_1	d_1	a
125	2			83	126	44.450	22	10	85	4.5
		2.25		58	124					
	2.5			50	125					
		2.75		42	126.5		24			
	3			46	126					
			3.25	38	126.75					
		3.5		33	126					
			3.75	34	127.5					
	4			32	128					
		4.5		28	126					
	5			25	125					
		5.5		23	126.5					
	6			21	126					
			6.5	20	130					
		7		19	133					
	8			17	136					
150	2			75	150	44.450	24	12	85	4.5
		2.25		67	150.75					
				60	150					
		2.75		55	151.25					
	3			50	150		26			
			3.25	47	152.75					
		3.5		43	150.5					
			3.75	40	150					
	4			38	152					
		4.5		34	153					
	5			30	150					
		5.5		28	154					
	6			25	150					
			6.5	24	158		30			
		7		22	154					
	8			19	152					
		9		17	153					
	10			15	150					

Gear Shaper Cutter DIN Standard

DTR

C/T Class

Below Module 1

Terms	PCD								
	10~50 Class			50~125 Class			125~280 Class		
	AA	A	B	AA	A	B	AA	A	B
Tooth Profile Error	2	2.5	3.5	2	2.5	3.5	2	2.5	3.5
Pressure Angle Error	2	2.5	3.5	2	2.5	3.5	2	2.5	3.5
Pressure Angle Form Error	2.5	3.5	5	2.5	3.5	5	2.5	3.5	5
Sigle Division Error	2.5	3.5	5	2.5	3.5	5	3	4	5.5
Adjacency Division Error	3	4.5	6	3.5	4.5	6.5	3.5	5	7
Accumulated Pitch Error	6.5	9	13	9	12	16	10	14	19
Run Out	6	9	11	7	10	12	8	10	14
Max Error	2.5	4	5	3.5	4.5	6	4.5	6	9

Module 1~2

Terms	PCD								
	10~50 Class			50~125 Class			125~280 Class		
	AA	A	B	AA	A	B	AA	A	B
Tooth Profile Error	2	3	4.5	2	3	4.5	2	3	4.5
Pressure Angle Error	2	3	4	2	3	4	2	3	4
Pressure Angle Form Error	3	4	6	3	4	6	3	4	6
Sigle Division Error	2.5	3.5	5	2.5	4	5	3	4	5.5
Adjacency Division Error	3	4.5	6	3	5	6	3.5	5	7
Accumulated Pitch Error	7	10	14	9	14	18	11	16	20
Run Out	7	10	12	8	10	14	9	11	16
Max Error	3	4.5	6	3.5	5	7	4.5	6	8

Module 2~3.55

Terms	PCD								
	10~50 Class			50~125 Class			125~280 Class		
	AA	A	B	AA	A	B	AA	A	B
Tooth Profile Error	3	4	6	3	4	6	3	4	6
Pressure Angle Error	2	3	4.5	2	3	4.5	2	3	4.5
Pressure Angle Form Error	4	5	7	4	5	7	4	5	7
Sigle Division Error	2.5	3.5	5	2.5	3.5	5	3	4	6
Adjacency Division Error	3	4.5	6	3	4.5	6	3.5	5	8
Accumulated Pitch Error	8	11	16	10	14	20	12	16	22
Run Out	8	10	14	9	11	16	10	12	17
Max Error	3.5	5	7	4.5	6	8	5	7	10

Module 3.55~6

Terms	PCD								
	10~50 Class			50~125 Class			125~280 Class		
	AA	A	B	AA	A	B	AA	A	B
Tooth Profile Error	4	5	7	4	5	7	4	5	7
Pressure Angle Error	3	4	5.5	3	4	5.5	3	4	5.5
Pressure Angle Form Error	5	7	9	5	7	9	5	7	9
Sigle Division Error	3	4	6	3	4	6	3.5	4.5	7
Adjacency Division Error	4	5	8	4	5	8	4	5.5	9
Accumulated Pitch Error	8	12	16	10	16	20	12	18	25
Run Out	9	11	16	10	12	17	10	14	19
Max Error	4	6	8	5	7	10	5.5	8	11

Module 6~10

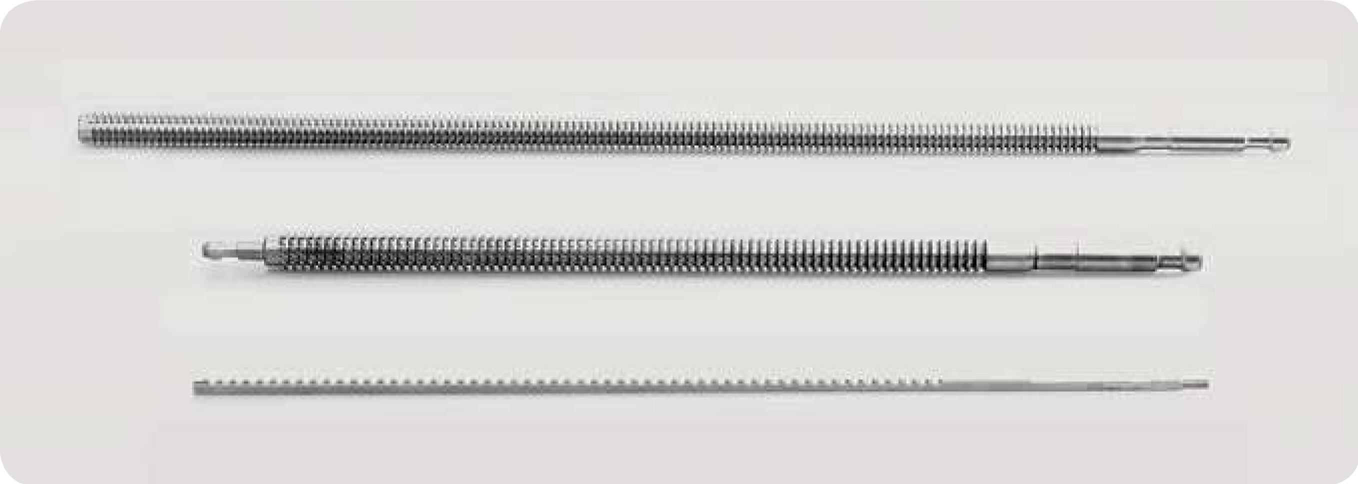
Terms	PCD								
	10~50 Class			50~125 Class			125~280 Class		
	AA	A	B	AA	A	B	AA	A	B
Tooth Profile Error	5	7	10	5	7	10	5	7	10
Pressure Angle Error	3.5	5	7	3.5	5	7	3.5	5	7
Pressure Angle Form Error	6	8	12	6	8	12	6	8	12
Sigle Division Error	3.5	5	7	4	5.5	8	4	6	8
Adjacency Division Error	4.5	6	9	5	6.5	10	5	8	10
Accumulated Pitch Error	11	15	22	14	20	25	16	22	28
Run Out	11	15	19	13	17	22	14	19	25
Max Error	5.5	8	11	6	9	12	7	10	14

Memo

Broach Cutter

Various Broach Cutters

Features



Round Broaches

These broaches perform precise broaching operations and do not require any pre-machining as in the case of other broaches.
Two kinds of round broaches are available, one for broaching only and the other with part burning.

Polygonal Broaches

These broaches perform precise and simple polygon profiles made by casting or forming.
Many kinds of polygon broaches are available such as square, rectangular, hexagonal or other polygon profiles.

