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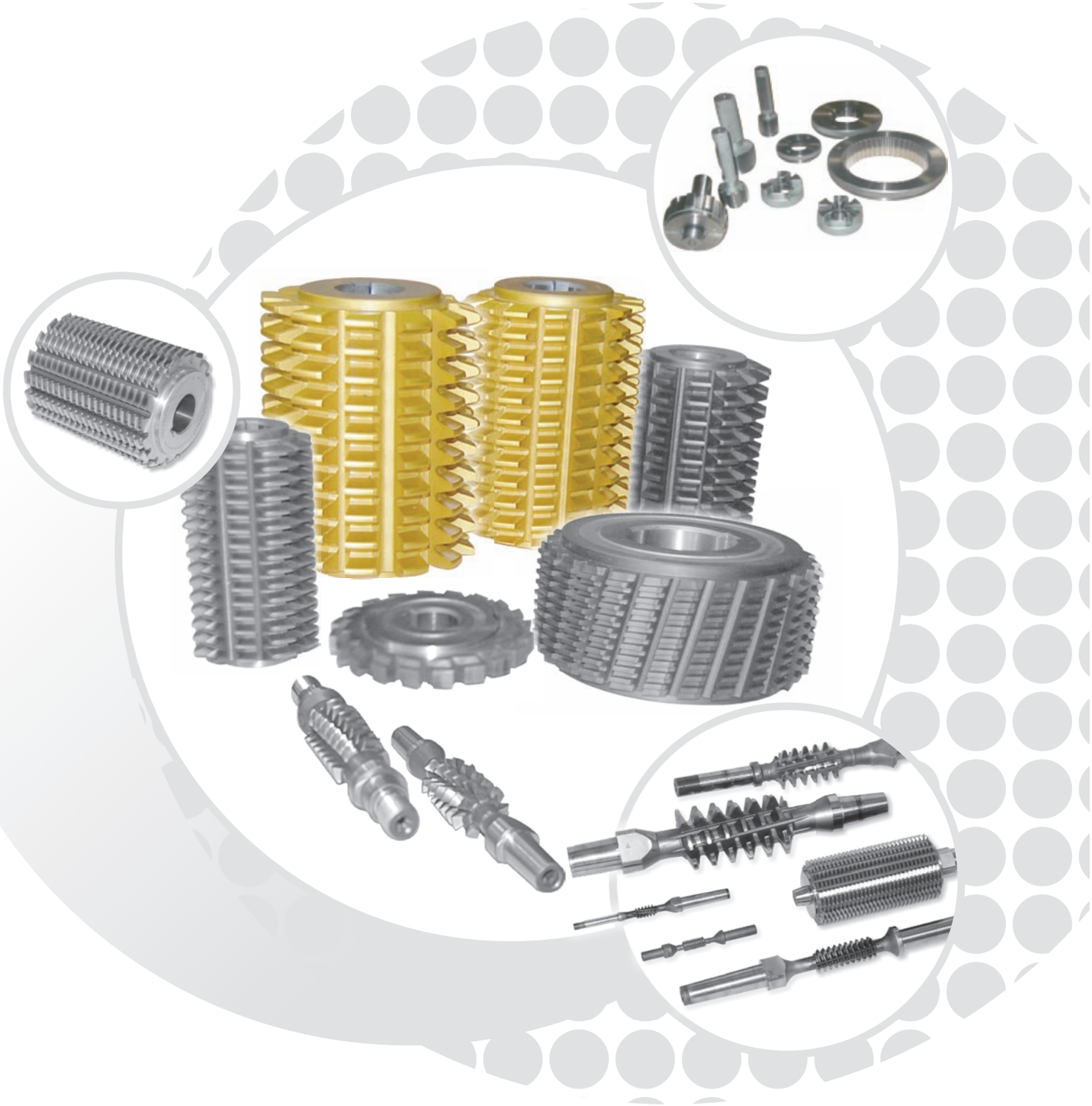
LEADERS IN HOBS & SPLINE GAUGES



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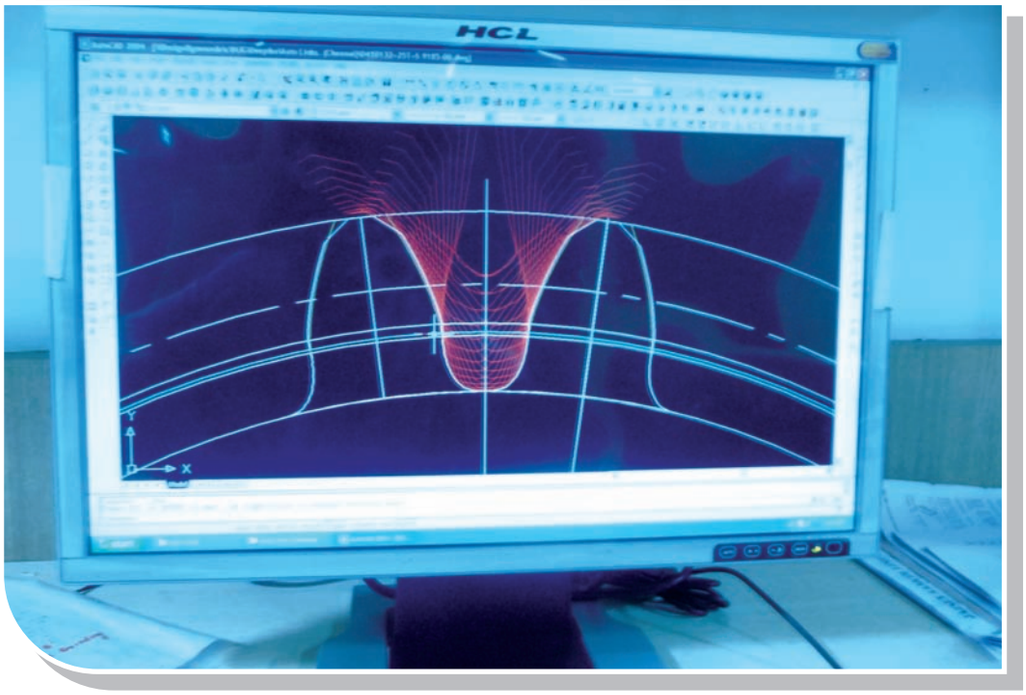
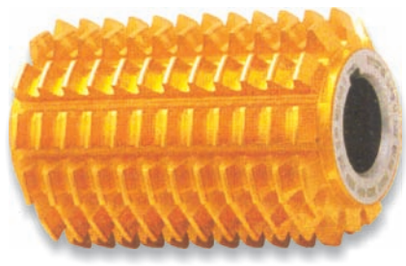
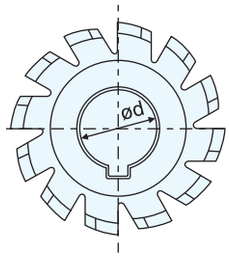
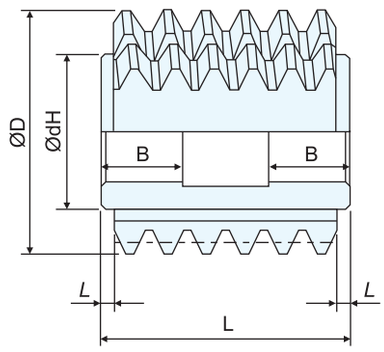


INDEX

Gear and Involute Spine Hob

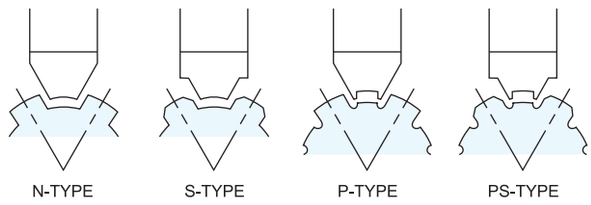






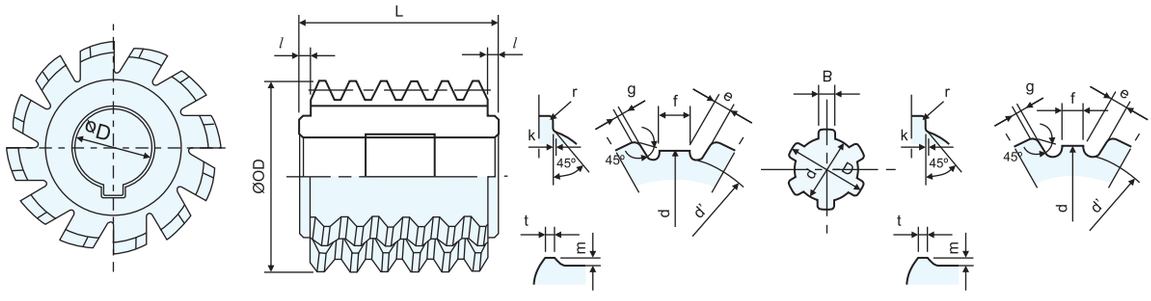
Sizes as per DIN-8002B

Module	Outside dia (ø D)	Length (L)	Bore diameter (ø d)	Hub length	Gashes
1.0 1.25	50	31	22 (3/4")	3	14
1.5 1.75	56	38	22 (3/4")	3	12
2.0	63	46	27 (1")	3	12
2.25 2.5 2.75	70	56	27 (1")	3	12
3.0 3.25 3.5	89	69	32 (1 1/4")	3	12
3.75 4.0	90	78	32 (1 1/4")	4	12
4.5	90	78	32 (1 1/4")	4	10
5.0 5.5	100	88	32 (1 1/4")	4	10
6.0 6.5 7	110	108	32 (1 1/4")	4	10
8 9	125	138	40 (1 ½")	4	10
10	140	170	40 (1 ½")	5	10
11	160	180	50 (2")	5	9
12	170	195	50 (2")	5	9
13	180	210	50 (2")	5	9
14	190	225	50 (2")	5	9
15	200	235	60 (2 1/4")	5	9
16	210	248	60 (2 1/4")	5	9
18	230	270	60 (2 1/4")	5	9
20	250	296	60 (2 1/4")	5	9