Spline Broaches

An involute spline is generally used vs. a parallel side spline, as it transmits more power and rotates more smoothly.
To enhance a concentric degree, spline broaches with round teeth are also produced.

Serration Broaches

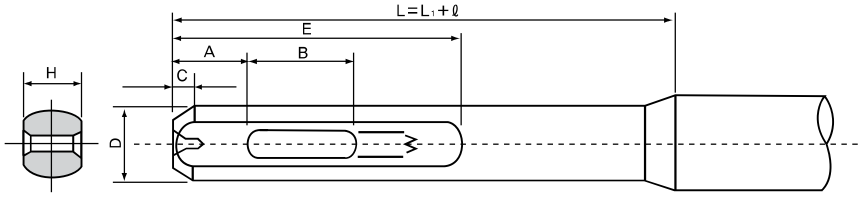
These broaches are generally used to cut a shaft and hole that is semi permanent. New models and involute serration broaches are available.

Special Broaches

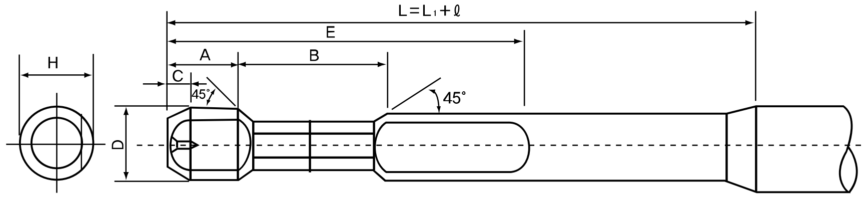
Upon special request, makes it possible to do very complicated machining.

Broach Cutter

Ordering Specifications



No.	workpiece bore dia	shank dia		A	B	W	C	H	E	allowable Load (ton)	L
		D	allowance (h8)(μ)								
101	10~12.5	10	+0/-22	16	16	3	3	9	50	2	150
102	12.5~14.5	12	+0/-27	18	18	3.5	3	10	50	3	160
103	14.5~16.5	14	+0/-27	18	18	4	3	12	50	4	160
104	16.5~18.5	16	+0/-27	18	20	5	4	14	60	5	180
105	18.5~20.5	18	+0/-27	18	20	5.5	4	16	60	6	180
106	20.5~22.5	20	+0/-33	18	25	6.5	4	18	70	7	200
107	22.5~26	22	+0/-33	20	25	6.5	4	20	70	10	200
108	26~29	25	+0/-33	20	32	7	5	22	80	13	220
109	29~33	28	+0/-33	20	32	7	5	25	80	17	220
110	33~37	32	+0/-39	20	32	8	5	28	80	23	240
111	37~41	36	+0/-39	22	40	9	5	33	90	28	240
112	41~47	40	+0/-39	22	40	11	6	36	90	34	260
113	47~52	45	+0/-39	22	40	13	6	40	90	42	260
114	52~57	50	+0/-39	25	45	14	6	45	100	53	280
115	57~62	55	+0/-46	25	45	14	8	50	100	66	280
116	62~67	60	+0/-46	25	50	16	8	55	120	77	280
117	67~72	65	+0/-46	25	50	16	8	58	120	95	300
118	72~78	70	+0/-46	30	55	18	10	63	150	108	300
119	78	75	+0/-46	30	55	18	10	68	150	127	300



No.	workpiece bore dia	shank dia		Neck dia.		A	B	C	E	H (d_9) (μ)		allowable Load (ton)	L
		D	allowance (h8) (μ)	D1	allowance (h10) (μ)								
201	10~12.5	10	+0/-22	7.5	+0/-58	12	25	3	50	8.5	-40/-76	1	110
202	12.5~14.5	12	+0/-27	9	+0/-58	12	25	3	50	10.5	-50/-93	2	120
203	14.5~16.5	14	+0/-27	10.5	+0/-70	12	25	3	50	12	-50/-93	3	120
204	16.5~18.5	16	+0/-27	12	+0/-70	15	30	4	60	13.5	-50/-93	4	130
205	18.5~20.5	18	+0/-27	13.5	+0/-70	15	30	4	60	15.0	-50/-93	5	130
206	20.5~22.5	20	+0/-33	15	+0/-70	15	30	4	70	17	-50/-93	7	140
207	22.5~26	22	+0/-33	16.5	+0/-70	15	30	4	70	18.5	-65/-117	8	140
208	26~29	25	+0/-33	19	+0/-84	18	35	5	80	21.5	-65/-117	11	160
209	29~33	28	+0/-33	21	+0/-84	18	35	5	80	24	-65/-117	13	160
210	33~37	32	+0/-39	24	+0/-84	18	35	5	80	27.5	-65/-117	18	180
211	37~41	36	+0/-39	27	+0/-84	18	35	5	90	31	-80/-142	22	180
212	41~47	40	+0/-39	30	+0/-84	20	40	6	90	34.5	-80/-142	28	200
213	47~52	45	+0/-39	34	+0/-100	20	40	6	90	39	-80/-142	36	200
214	52~57	50	+0/-39	38	+0/-100	20	40	6	100	43.5	-80/-142	45	220
215	57~62	55	+0/-46	41	+0/-100	25	50	8	100	48	-80/-142	55	220
216	62~67	60	+0/-46	45	+0/-100	25	50	8	120	53	-100/-174	63	240
217	67~72	65	+0/-46	48	+0/-100	25	50	8	120	57	-100/-174	72	240
218	72~78	70	+0/-46	52	+0/-100	30	50	10	150	60	-100/-174	85	260
219	78	75	+0/-46	56	+0/-100	30	50	10	150	65	-100/-174	100	260

PVD Coating Service

DTR

DTR was the first company in South Korea to study PVD HARD Coating and continues its R & D in order to contribute to the further development of the surface processing industry. DTR supplies the best quality and variety of coatings which offer higher wear resistance, corrosion resistance, good color and better lubrication function.

History of DTR Coating

1988	• Developed PVD coating equipment • Developed the first hard coating system in cutting industry
1995	• Developed quality inspection system • Developed second PVD coating machine • Agreement with Medium and Small Enterprises Technology Support Center in YonSei University. • Expansion quality inspection system
2000	• Developed cooperative study with Technology Support Center. • Obtained QS9000/ISO9001 Certification • Provided equipment for company and university technology support; and collaborated on study system.
2003	• Extension R&D washing line by DTR • Upgrade Hybrid type coating Machine
2005	• Cooperated with German coating company and equipped with R&D system • Moved to new factory
2007	• Adapted new coating equipment and developed R&D and own process
2008	• Start coating service • Launched MAX Series brand • Fostered cooperation with a university
2010	• Established a lower temperature system, Developed Si Nano coating. • Established Coating R&D Institute, a technology connection with the Production Technology Institution in South Korea.

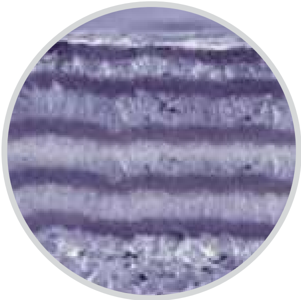
Summary of Coating

PVD coatings enhance heat and wear resistance of cutting tools: a high-performance coating applied to cutting tools using PVD technology offers advantages in cutting. It reduces abrasions and crater wear on the tools for conventional wet, dry cutting and high speed machining. Modern coating technology ensures smooth coatings, which reduce the friction between the chip flow and the tool.