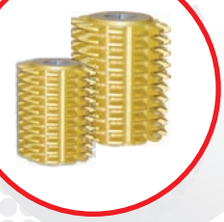


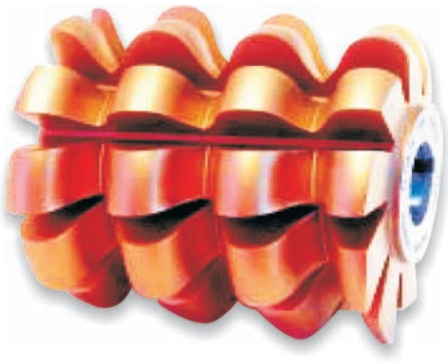
Title of Spline of	Specification of HOB			Dimension of Each Spline Type									
				I Typr					II Typr				
	Outer Diameter (OD)	Full Length (L)	Inner Diameter	Number of Splines N	Minor Diameter d	Major Diameter D	Width B	Chamfering g	Number of Splines N	Minor Diameter d	Major Diameter D	Width B	Chamfering g
11	60	60	19.05	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	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	

The values of Tip width (f), undercut width (e) and lug diameter (d') are decided as per DIN-5462, DIN-5463 or DIN-5464.



Sprocket Hob

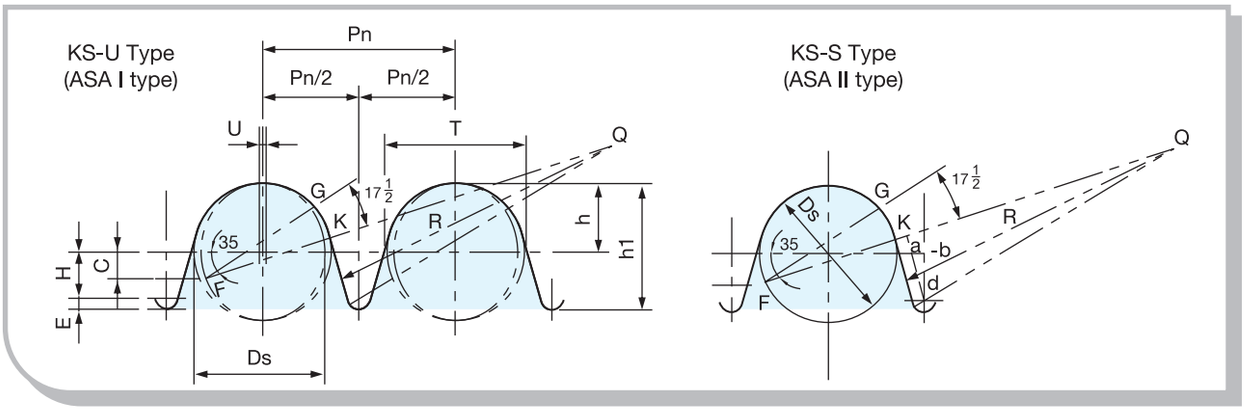




(mm)

Types of Chain Sprocket			HOB Dimensions			
KS, ASA I & II	C P	R D	Outer Diameter (ø D)	Full Length (L)	Inner Diameter (ø 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 (½")	7.77	75	75	27	25.4 (26.988)
40	12.7 (½")	7.95	75	75		
40	12.7 (½")	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 ¼")	19.05	120	140		
120	38.1 (1 □")	22.225	130	170		
140	44.45 (1 □")	25.4	160	190	40	38.1
160	50.8 (2")	28.575	170	210		
180	57.15 (2 □")	35.72	190	240		
200	63.5 (2 □")	39.688	210	260	50	50.8
240	76.2 (3")	47.625	240	3100		

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

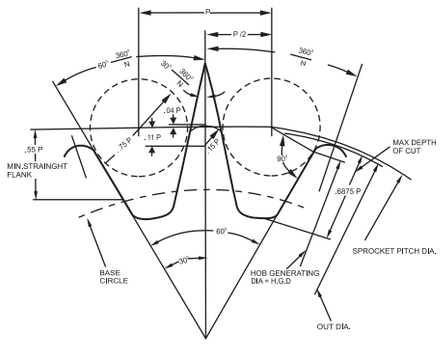
" KS-S Type

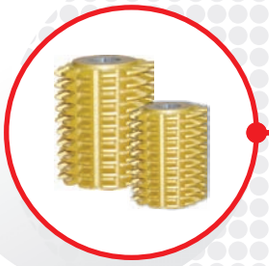
U = 0

Silent Chain Sprocket Hob

For tooth profile; ASA B29.2-1950 and UDC NO.621.855

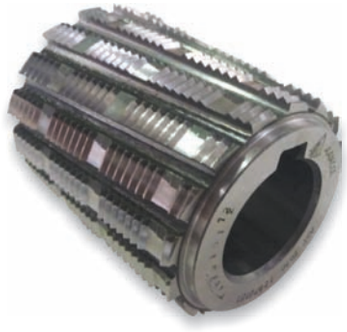
Chain Pitch	Hob Number	Standard Number of Teeth	Range of Tooth Profile of Hob
SC3 = .375"	1	20	17-23
SC4 = .500"	2	28	24-32
SC5 = .625"	3	38	33-43
SC6 = .750"	4	51	44-58
SC8 = 1.000"	5	69	59-79
SC10 = 1.250"	6	95	80-110
SC12 = 1.500"	7	100	111-150
Sc16 = 2.000"			

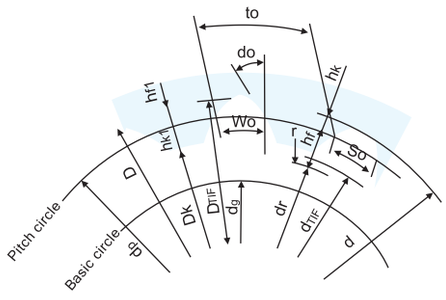




Serration Hob

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





Order specifications for Involute Serration Hob are the same as that of Involute Spline Hob. For overall dimensions, please refer to Involute Spline Hob described in page 2. Basic formulae 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_0	Pressure Angle on pitch circle $\alpha_0 = 45°$
	Tooth Height	h_t	0.8m
	Shift	χ	0.1m
	Major Diameter	d	d=(z+0.8+2χ)m=(z+1)m
	Pitch	t_0	to = π . m
	Pitch Diameter (Pitch Circle Diameter)	d_p	dp= z .m
Inner Diameter Serration	Major Diameter	D	D=(z+1.4)m = d + 0.4 m
	Minor Diameter	Dk	Dk = (z-0.6)m = d -1.6m
	Limit Diameter of Involute	DTIF	DTIF = (Z+1.1)m
	Addendum	hk1	hk1=(0.4-χ)m=0.3m
	dedendum	hf1	hf1=(0.6-χ)m=0.7m
	Width of Arc of Groove on PCD	Wo	Wo=($\frac{\pi}{2}$+2χ tan α_0)m = (0.5π+0.2)m
Outer Diameter Serration	Major Diameter	d	d=(z+0.8+2x)m = (z+1)m
	Minor Diameter	dr	dr=(z-1)m=d-2m
	Limit Diameter of Involute	dTIF	dTIF = (Z-0.7)m
	Addendum	hk	hk=(0.4+x)m=0.5m
	deddendum	hr	hr=(0.6-x)m=0.5m
	Thickness of Arc of Tooth on PCD	So	So=($\frac{\pi}{2}$+2xtanα_0)m=(0.5π+0.2)m

Ratchet Hob

The importance of designing ratchet should be recognized considering its indispensable functions.

Following are to be considered in designing ratchet.

" Force 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 normal dry ambience θ=12-20°

Under lubrication θ=10-15°

Things to accompany with Order

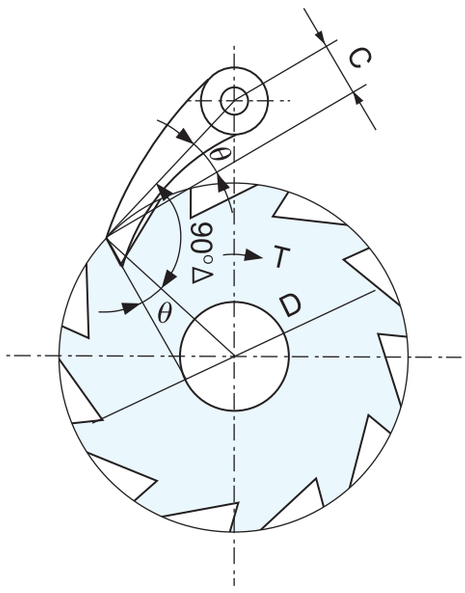
When ordering RATCHET HOB, please provide following data

" Detailed Drawing of Ratchet Profile

" Overall dimensions of Hob (Outer Diameter x Inner Diameter x Length)

" Specification of Hob

-Number of Threads and Blades, etc.



Timing Pulley Hob

❖ **Order Specification**

Timing belt varies in its tooth profile depending upon manufacturer. As such tooth profile data is required along with order specification.

" Belt Specification (Model Type and Pitch)

" Belt Manufacturer " Pulley Teeth

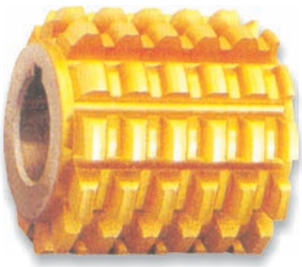
" Detailed Descriptions and Drawing of Pulley Teeth

" Size of Exterior Look of Hob ordered (outer diameter x inner diameter x full length, etc.)

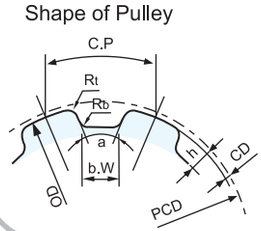
" There is no limit in designing pulley hob beyond 24T for using it for common purpose in the industry in general.

❖ Common Dimension Table

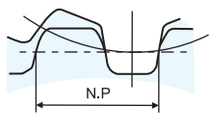
Hob Number	Number of Pulley Teeth	Standard Tooth for Design
1	More than 40	40
2	25-39	25
3	17-24	17
4	12-16	12
5	9-11	9



Shape of Pulley



Shape of Hob



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TIMING BELT PROFILE

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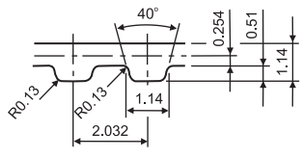
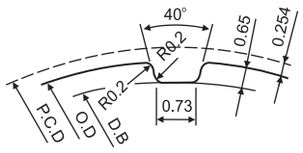
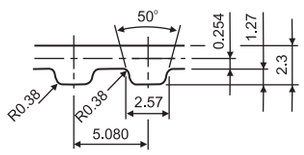
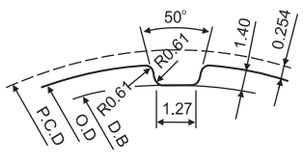
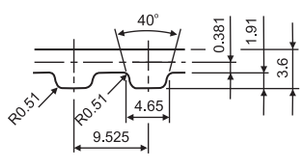
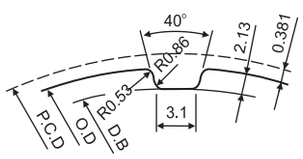
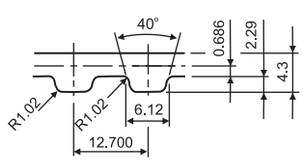
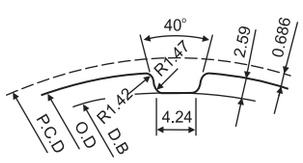
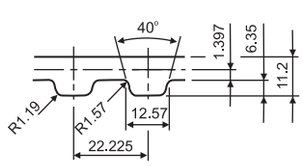
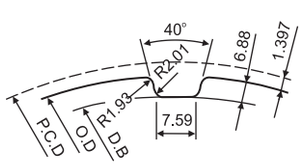
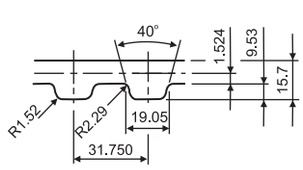
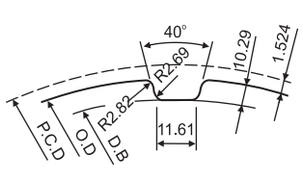
	Timing Belt Profile	Timing Pulley Profile
MXL		
XL		
L		
H		
XH		
XXH		

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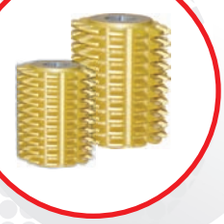
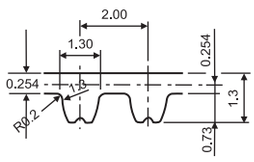
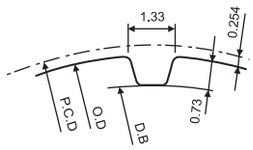
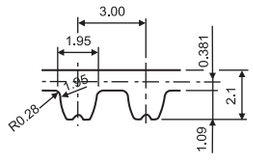
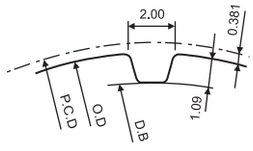
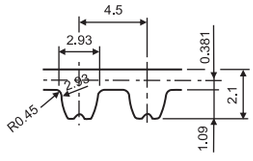
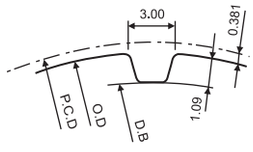
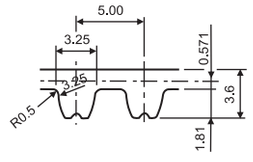
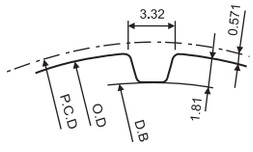
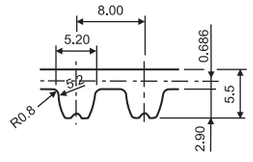
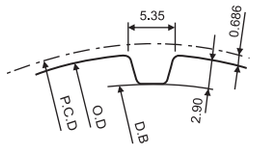
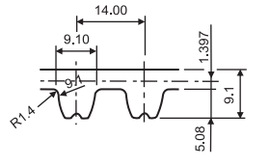
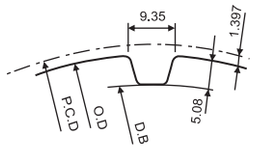
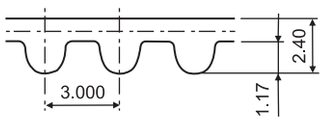
Timing Belt Profile



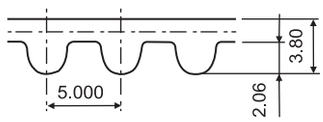
	Timing Belt Profile	Timing Pulley Profile
STS 2M		
STS 3M		
STS 4.5M		
STS 5M		
STS 8M		
STS 14M		