X 3,000 Surface

The surface of coating layer

As a dimple type structure, it brings outstanding lubrication.



X 15,000 Section

Multi Layer coating surface

As a multi layer, it maximizes resistance from loading.

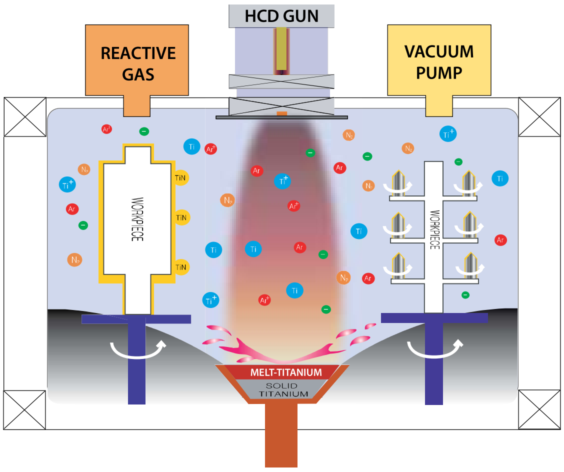
PVD Coating Service

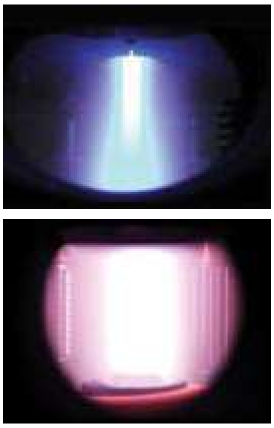
DTR

Coating Type and Plasma Principles

HCD Type

Making Electric Beam as putting high voltage on the Electric Gun around Ar condition. When the Titanium is melting, Ionized Titanium is released on the vacuum, it can be making strong and accuracy thin film as accelerating Ion on the substrate of the stable field.

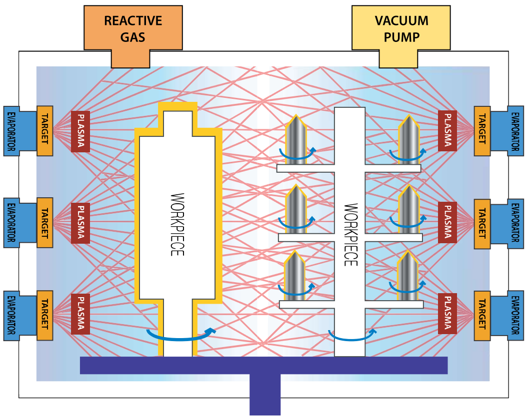


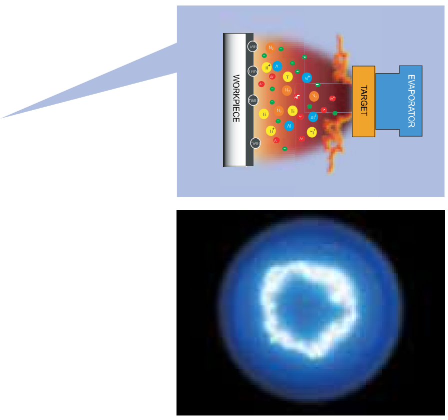


Hollow Cathod Discharge

ARC Type

After making strong electromagnetic field from specific electric current and magnetic on the Ionized Titanium with one autom can be sticking strongly on the material from the cathode on the vacuum. Evaporation Ion is possible to make strong adhesion thin film as following mutual spreading layer from the energy which is brought concentrative Arc currency(60~150A) of Arc discharge.





Arc Evaporation in Progress

PVD Coating Service

Kinds of DTR PVD Coating

MULTI-TiN

Multi-TiN coating is used for the mechanical industry such as dies, die-casting, molds, punches, and a range of metal stamping and forming tools. It performs well under lubricated machining. Based on the refining ingredient Cr which has strong resistance to high temperature, this coating is applied to the molding and sliding core for strength and hardness.

MAX-Cr

Based on refining Cr ingredient which has strong resistance from high temperature, this coating is applied molding and sliding core that needs strong hardness, high temperature and good lubrication.

MAX-Ⅰ

MAX-Ⅰ coating is the most common coating and it is wear resistant for general purpose; and a wide variety of materials and cutting conditions. It reduces friction and resists corrosion. TiN performs well when extended tool life and elevated feeds and speeds are required.

MAX-Ⅱ

MAX-Ⅱ is designed for machining hard materials. It offers a higher hardness compared to TiN and can show a slightly lower friction coefficient in hardness applications. It is primarily used to achieve enhanced abrasive wear resistance.

MAX-Ⅲ

MAX-Ⅲ coating is a multi-layer coating offering an optimized combination of TiN plus TiCN. This coating has a super-nitride layer which provides added strength. Multi-layered coatings can improve the hardness and toughness compared to single layers.

MAX-α

MAX-α is designed for use in high temperature (800°C) applications and difficult to machine materials. Speeds and feeds can be dramatically increased with TiALN, boosting productivity. In many cases, tools may be operated dry and this coating provides exceptional oxidation resistance and extreme hardness.

MAX-β

MAX-β is an extremely hard, thin film coating that can be used in both wet and dry cutting conditions. It offers very high temperature (1000°C) resistance and performs well in corrosive environments and in sliding wear applications.

MAX-γ

MAX-γ a multi layer coating which is compounded with TiALN and TiN. It offers good heat and wear resistance. This coating offers high durability as well as due to its gold color, it is useful to find wear conditions.

MAX-θ

MAX-θ is a nano structure type composition coating with Si as an ingredient. It has strong heat resistance under demanding working conditions. It forms a smooth grain and offers greater chip resistance under high lubrication conditions. Also, due to its nano structure it performs well during high speed dry processes.

MAX-Ω

MAX–Ω with Gpa42 it performs well in extremely high temperature environments. It protects severely loaded edges against wear at extreme temperatures (1100°C).

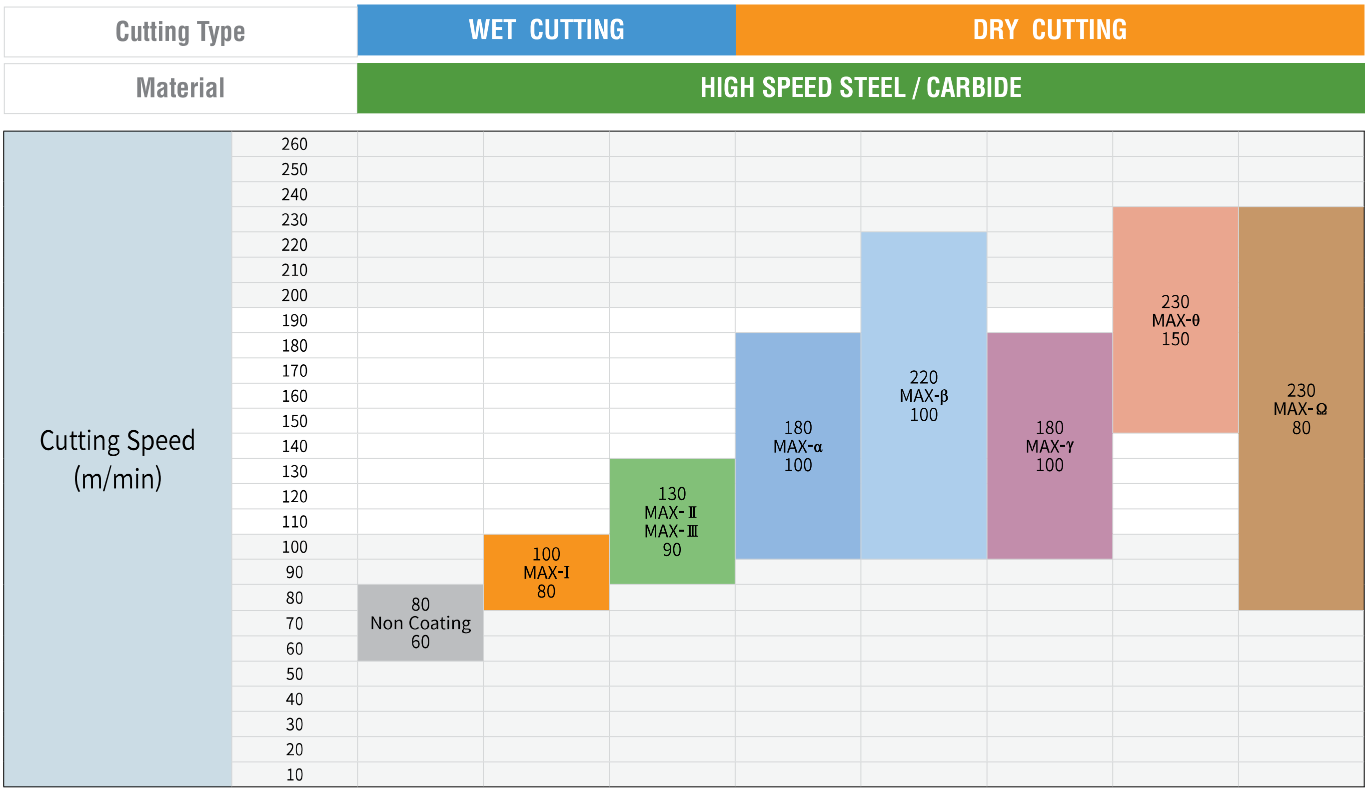
PVD Coating Service

DTR

Characteristic of Coating

Kinsa of Coating / Co. Spec	Multi-TiN	MAX-Cr	MAX-I	MAX-II	MAX-III	MAX-α		MAX-β	MAX-γ	MAX-θ	MAX-Ω
	Mold	CrN	TiN	TiCN	TiCN+TiN	Nano TiAlN	Nano AlTiN	nc-Marvel Special Co	TiAlN+TiN	Super-Marvel Special Co Based Si_3N_4	Hard-Marvel Special Co Based TiAlN
Coating type	HCD & ARC	ARC	HCD & ARC	HCD	HCD	ARC	ARC	ARC	ARC	ARC	ARC
Coating layer	Multi Layer	Mono Layer	Mono Layer	Multi Layer	Multi Layer	Multi Layer	Multi Layer	Multi Layer	Multi Layer	Nano-Multi Layer	Multi Layer
Vickers hardness (HV)	2200	2000	2200	2500~2800	2500~2800	3500	3500	3500	3500	3500	3600
Coefficient	0.4	0.15	0.4	0.4	0.4	0.2~0.4	0.2~0.3	0.2~0.3	0.2~0.3	0.3	below 0.2
Thickness(㎛)	1~10	1~10	1~5	1~5	1~5	1~5	1~5	1~5	1~5	1~5	3~4
Possible Temp.(℃)	600	750	600	500	600	800	900	1000	900	1100	1100
Color	GOLD	SILVER	GOLD	VIOLET GREY	GOLD	BLACK	BLACK	DARK GREY	GOLD	DARK BRONZE	DARK GREY
Recommendation method related cutting condition											
HOB (HSS)	Forming Tools	Forming Tools	General Cutting	Difficult to Machine Materials Cutting	Difficult to Machine Materials Cutting	High Speed Cutting	Highest Speed Cutting	General-Highest Speed Cutting (include difficult to machine materials)	High Speed Cutting	High Speed Cutting	General-Highest Speed Cutting (include difficult to machine materials)
Recommended Cutting Condition	Vast Range	Vast Range	Vast Range	High Loading	High Loading	High Temperature	Middle-High Temperature	Low-Highest Temperature	High Temperature	Highest Temperature	Low-Highest Temperature
	General Application	General Application	General Application	General Application	General Application	DIN AA Class	General Application	Application for difficult to Machine Materials	DIN AA Class	Application for difficult to Machine Materials	Application for difficult to Machine Materials
Speed (m/min)	-	-	80~100	90~130	90~130	100~180	150~200	100~220	100~180	150~230	80~230
Cutting Method	-	-	WET	WET	WET	DRY	DRY	WET, DRY	DRY	DRY	WET, DRY

Application of cutting condition



Heat-treatment

DTR

Comparing composition of raw material

Material / Ingredient(%)	M35(SKH55)	M2(SKH51)	M42(SKH59)	DHS4	DHS1	DHS2	DHS3	DHS5
c	0.9	0.9	1.1	1.1	1.28	1.6	2.3	2.45
Si	0.5 and less			0.4				
Mn	0.4 and less			0.4				
P	0.03 and less			0.03				
S	0.03 and less			0.03				
Cr	4	4.2	4	4.5	4.2	4.8	4.2	4
Ni	0.25 and less			0.25				
Cu	0.25 and less			0.25				
Mo	5	6.4	9.5	6.5	5	2	7	5
W	6	1.8	1.5	6.5	6.4	10.5	6.5	11
V	2	5	1.2	2.7	3.1	5	6.5	6.5
Co	5		8	5.5	8.5	8	10.5	16

Working Condition

Kinds of Steel	Size	Hardness	Kinds of Steel
HSS	350×350×450 (mm)	HRC56-68	M2(SKH51), M35(SKH55), M42(SKH59), CPM, REX15, REX41, REX45, ASP23, ASP30, HAP40, HAP50, SKH4H, YXM60
An alloy	350×350×450 (mm)	HRC40-63	SKD11, SKD12, SKD61, SKD5, SUS410, SUS416, SUS420, SUS440, B407, QR090, DC53, STAVAX, XW41
Structural steel	350×350×450 (mm)	HRC20-60	S45C, S55C, SCM4, SNCM8, SK3, SK5, SKS3, SUJ2, SUP, SCM420, 430, 440, SNC836, SNCM439, STD4
SUS	350×350×450 (mm)	HB210 below	SUS303, SUS304, SUS310, SUS316, SUS360

Heat-treatment Hardness Standard

Material		Heating Temperature	Tempering				Hardness
			1	2	3	4	
M35(SKH55)		1190~1200°C	560°C	560°C	560°C		65~66
M35(SKH55)	M≥4	1170~1180°C					64~65
	M≤3.5	1190~1200°C					65~66
M42(SKH59)		1180~1190°C					66~67.5
DHS2		1200°C	560°C	560°C	560°C	560°C	66~67
DHS1		1180~1190°C					66~67
S290							69~70
FAX38							66~67.5
CPM45							66~67
DHS5							69~70
DHS3		1140~1150°C					67~67.5
Temperature Management		Heating and Tempering Temperature ±5°C					