Timing Belt Profile of HTD Type

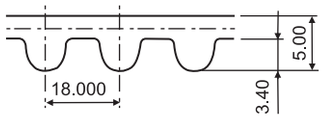
HTD 3M



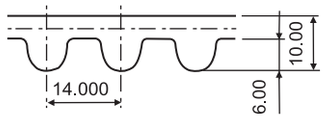
HTD 5M

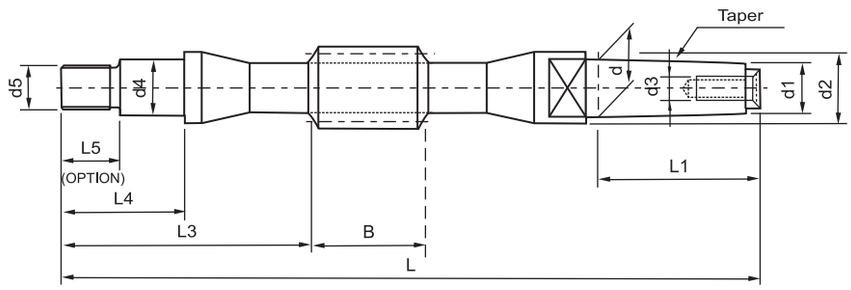


HTD 8M



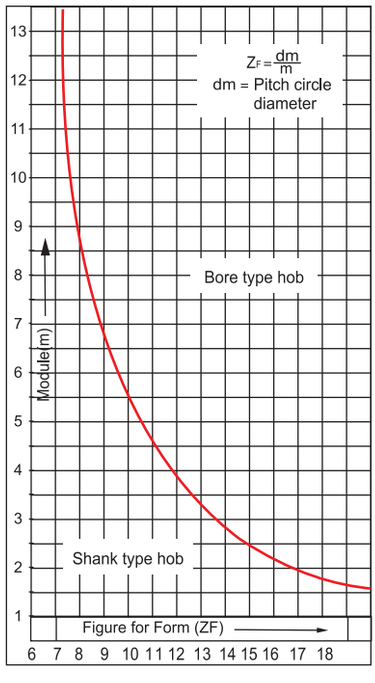
HTD 14M



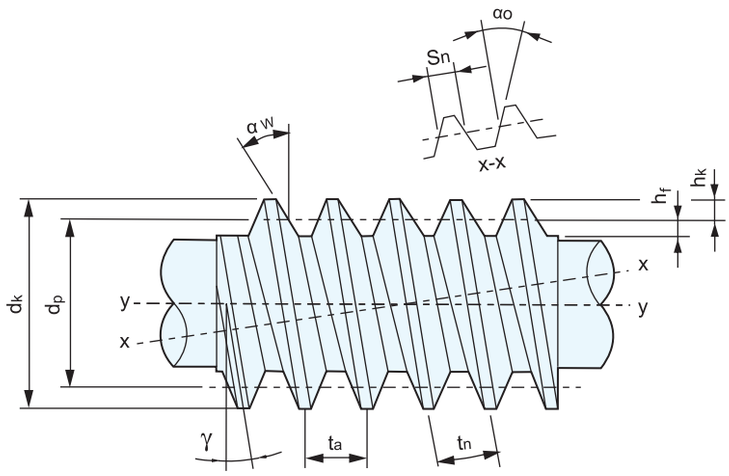


- Worm Data is mostly influential on designing Worm Hob, so that when ordering worm hob, data of worm is required.
- While ordering please choose type, profile and data among the following options, and furnish with Worm Data (drawing).
  - " Select either BORE TYPE or SHANK TYPE
    - In case of SHANK TYPE, present specification of SHANK, along with direction of rotation of Hob.
  - " Select Standard of tooth profile; ZI, 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
    - Normal pressure angle
    - Worm out diameter and pitch circle diameter
    - Lead angle and direction
    - Number of worm threads
    - Centre Distance and Backlash.
- For general bore type and shank type hobs, please refer to the graph on the right.

Selection Table for VWorm Hob Type

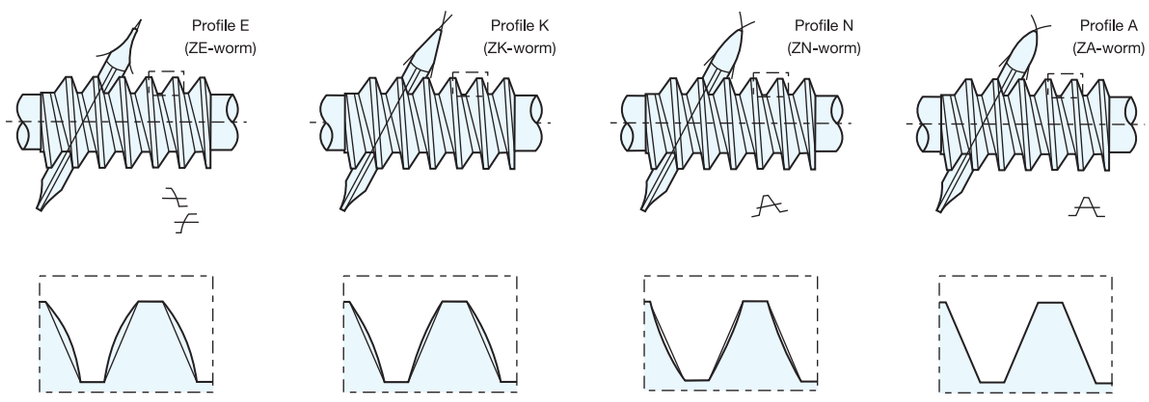


Worm Hob - Vocabulary



x-x	:	Normal Section	α_o	:	Normal Pressure Angle
y-y	:	Axial Section	α_w	:	Axial Pressure Angle
d_p	:	Pitch Diameter	h_x	:	Addendum
d_k	:	Outer Diameter	h_i	:	Dedendum
t_n	:	Normal Pitch	m_n	:	Normal Module
t_a	:	Axial Pitch	m_s	:	Axial Module
S_n	:	Normal Tooth Thickness	Z_w	:	Number of Threads
γ	:	Helix Angle (Right/Left)	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 ground by giving standard pressure angle.

ZN Tooth Profile
A tooth profile having normal profile in straight line

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

SPLINE GAUGE is an inspection tool used to quickly ascertain the acceptability of Internal/External splines or serration dimensions.

It checks cumulative effect of various dimensions & permissible errors to confirm suitability for assembly of component(s). Thus, it helps in mass production to achieve perfection to micron level & eliminates need for skilled hands.

PROFILES : Involute
Serration/Trapezoidal
Straight Sided Splines

TYPES : **Spline Ring Gauge** for Checking External Splines
Spline Plug Gauge for Checking Internal Splines
These are further classified in two types depending on dimensional limits of component

GO GAUGE : To check maximum material condition of component (full form)

NO-GO GAUGE : To check minimum material condition of component (sector type)

OTHER PRODUCTS : Spline Mandrels
Index Plates
Serration Drifts

QUALITY ASSURANCE : Each Gauge is individually checked on **Klingelnberg P-26 Gear Tester** to conform that the involute profile meets the applicable DIN Standards.

MATERIAL : SAE 01/02

PROPERTIES : Cold work Tool Steels. Dimensional Stability. Very high resistance to cracking.

HARDNESS : RC 58 to 61

INVOLUTE SPLINE GAUGES

	PLUG	RING
Max. Major dia.	180 mm	176 mm
Min. Major dia.	10 mm	-
Min. Minor dia.	-	20 mm
Module Range	0.5 to 5.0	0.5 to 5.0
Spline Length	60 mm	45 mm

STRAIGHT SPLINE GAUGES

	PLUG	RING
Max. Major dia.	180 mm	176 mm
Min. Major dia.	10 mm	-
Min. Minor dia.	-	8 mm
Spline Length	60 mm	35 mm Cross-Cut Length

SERRATION GAUGES

	PLUG	RING
Max. Major dia.	180 mm	176 mm
Min. Major dia.	10 mm	-
Min. Minor dia.	-	20 mm
Spline Length	60 mm	40 mm

INDEX PLATES

For Tooth chamfering machines
HOB sharpening machines
Hurth spline milling machines
Kaap spline grinders
Or similar as per customer drawings

SPLINE MANDRELS

Max. Major dia.	180 mm
Max. Spline Length	250 mm
Total Length	350 mm

MATERIAL : OHNS - SAE 01/02
HARDNESS : HRC 58 TO 61

BROTECH

FORM RELIEVED MILLING CUTTERS

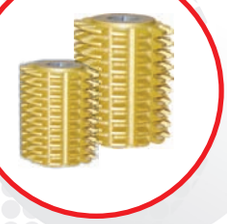
AAMCOL

AAMCOL offers precision form relieved ground or unground profile cutters ranging from standard single angle, double angle, convex/concave cutters to most complex intricate profile cutters like end mill type gear cutters, spline milling cutters, turbine blade profile milling cutters etc.

These milling cutters are made out of high alloy super high speed steels; with precision ground or unground forms; with straight or helical flutes for shear cutting; continuous or intermittent (staggered) cutting teeth; with or without chip breakers; radial, positive or negative rake tooth faces; with radial, axial or undercutting clearances; individual, gang or solid sections. As cutter teeth are cam relieved, only rake faces need to be sharpened without changing the tooth form through their full life. Cutter accuracy is maintained as long as they are accurately resharpened. This simplifies tool maintenance and provides more consistent quality. These cutters provide high degree of accuracy and efficient cutting geometry and hence ordinary cutters can not be comparable in no way with these AAMCOL special cutters. Some important applications of these cutters are highlighted below :

- Spur gear teeth milling for specific number of teeth or in sets of 8 and 15 cutters to IS or BS standards.
- Sprocket teeth milling cutters, precision ground or unground profile.
- Rack teeth milling of highest accuracy, single or multistrand, precision ground or unground profiles.
- Worm thread milling, roughing or finishing, with and without chamfer ground or unground form.
- Spline milling on universal or HURTH type machines.
- Special serration milling on machine chuck-jaws, automobile con-rod jaws etc.
- Special narrow & deep groove milling on automobile con-rods.
- Serration milling cutter for flanged yoke and companion flange.

HI-BITE MILLS, "DO-ALL" CUTTERS



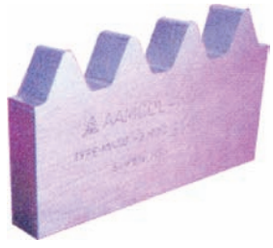
Heavy duty cobalt bearing super HSS Hi-Bite multipurpose mills, shank type or shell type designs are manufactured in various diameters as per DIN 844 and DIN 845B or to customers specific requirement and provide the following advantages :

- Most versatile milling cutter.
- Ability to take heavier cuts at higher speeds with less chatter and vibration.
- High rate of metal removal with minimum Horse Power.
- Removes metal at the higher rate with less deflection than conventional end mills, particularly in the longer lengths.
- Tooth form provides excellent heat dissipation during heavy cutting operations.
- Unique computer generated tooth profile designed for excellent chip breaking characteristics.
- Wide applications viz : die-sinking, horizontal boring, universal milling, CNC machining centers, drilling machine etc...
- Also supplied with special large profiles with helical flutes for finish die sinking, form milling or turbine blade milling etc...
- The cutters are form relieved which means simplified resharpening with no change in tooth profile. Many more resharpenings possible as compared to ordinary end mills.