Heat-treatment

Maintenance Time Heating

■HSS

Thickness(mm)	5	10	15	20	25	30	35	40	45	50
Time	1′5	2′5	3′5	4′5	5′	5′5	6′5	7′5	8′5	9′5

■PM

Thickness(mm)	5	10	15	20	25	30	35	40	45	50
Time	2′	3′	4′	5′	5.5′	6′	7′	8′	9′	10′

Technical Information for Hobs

DTR

Hob Specification Criteria

■Raw material for Tooth - HSS, PM, CARBIDE
■Structure - Solid Hob, Built-up Hob, Attached Tooth part
■The way of Formation and Conjunction - Arbor(Bore), Shank, Straight, Flute, Rake angle, Single Start Hand, Multi Start Hand
■Items - Involute, Spline, Serration, Sprocket, Timing, Worm, Cycloid, Ratchet, Sign curve, Special Tooth Profile(Pump, & etc.)
■Function and Use - Shaving or Grinding, Finishing Purpose, Pre-shaving, Protuberance, Semi topping, Topping, BS tooth profile
■The way of Manufacture - Grinding, Ungrinding

The Method of Hob Computation

■Normal pitch = Mn ×π (Mn: NORMAL MODULE)
■Axial pitch = Mn / cos LA
■LEAD = Axial pitch × Number of start
■LA(Lead Angle) = sin-1(Mn×Number of start/HOB PCD)
■Cam amount(relief amount)=HOB OD×π ×tan(cam angle)/HOB NT
■Cam angle: Generally PA20°→10°, 14.5°→12°, 25°→9°
■Groove Lead=HOB PCD×π / tan LA
■Flute depth = Total tooth height of a hob + Cam amount + 1.5(mm)
■HOB'S RELIEF ANG = tan-1 (tan PA×tan Cam angle)

Hob Cutting Condition

■Cutting speed V = πDN/1000(m/min)
π : Circle Ratio D(Hob OD), N(RPM)
■A factor of cutting speed
1. Workability of material
2. The module of gear
3. Cutting depth
4. Gear class
5. Hob material
6. Required hobbing time per piece
7. Machine rigidity

Feed

• Finishing: 0.8~2.5mm/rev
• Roughing: 2.5~5mm/rev

Number of start	Feed	Hobbing Time
1	1	1
2	0.8	0.63
3	0.55	0.61
4	0.42	0.59
5	0.35	0.57
6	0.3	0.55

Cycle time of Hob

1. Hob Shift

The most vulnerable wear portion on the hob is the cutting edge due to the initial cut starting from the edge of the hob addendum. By shifting the hob in an axial direction, the wear amount can be distributed, and the tool can be used more efficiently.

$$\text{Straight Flute Shift} = \frac{M \times \pi \times (Zh)}{NT \times \cos LA} \qquad \text{Helical Flute Shift} = \frac{M \times \pi \times (Zh) \times \cos LA}{NT}$$

M: Module, NT: HOB teeth, LA: HOB lead angle, Zh: HOB number of start

Technical Information for Hobs

DTR

2. Cycle Time

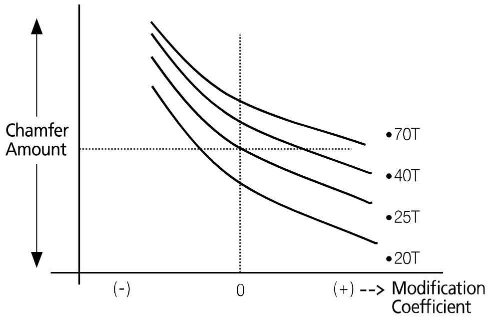
Increasing RPM for higher productivity

$$T = \frac{Z \times L}{RPM \times F \times Zh}$$

Z: Gear teeth, L: HOB moving distance(mm), RPM: HOB revolution,
F: Feed(mm/rev), Zh: HOB number of starts

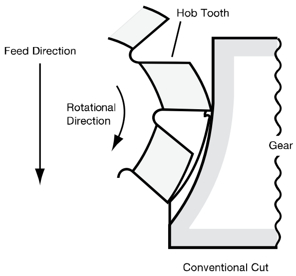
Common Uses of a Hob

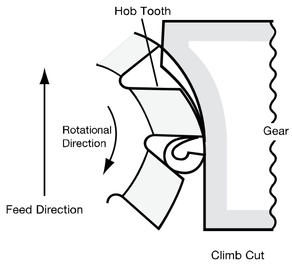
• The relation of chamfer, tooth thickness and tooth height



In the case of gears with equal tooth thickness but different numbers of teeth. The same hob will cut the gear with fewer teeth. The chamfer amount will decrease accordingly

Cutting Method of a Hob





Climb & Conventional

Item	Climb cutting (up cutting)	Conventional cutting (down cutting)
Formulation of chip(less than 25˚)	thicker chip	thinner chip
Basic shape of chip	same	same
friction force of cutting	small	big
The wear by sliding	small	big
The wear by cutting force	big	small
Hob profile roughness	bad	good
Workpiece Helix angle	less than 25 is good	more than 25 is good
The most worn part of a Hob	left part	right part
Cutting speed	possible to increase	impossible to increase
Cutting a huge gear	possible	impossible
The clamping condition of a work piece	strong	weak

Technical Information for Hobs

DTR

Comparision of the Amount of Chamfer By Each Number of Teeth

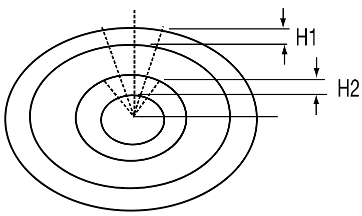
1.M1 PA20” The chamfering distance of S-Top Hob by the number of teeth

M	PA	The Number of Teeth	WD (2.25×M)	Chamfering amount (0.1×M)	Addendum	Thickness of Tooth	chamfering distance			Actual applied amount	
							Modification ramp	Chamfering angle		Modification ramp	Chamfering angle
		10					2.0658	58° 21′ 53″	58.3647222	2.0554	
		15					2.0846	57° 40′ 29″	57.6747222	2.0782	
		20					2.0964	57° 13′ 36″	57.2266667	2.092	
		25					2.1046	56° 54′ 37″	56.9102778	2.1014	
		30					2.1104	56° 40′ 27″	56.6741667	2.108	
		35					2.115	56° 29′ 27″	56.4908333	2.113	
		40					2.1186	56° 20′ 39″	56.3441667	2.117	
1	20°	45	2.25	0.1	1.25	1.5708	2.1214	56° 13′ 26″	56.2238889	2.1202	55°
		50					2.124	56° 7′ 26″	56.1238889	2.1228	
		55					2.126	56° 2′ 20″	56.0388889	2.125	
		60					2.1276	55° 57′ 58″	55.9661111	2.1268	
		70					2.1304	55° 50′ 51″	55.8475	2.1298	
		80					2.1326	55° 45′ 17″	55.7547222	2.1322	
		90					2.1344	55° 40′ 50″	55.6805556	2.134	
		100					2.1358	55° 37′ 10″	55.6194444	2.1356	

2.N5 PA20” The chamfering distance of S-Top Hob by the number of teeth

M	PA	The Number of Teeth	WD (2.25×M)	Chamfering amount (0.1×M)	Addendum	Thickness of Tooth	chamfering distance			Actual applied amount	
							Modification ramp	Chamfering angle		Modification ramp	Chamfering angle
		10					10.329	58° 21′ 53″	58.3647222	10.277	
		15					10.423	57° 40′ 29″	57.6747222	10.391	
		20					10.482	57° 13′ 36″	57.2266667	10.46	
		25					10.523	56° 54′ 37″	56.9102778	10.507	
		30					10.552	56° 40′ 27″	56.6741667	10.54	
		35					10.575	56° 29′ 27″	56.4908333	10.565	
		40					10.593	56° 20′ 39″	56.3441667	10.585	
5	20°	45	11.25	0.5	6.25	7.8540	10.607	56° 13′ 26″	56.2238889	10.601	55°
		50					10.62	56° 7′ 26″	56.1238889	10.614	
		55					10.63	56° 2′ 20″	56.0388889	10.625	
		60					10.638	55° 57′ 58″	55.9661111	10.634	
		70					10.652	55° 50′ 51″	55.8475	10.649	
		80					10.663	55° 45′ 17″	55.7547222	10.661	
		90					10.672	55° 40′ 50″	55.6805556	10.67	
		100					10.679	55° 37′ 10″	55.6194444	10.678	

As referenced above, even though the gear has the same module and the change coefficient is 0, the chamfer distance of the hob is based on the gear's tooth because the chamfer diameter is not the same. The difference between the real chamfer part and root diameter's height is H1>H2, the tooth no. of gear is getting smaller even though it has same tooth height.
The gear which has same module, same pressure angle, and same BS is changed the chamfer distance as following of no. of tooth because of the above situation. For the detail, refer to the above exact values.



Technical Information for Hobs

HOB Resharpening

Resharpening time should be decided not to be late for better efficiency.
The guidelines for determining the time to resharpen are as follows:

1. Wear amount

When the gear is cut by roughing or finishing process, the hob wear amount can be different.
Generally, it is recommended to regrind per chart below

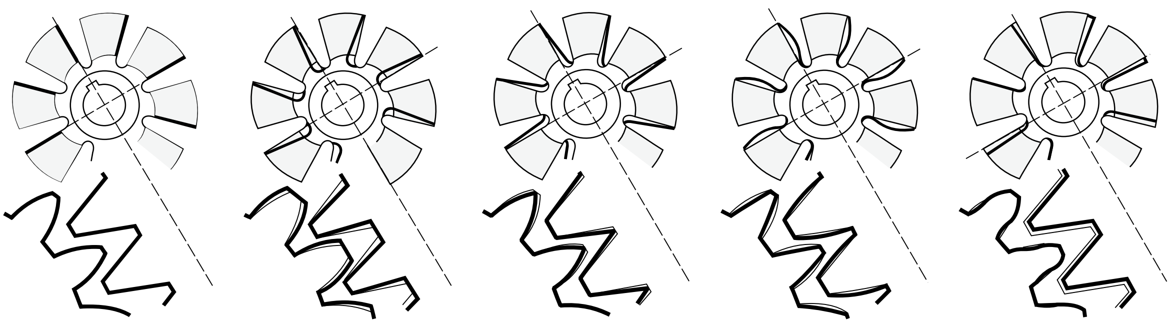
MODULE	Wear amount of teeth edge	
	Roughing	Finishing
0.5	0.13~0.18	0.08~0.1
0.5~1.5	0.15~0.25	0.1~0.2
1.5~2.5	0.25~0.4	0.2~0.3
2.5~6	0.4~0.5	0.25~0.4
6~12	0.5~0.65	0.4~0.5

2. Tool life

To preserve an optimum cutting condition and get long tool life, a tool should be resharpened after checking the wear amount. If you use a worn tool, the tool's cutting ability is reduced.

■During grinding, if you exceed the proper grinding amount an invisible grinding crack may occur so it makes the tooth separate and causes the hob to break. If you suspect that a grinding error has occurred, continue to inspect the teeth and if you notice any color variation, this could be an indication that a crack has formed and you should stop using the hob.

The Relation of Grinding Hob Teeth and Gear Profile



Technical Information for Hobs

DTR

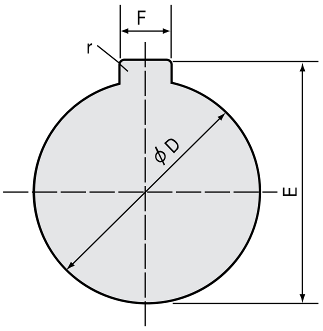
Gear Involute Curve Error Cause

The Cause of Error	The Cause of Error	Solution
Checked workpiece parts are different.	1. Hob Class Error 2. Hob Setting Error 3. Hob Arbor Error 4. Occur of Built-up-edge 5. Decreased Hob Spindle Class 6. Error of master worm	• Re-Grinding • Check Setting Angle, Error, OD • Switch arbor • Re-Grinding • Error, Metal Wear • Back Lash, Bearing Crack
In case Shifting makes, there are tooth from change	1. Hob Class Error 2. Hob Setting Error 3. Hob Arbor Error 4. Hob Spindle Runout	• Re-Grinding • Re-set • Switch arbor • Fix to spindle
There are difference between left and Right profile	1. Build up on Cutting Edge 2. Re-Grinding Error 3.Hot setting Angle 4. Master worm Error 5. Heavy Hob Wear	• Re-Grinding • Re-Grinding • Check Setting Angle • Check Back Lash • Re-Grinding
While using multi-thread hob, tooth profiles are different	1. Hob Class Error 2. Hob Arbor Error 3. Hob Thread to Thread Error	• Back Lash, Cycle Error Pitch Error, Run out Bearing Crack
Every tooth profile is different	1. Master Worm Error 2. Table Class Error 3. Center Rotation Error	
	4. Causes of Gear Profile Error. 1) During Set-up, bolts & nuts aren't tightened. 2) Head part of metal error. 3) Error of hob shift range setting. 4) Too much vibration on each center of datum plane. 5) Scratching on Work Center. 6) For helical, wrong feed result in bad lead and profile error. 7) Error and run-out of Differential gear. 8) Stamping on tooth profile on differential gear and key crack. 9) Tooth error of differential gear.	

Considerations When Selecting Hobs

1. Bore Dia: Using standard table(Caution: Tolerance of inch and metric)
2. Outside Dia: Usually using the standard table, however Outside Dia can be increased for increasing productivity and fewer interruptions of machining (For HIGH AUTO MOTIVE VOLUMES : For M2.5, bore Multi-Gash(17~20N))
3. OAL(Overall Length): Per Massive volume, OAL can be increased up to maximum of Machine shift amount.
4. No. of Thread: Select threads depending on cut type finishing
5. No. of Flutes: Use 1 thread for Finish Cutting, and use multi thread for roughing, or semi-topping.
   (When the number of gear teeth is divisible by no: threads, a profile error may result.)
6. Rake angle: Normally don't need.
7. Hand: Same direction as gear's.
8. GL: If hob lead angle is over 5 degrees, use spiral gashes.
9. Class: Normally use DIN A (Gear:JIS4~5)
10. Material: If high speed of hardness is required, Powder Material is used. Otherwise, SKH55 is used.