" Maximum profile length	300 mm
" Maximum cutter diameter	220 mm
" Involute cutters for external and internal gear teeth	4 module to 48 module

AAMCOL SPECIAL TOOLS

AAMCOL special tools programme includes rack type shaper cutters used for shaping spur, helical or herringbone gears on *Maag* or *Sunderland* shaping machines; profile rollers for cold rolling on *Grob* machines; hi-bite mills with special design chip breakers etc.



HEAT TREATMENT

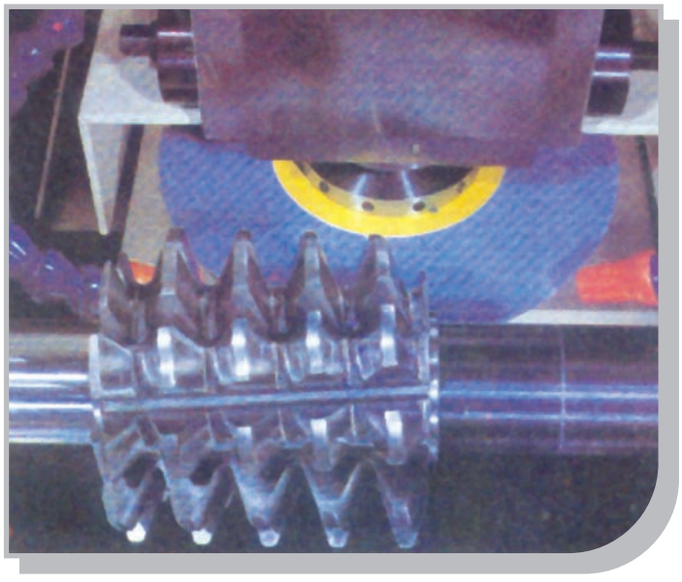
Through decades of experience in producing highest quality tools made trom different types of super HSS, AAMCOL has established guaranteed resources in HSS heat treatment technology. Heat treatment on Super HSS & HSS tools requires special skills & precautions, especially for long shank tools having varying cross-sections.

State-of-the-art heat treating equipments and Instruments added with skilled & specialized team assure delivery of uniform, consistent quality of treated tools.

When your tools are sent to AAMCOL for heat treating, you are assured of high quality services. Heat treatment services for SHSS or HSS tools on contract basis are also offered.

RE-SHARPENING - HOBS & SHAVING CUTTERS

With the long experience and know-how gained during last 25 years working experience, AAMCOL tool sharpening, putting latest technology in the field, gives edge over others. Accurate resharpening of tools is of utmost importance for maintaining quality of machined components. A highest quality tool shall be rendered useless due to bad resharpening. Extra care is taken to maintain thermal & metallurgical stability of resharpened tools at AAMCOL. Every care is taken to avoid common tool sharpening problems such as true hob or cutter mounting on arbor, setting up to maintain desired rake faces, flute helix and correct flute indexing etc.

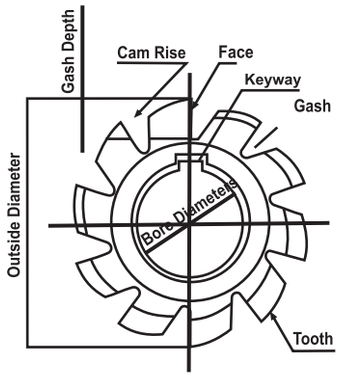


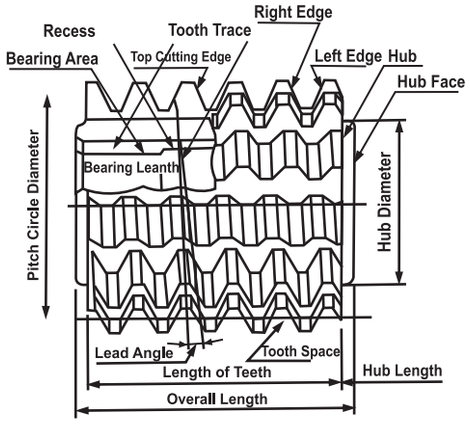
When your hobs are sharpened at AAMCOL, you are guaranteed of accurate and consistent quality.

Aamcol also equipped to provide services of Shaving Cutter Resharpening to our esteemed customers. We carry out the sharpening of Shaving cutters with straight profile, lead crowning and profile crowning.

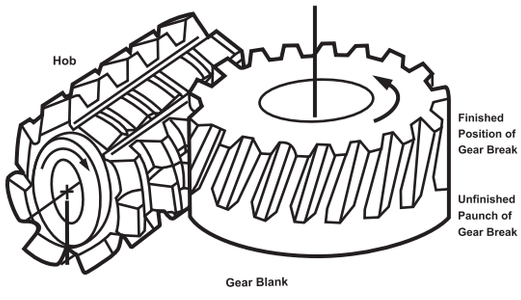
After resharpening, all parameters are checked on Klingelnberg Gear Tester P26 and protocol furnished.

Hob Nomenclature

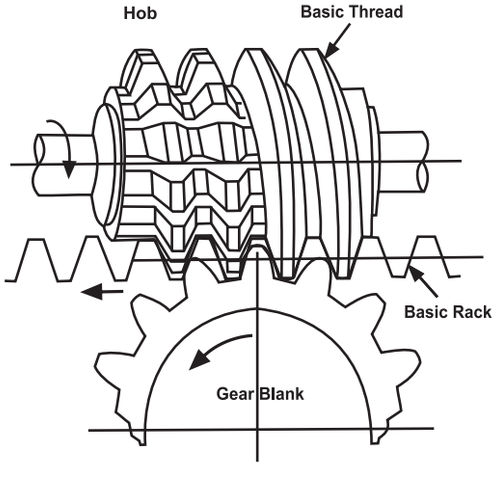




Hobbing Principle

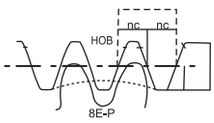
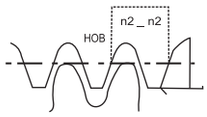
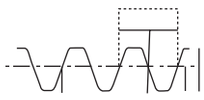
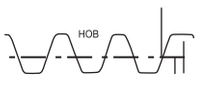
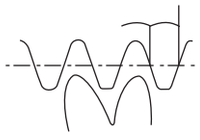


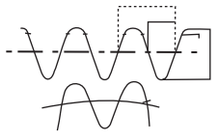
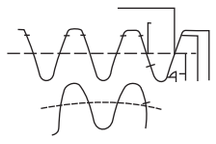
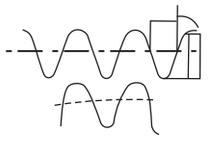
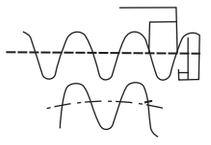
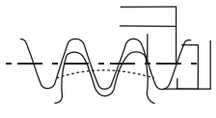
Hob Cutting



Hob Cutting Action

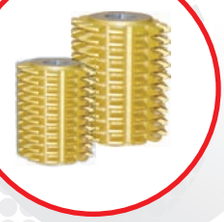
Basic Rack Tooth Profile (Din 3972)

Type	Class Cation	Symbol	Basic rack tooth Profile
FINISHING	STANDARD	FIN	 PA = 20º or 14.5º hao = 1.25m D+F = 2.25m ho = 2.5m r = 0.2m - 0.39m
	SEMI-TOPPING	S-TOP	 PA = 20º or 14.5º hao = 1.25m D+F = 2.25m r = 0.2m - 0.39m Values of X, A3 & ho must be cal
	FULL-TOPPING	TOP	 PA = 20º or 14.5º hao = 1.25m ho = D+F = 2.25m r = 0.2m - 0.39m
	STUB TOOTH	STUB	 PA = 20º hao = 0.8m D+F = 2.25m ho = 2.0m r = 0.3m
	INVOLUTE SPLINE	STUB DIN5480	 PA = 30º hao = 0.6m D+F = 0.6m ho = 1.2m r = 0.16m
	TIP MODIFICATION	TIP RELIEF	 PA = 20º or 14.5º hao = 1.25m D+F = 2.25m ho = 2.5m r = 0.2m = 0.39m Relief = Tr = As per std. or as per requirement

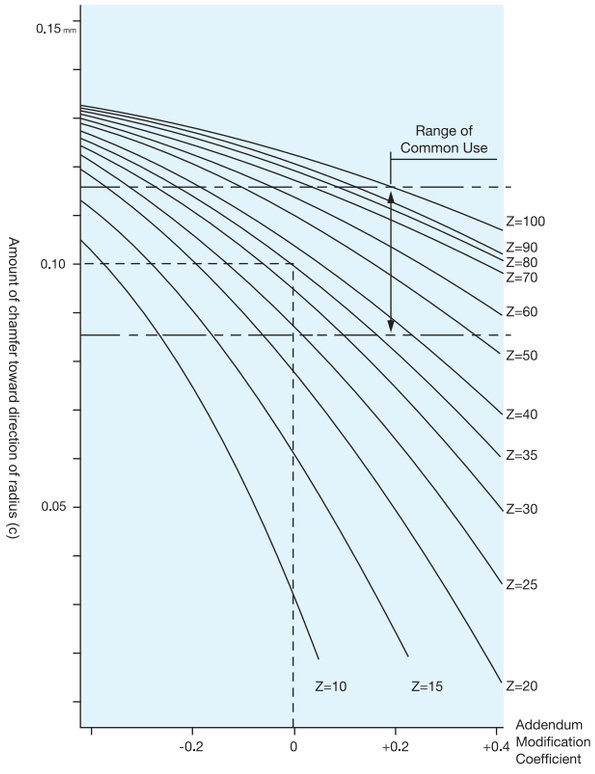
Type	Class Cation	Symbol	Basic rack tooth Profile
PRE - FINISHING	PRE-SHAVING/PRE-GRINDING — HIGH ADDENDUM	PER-S PER-G	 PA = 20º or 14.5º hao = 1.35m So = tn/2 - (2 X FA) D+F = 2.35m r = 0.3m FA = As per chart or as per requirement.
	PROTUBERANCE	PS-P PG-P	 PA = 20º or 14.5º hao = 1.4m So = tn/2 - (2 X FA) D+F = 2.4m ho = 2.6m r = 0.3m FA = As per chart or as per requirement.
	SEMI-TOPPING	PS-ST PG-ST	 PA = 20º or 14.5º hao = 1.35m or 1.25m So = tn/2 - (2 X FA) D+F = 2.35m or 2.25m ho = 2.6m r = 0.3m FA = As per chart or as per requirement.
	PROTUBERANCE SEMI-TOPP	PSP-ST PGP-ST	 PA = 20º or 14.5º hao = 1.35m or 1.25m So = tn/2 - (2 X FA) D+F = 2.35m or 2.25m ho = 2.6m r = 0.3m FA = As per chart or as per requirement.
	ROUGHING	RGH	 PA = 20º or 14.5º hao = 1.25m So = tn/2 - (2 X FA) D+F = 2.25m ho = 2.5m r = 0.2m - 0.39m

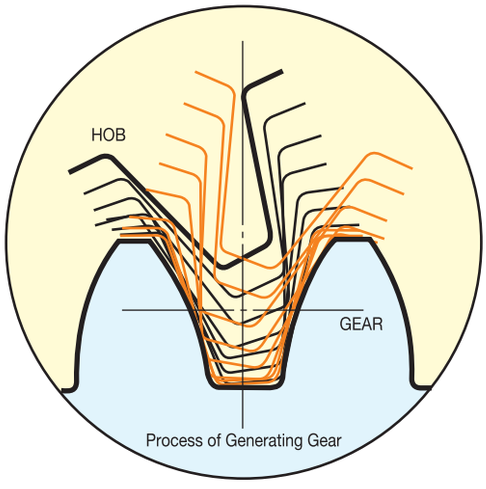
Finishing Stock

Module / Tooth profile		Above 1 Upto 1.5	Above 1.5 Upto 2.5	Above 2.5 Upto 4.0	Above 4.0 Upto 6.3	Above 6.3 Upto 10	Above 10 Upto 12	Above 12 Upto 6	Above 16 Upto 26
△S	Roughing					0.5	0.8	1.0	1.2
	Pre-Shaving	0.02	0.03	0.05	0.08				
	Pre-Grinding	0.12	0.15	0.18	0.20	0.26	0.40		0.60



Addendum Modification Coefficient and Amount of Chamfer





Pressing Tool(HOB) into Groove when Cutting Gear

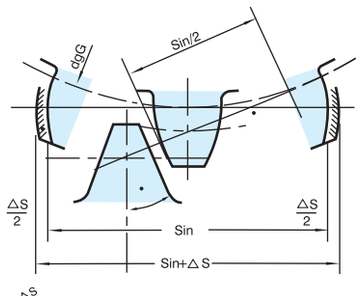
Conversion Table for Adding or Subtracting Thickness of Tooth when cutting gear

Input Value α=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	0921	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 a=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°
$\triangle C = 1.997$, $\triangle S = 2\triangle C$
In case α_o is 20°
$\triangle C = 1.462$, $\triangle S = 1.5\triangle C$

Timing Belt Profile
Cutting Parameters (Standardized Condition of Module 2-2.5)

Item	Range of Use			
	Subject Material to be machined	Cutting Speed (m/min)	Climb Cut Feed (mm/rv)	
			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 x (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)			

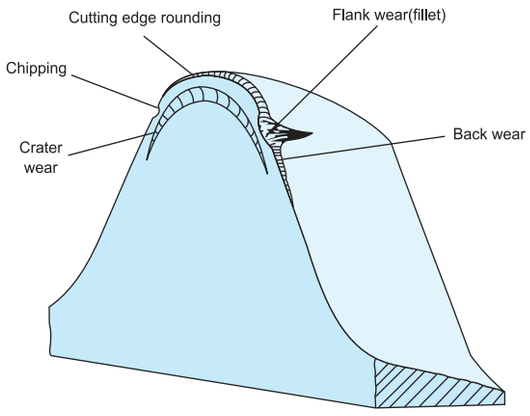
Tool Wear

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 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	200 mm	2200-3000/min	300-600/mim	Rough	0.10-0.15mm	Liquid exclusively for grinding purpose
				Completion	0.02-0.05mm	
Powder metal	200mm	2200-3000/mim	300-600/mim	Rough	0.05-0.10mm	
				Completion	0.01-0.02mm	

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.

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

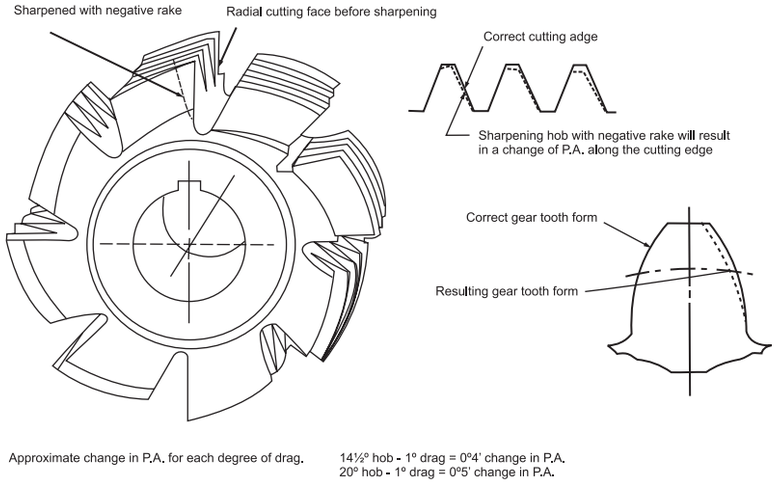
Effect of sharpening errors

Hobs resharpened on an arbor in a resharpening machine that runs eccentrically will result in sharpening errors that give the same "wandering" profile characteristic to an involute profile as an eccentrically mounted properly sharpened hob in a hobbing machine.
Other sharpening errors to the basic rack that effect hob profile are:

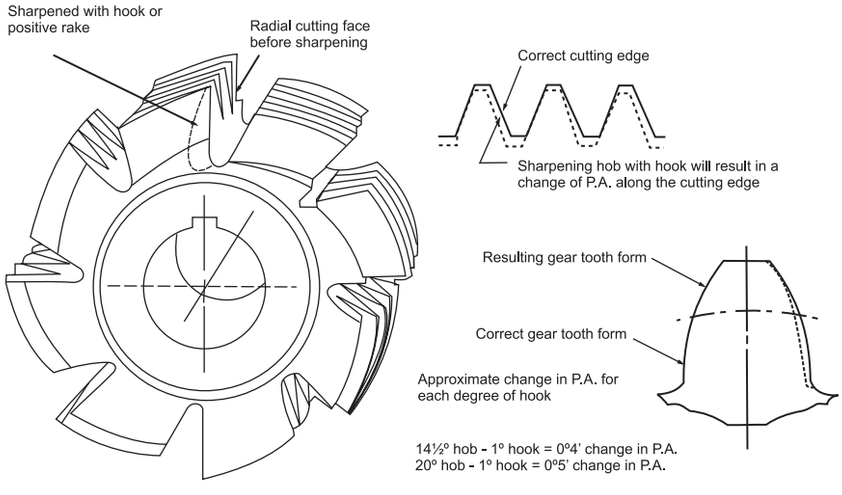
- Hob cutting faces are sharpened with negative rake
- Hob cutting faces are sharpened with positive rake
- Hob cutting faces are sharpened by unequal amounts resulting in uneven flute spacing

A hob sharpened with incorrect lead will result in one end of the hob being larger in diameter than the other. As the hob is shifted across its usable life in the hobbing machine, a change in the size of the work piece will be evident.