Standard Hob Keyway Dimensions



1. A Type

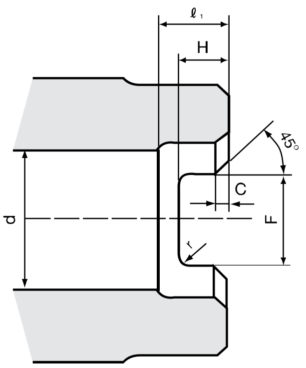
Unit: mm

Designation	D Standard Sesignation	D Allowance	E Standard Sesignation	E Allowance	F Standard Sesignation	F Allowance	Referene r
8	8	H5	8.9	+0.250 0	2	+0.16 +0.06	0.4
10	10		11.5		3		
13	13		14.6				0.6
16	16		17.7		4	+0.19 +0.07	
19	19		21.1		5		1
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	+0.30 0	10		
50	50		53.5		12	+0.275 +0.095	1.6
60	60		64.2		14		
70	70		75		16		2
80	80		85.5		18		
100	100		107.0		25	+0.32/+0.11	2.5

2. B Type

Unit: mm

Designation	D Standard Sesignation	D Allowance	E Standard Sesignation	E Allowance	F Standard Sesignation	F Allowance	Referene r
12.7	12.7	H5	14.2	+0.250 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		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		



3. SHELL KEY

Unit: mm

Bore d A type	Bore d B type	F Allowance	F Standard Sesignation	H Allowance	H Standard Sesignation	r	e	ℓ_1	C
22	22.225	10.4	+0.110 0	6.3	+0.2200 0	1.2 $^{0}_{-0.3}$	0.100	7	0.6 $^{+0.2}_{0}$
27	26.988	12.4		7				8	0.8 $^{+0.2}_{0}$
32	31.75	14.4		8		1.6 $^{0}_{-0.4}$		9	
40	38.1	16.4		9		2.0 $^{0}_{-0.5}$		10	1.0 $^{+0.3}_{0}$
50	50.8	18.4	+0.1300 0	10				11	
60	63.5	20.5		11.2	+0.2700 0		0.125	12	1.2 $^{+0.3}_{0}$
80	76.2	24.5		14		2.5 $^{0}_{-0.5}$		15	

▶ e is Inner diameter maximum acceptance between center ex. of d-axle and F-axle.

Technical Information for Hobs

DTR

Comparison Table of Gear and Hob Class

Gear \ Class	0	1	2	3	4	5	6	7	8
Inspection Machinery	■								
Measure Machinery	■	■	■	■	■				
Aircraft Machinery		■	■						
Printing Machinery		■	■	■	■				
Train Machinery		■	■	■	■	■			
Machine Tool		■	■	■	■	■	■		
Auto Mobile			■	■	■	■			
Geared Pump				■	■				
Rolling Mill				■	■	■			
Crane					■	■	■		
Farm Machinery						■	■		
Hand Machinery								■	■
Internal Gear(Except Big Size Gear)					■	■	■		

Comparison Gear Class

As following Each country's GEAR standard, the class is like below table.

Standard	Class												
KS B 1405 (Korea)				0	1	2	3	4	5	6	7	8	
JIS B 1702 (Japan)				0	1	2	3	4	5	6	7	8	
DIN 3962 (German)	1	2	3	4	5	6	7	8	9	10	11	12	
GB (China)			3	4	5	6	7	8	9				
AGMA 390.03 (USA)	15	14	13	12	11	10	9	8	7	6	5	4	3
3SEIS (France)				A	B	C	D	E					
BS 4 (England)					A_1	A_2	B	C	D				

Comparision of Hob Class

Classfication		KS	DIN	GOST	AGMA	BS
Class	Ground				AA	AA
		0	AA	AA	A	A
		1	A	A	B	B
		2	B	B	C	
	Un-Ground	3	C	C	D	D
			D			

▶AGMA "C" Class is unground

Technical Information for Hobs

DTR

HOB CLASS TABLE(DIN 3968)

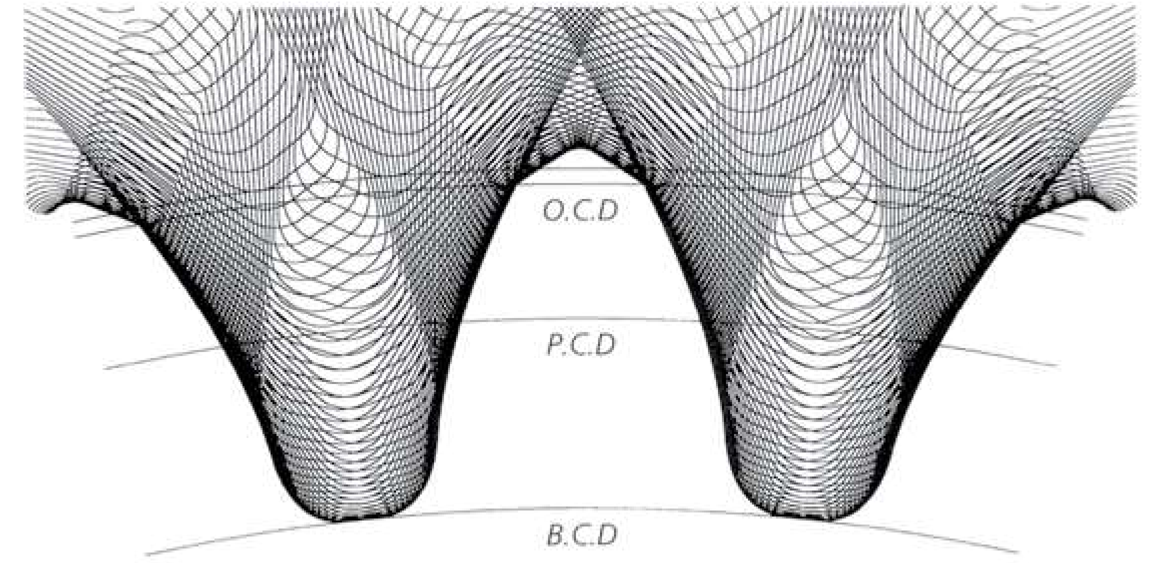
1μm= 0.001mm

	Division	Class	0.63 More 1.0 Below	1.0 More 1.6 Below	1.6 More 2.5 Below	2.5 More 4.0 Below	4.0 More 6.3 Below	6.3 More 10.0 Below	10.0 More 16.0 Below	16.0 More 25.0 Below	25.0 More 40.0 Below
			Acceptance Value and Range of Acceptance(μm)								
HOB	Swing of OD	AAA	4	4	4	4	4	4	5	5	5
		AA	5	5	5	5	5	5	6	6	8
		A	5	5	5	6	8	10	12	16	20
		B	6	6	6	8	10	12	16	20	25
	Swing of Hub Side	AAA	2	2	2	2	2	3	4	4	5
		AA	3	3	3	3	3	4	5	5	6
		A	3	3	3	5	5	8	8	10	10
		B	4	4	4	6	6	10	10	12	12
	Swing of top side of Tooth	AAA	7	7	9	11	14	18	23	28	35
		AA	10	10	12	16	20	25	32	40	50
		A	12	16	20	25	32	40	50	63	80
		B	25	32	40	50	63	80	100	125	160
	Center Error.	AAA	7	7	9	11	14	18	23	28	35
		AA	10	10	12	16	20	25	32	40	50
		A	12	16	20	25	32	40	50	63	80
		B	25	32	40	50	63	80	100	125	160
	Single Division Error	AAA	± 7	± 7	± 9	± 11	± 14	± 18	± 23	± 28	± 35
		AA	± 10	± 10	± 12	± 16	± 20	± 25	± 32	± 40	± 50
		A	± 12	± 16	± 20	± 25	± 32	± 40	± 50	± 63	± 80
		B	± 25	± 32	± 40	± 50	± 63	± 80	± 100	± 125	± 100
	Adjacency Division Error	AAA	7	7	9	11	14	18	23	28	35
		AA	10	10	12	16	20	25	32	40	50
		A	12	16	20	25	32	40	50	63	80
		B	25	32	40	50	63	80	100	125	160
	Accumulated Division Error	AAA	14	14	18	23	28	35	44	56	70
		AA	20	20	25	32	40	50	63	80	100
		A	25	32	40	50	63	80	100	125	160
		B	50	63	50	100	125	160	200	250	315
	Lead Error	AAA	± 50 ± 70 ± 100 (Total length 100mm standard) ± 140 ± 200								
		AA									
		A									
		B									