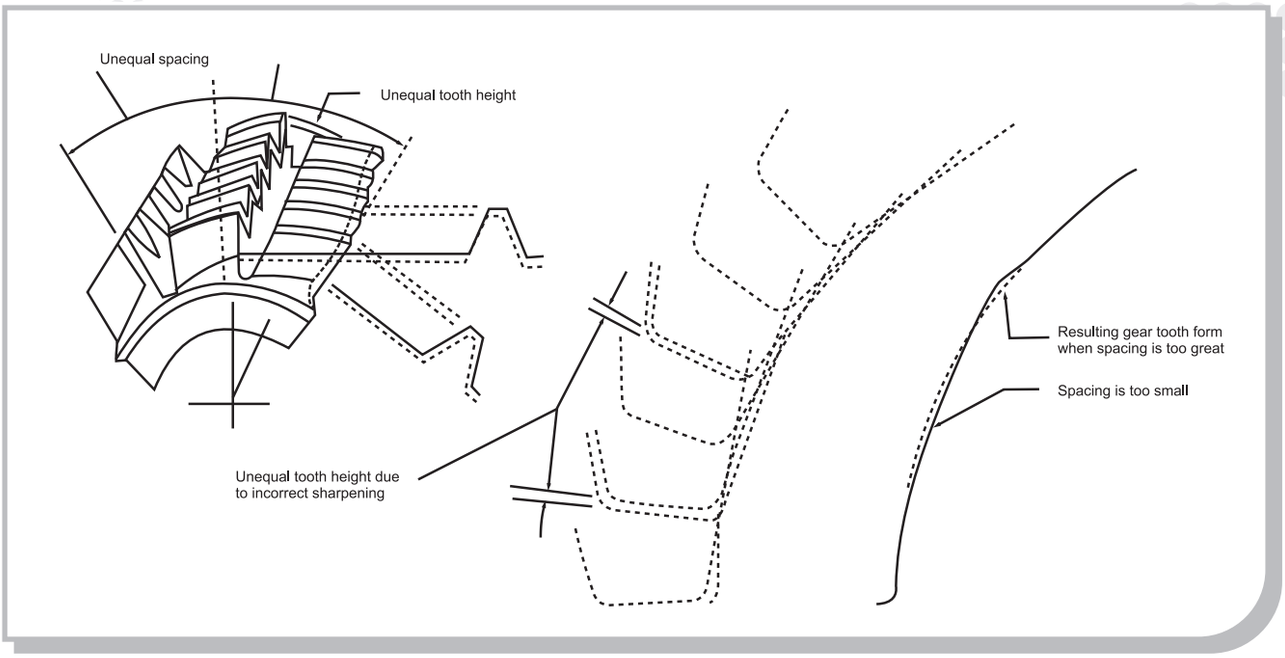
Effect on profile of a hob resharpened with negative rake



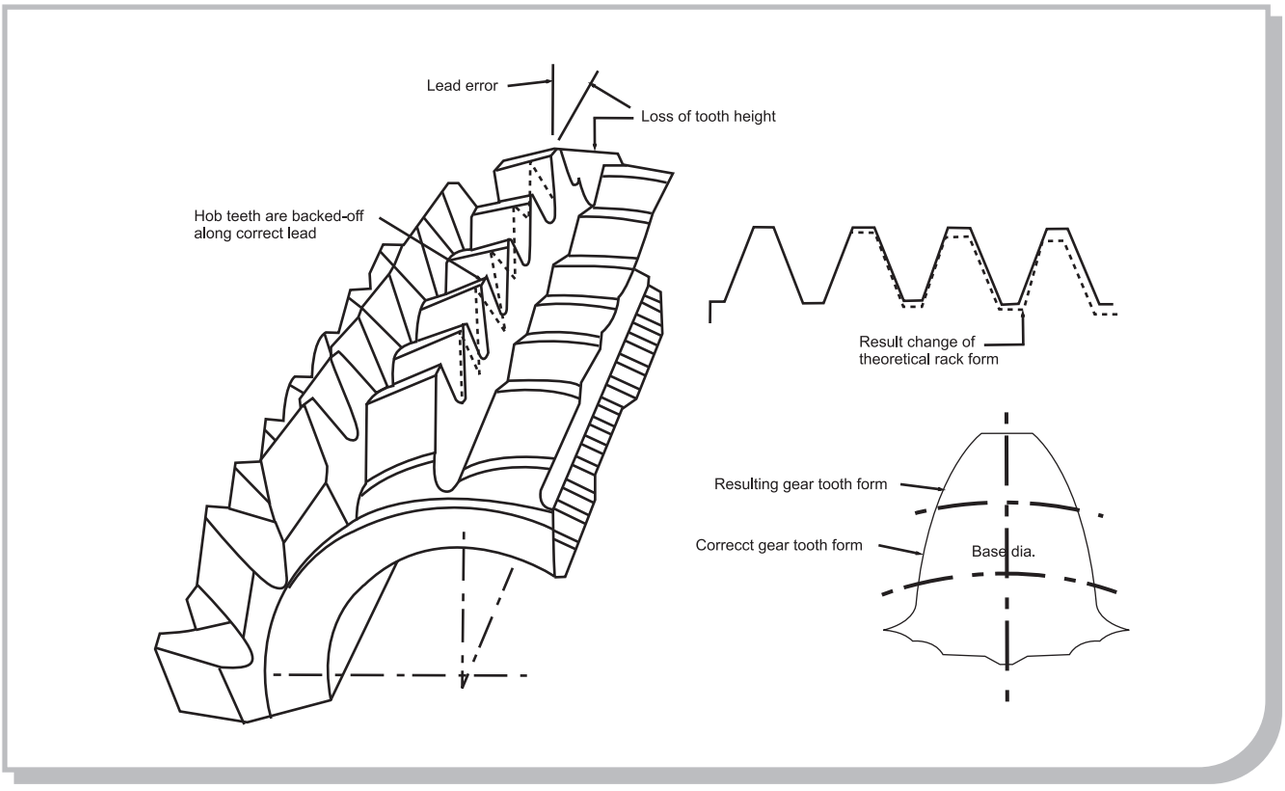
Effect on profile of a hob resharpened with Positive rake



Sharpening Errors and their effect



Effect on profile of a hob resharpened with cutting faces unequally spaced, creating accumulated flute spacing error.



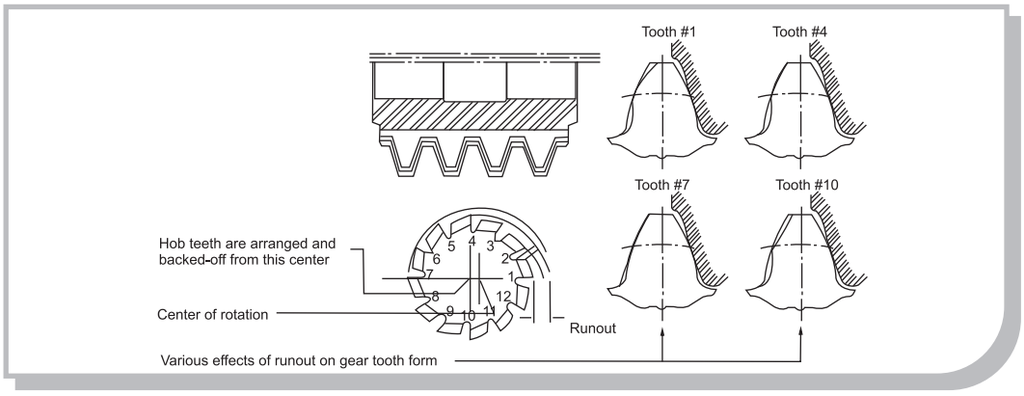
Effect on size of work piece when hob is resharpened with the incorrect lead. The loss of tooth height from one end of the hob to the other results in a change of size on the work piece as the hob is shifted across its usable life.

The Effect Of Hob Mounting Errors

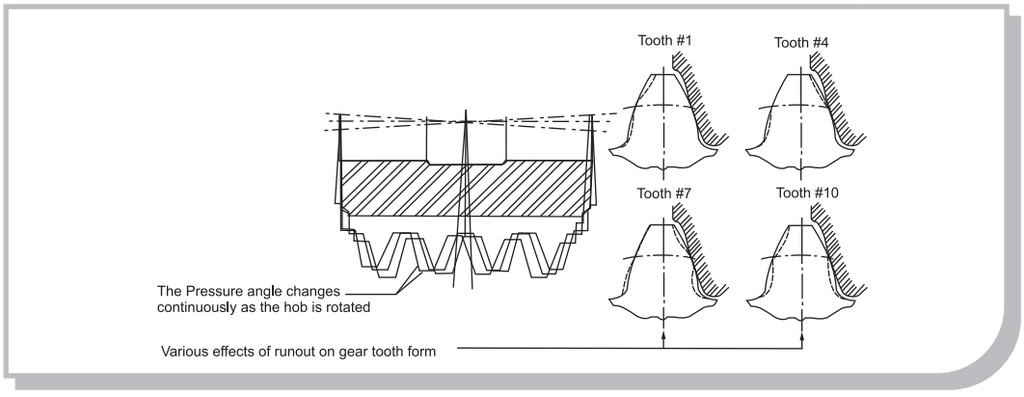
Despite a hypothetically perfect hob, manufactured error free, the hob can produce profile errors if mounted eccentrically on the hobbing machine arbor. Hob runout error due to either careless mounting or to improper resharpening is the greatest contributor to out-of-tolerance hobbed involute profiles. Figures 1,2, & 3 illustrate the effects three types of hob runout have upon the gear tooth form. These effects are created, most often, by:

- Failure to true up the hob arbor.
- Failure to true up the hob on the hob arbor by truing the hub indicating bands.
- Bent, oversize or undersize hob arbor.
- Non-parallel hob clamping spacers, misaligned or wornout arbor support bearing.