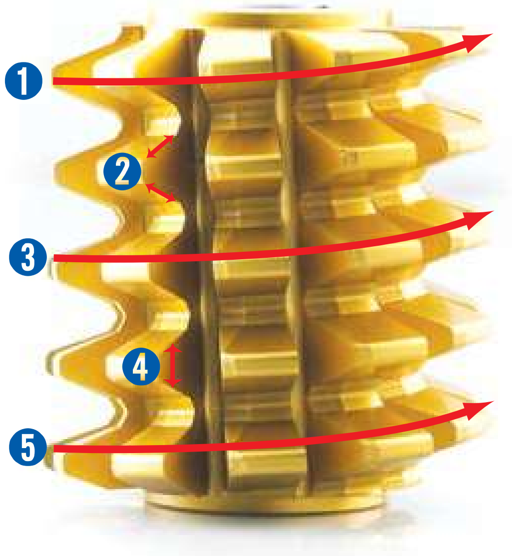
	Division	Class	0.63 More 1.0 Below	1.0 More 1.6 Below	1.6 More 2.5 Below	2.5 More 4.0 Below	4.0 More 6.3 Below	6.3 More 10.0 Below	10.0 More 16.0 Below	16.0 More 25.0 Below	25.0 More 40.0 Below
			Acceptance Value and Range of Acceptance(μm)								
HOB	Tooth profile Error	AAA	4	4	4	6	7	9	10	13	15
		AA	6	6	6	8	10	12	14	18	22
		A	10	11	12	14	16	20	25	32	40
		B	20	22	25	28	32	40	50	63	80
	Tooth Thickness Error	AAA	-11	-11	-11	-14	18	-23	-28	-35	-44
		AA	-16	-16	-16	-20	-25	-32	-40	-50	-63
		A	-25	-28	-32	-36	-40	-50	-63	-80	-100
		B	-50	-56	-63	-71	-80	-100	-125	-160	-200
	One revolution Error	AAA	± 3	± 3	± 3	± 4	± 5	± 6	± 7	± 9	± 11
		AA	± 4	± 4	± 4	± 5	± 6	± 80	± 10	± 12	± 16
		A	± 6	± 7	± 8	± 9	± 10	± 12	± 16	± 20	± 25
		B	± 12	± 14	± 16	± 18	± 20	± 25	± 32	± 40	± 50
	Three revolution Error	AAA	4	4	4	6	7	9	10	13	15
		AA	6	6	6	8	10	12	14	18	22
		A	10	11	12	14	16	20	25	32	40
		B	20	22	25	28	32	40	50	63	80
	Pitch for a line of action between two cutting tooth.	AAA	3	3	3	4	5	6	7	9	11
		AA	± 4	± 4	± 4	± 5	± 63	± 80	± 10	± 12	± 16
		A	± 6	± 7	± 8	± 9	± 10	± 12	± 16	± 20	± 25
		B	± 12	± 14	± 16	± 18	± 20	± 25	± 32	± 40	± 50
	Length of a line of action	AAA	6	6	6	7	9	11	14	18	23
		AA	8	8	8	10	12	16	20	25	32
		A	12	14	16	18	20	25	32	40	50
		B	25	28	32	36	40	50	63	80	100

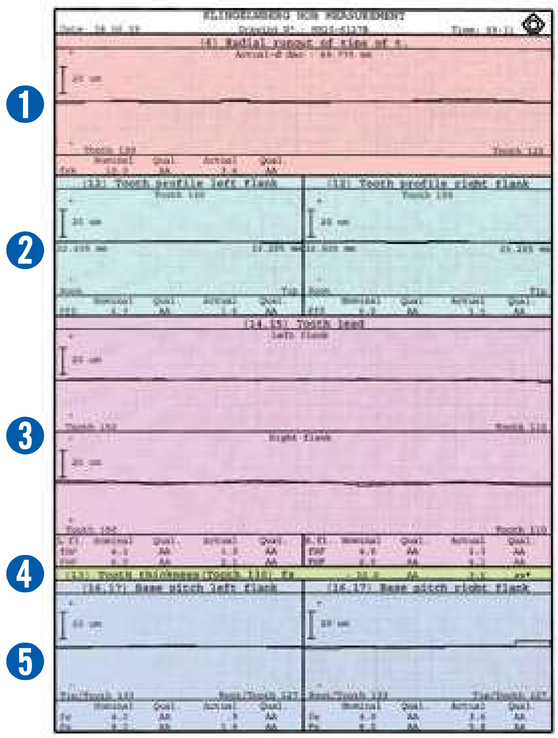
Technical Information for Hobs

Simulation of Tooth Profile



Certificate of Hob Quality





GEAR HOBS

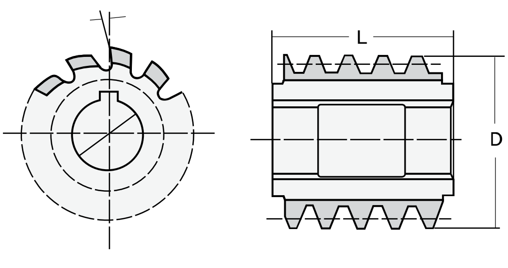
DTR CORPORATION

Ordering Information
for Gear & Involute Spline Hobs

Customer Name			
M / DP × Pressure Angle			
Out Dia × Length × Bore Dia			
Tool Material		Applicable Standard	

DESIGNED	CHECKED

Hob Details		Work Details		Mating Gear Details	
Tool No.		Name		No of Teeth	
Tooth Profile (See Below Figures)	General (Standard, Stub etc.)	No of Teeth		Outside Dia	
	Semi-Topping	Outside Dia		Center Distance	
	Pro-Shaving	Root Dia		Hobbing Condition	
	Pre-Grinding	Whole Depth			
	Pro-Skiving	Helix Angle	RH LH		
	Protuberance	Normal Tooth Thickness		Machine	
	Special	Given No of Teeth		Work Material	
No of Thread		Span Measurement		Hardness	
Lead Angle	RH LH	Pin Dia		Cutting Speed	m/min
No of Flute		Over Pin Distance		Revolution	rpm
Rake Angle		True Involute Form Dia		Feed	mm/rev
Keyway		Chamfer of Radius Direction		Cutting Method	Ciimb Conventional
Marking of Customer's Appointment		Finishing Stock on Tooth Thick	Shaving Stock	Others	
			Grinding Stock		
			Skving Stock		



Tool Size