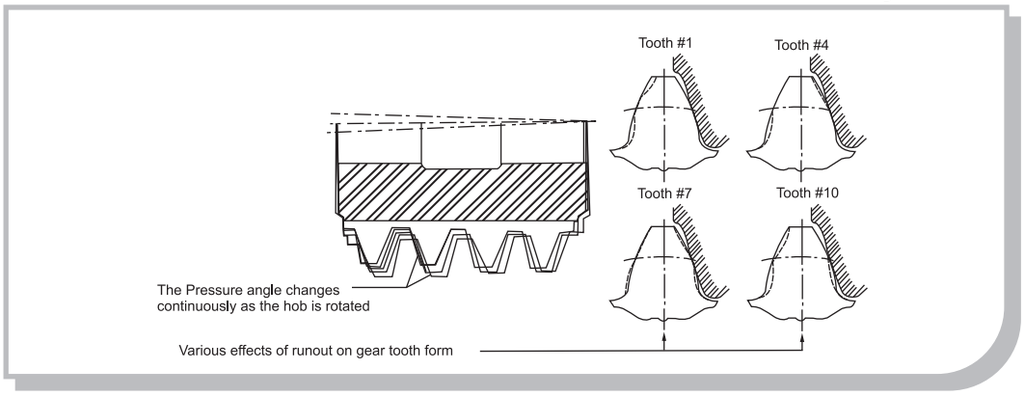
The effect of uniform runout over the entire hob.



The effect of runout on each side of the hob 180° apart.



The effect of hob runout on one side of the hob only.



❖ HOBS FOR SPUR & HELICAL GEARS AND INVOLUTE SPLINES

" Gear Data	" Hob Data
[a] Normal module/DP	[a] Overall size - OD x Length x Bore
[b] No. of teeth	[b] No. of starts
[c] Normal pressure angle	[c] Hand of threads
[d] Helix angle and hand	[d] Type - Finishing/preshave/pregrinding/roughing
[e] Outside diameter	[e] Type of profile-Nontopping/semitopping/full topping
[f] Root diameter	[f] Class of accuracy
[g] Amount of tip chamfer- If applicable	[g] Amount of shaving/grinding allowance wherever applicable
[h] Root-flat/full fillet	
[I] Tip relief details - If applicable	
[j] DOP or MOT sizes at hobbing and finishing stage	
[k] Material and hardness at hobbing stage	

❖ HOBS FOR STRAIGHT SPLINES

" Spline Data	" Hob Data
[a] No. of splines	[a] Overall size- OD x Length x Bore
[b] Spline width	[b] No. of starts
[c] Out side dia.	[c] Hand of threads
[d] Root dia.	[d] Type of hob - Finishing/ pre-grinding
[e] Form dia.	[e] Type of profile- Semitop/nontop/ with lugs, with shoulder etc.
[f] Amount of chamfer- for semitopping hobs	[f] Amount of grinding allowance wherever applicable
[g] Under-cut details, if required	
[h] Shoulder details, if applicable	
[i] Basic profile reference standard	
[jj Material & its hardness at hobbing stage	

❖ WORM WHEEL HOBS

Since these must be tailored to the respective gears & applications, worm wheel hobs can not be manufactured in standard sizes. Therefore following details will be required -

[a] Drawing / details indicating worm thread & wheel tooth particulars, center distance, ratio etc.

[b] The type of worm thread profile ZN, ZA, ZK or ZI according to DIN 3975 or other special profile.

[c] The amount of assembly backlash & type of contact pattern required.

[d] In case of shank type hob, shank holding dimensions to suit the hobbing machine will be required.

❖ SPROCKETHOBS

" Sprocket Data	" Hob Data
[a] Chain pitch	[a] Overall size- OD x Length x Bore
[b] Roller dia	[b] No. of starts
[c] Chain/ Sprocket reference standard	[c] Hand of thread
[d] Component drawing/details	[d] Ground/unground profile

For special hobs having non standard profiles, fixed position type etc., component drawing indicating tooth profile details will be required. Hob size & profile details can be designed depending upon part requirements and suitable hob will be manufactured.

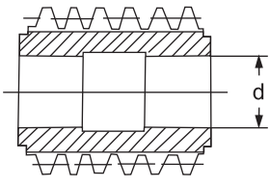
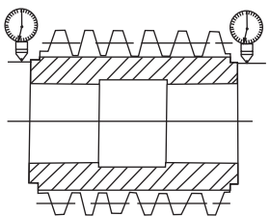
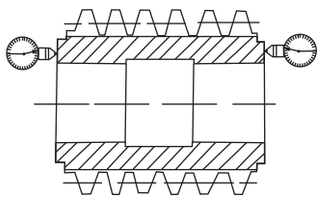
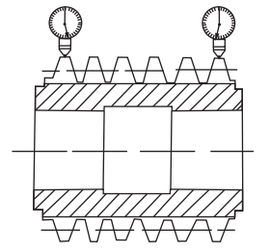
Component Data Required for Design of Spline Gauges

Sr. No.		PLUG GAUGES			RING GAUGES		
		Involute	StSpline	Serration	Involute	St.Spline	Serration
1	No. of Teeth	✓	✓	✓	✓	✓	✓
2	Module/DP	✓			✓		
3	Pressure Angle	✓			✓		
4	Spline Width/Gap		✓			✓	
5	Flank Angle Internal/Extemal			✓			✓
6	Minor Dia with Tolerance	✓	✓	✓	✓	✓	✓
7	Major Dia with Tolerance	✓	✓	✓	✓	✓	✓
8	Chamfer/Radius at major diameter	✓	✓	✓	✓	✓	✓
9	Chamfer/Radius at minor diameter	✓	✓		✓	✓	
10	Length of Splines	✓	✓	✓	✓	✓	✓
11	Form Diameter	✓		✓	✓		✓
12	DOP/DBP with Pin Dia.	✓		✓			
13	Max. Major Dia. of mating part	✓			✓		✓
14	Min. Minor Dia. of mating part			✓	✓		✓
15	Circular space/tooth width at PCD	✓		✓	✓		✓
16	Minor/Major Apex. Diameter with Tolerance			✓			✓

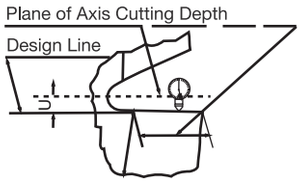
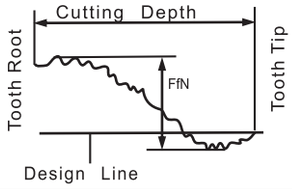
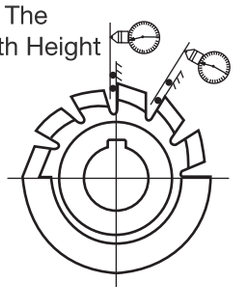
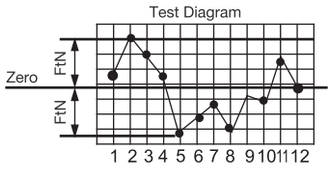
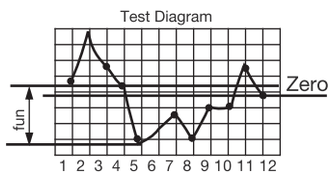
IN ADDITION CUSTOMERS TO INDICATE FOLLOWING GAUGE REQUIRED FOR CHECKING

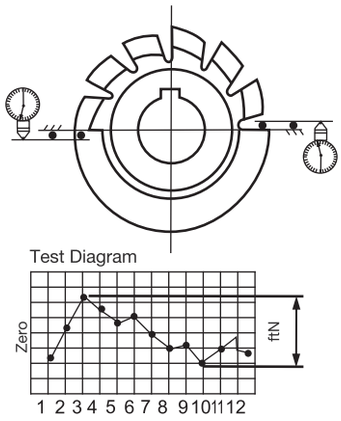
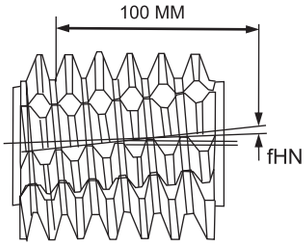
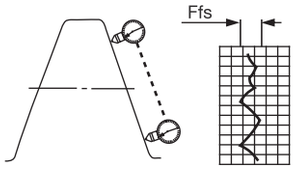
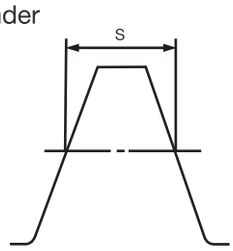
	Yes/No
Flank	Y/N
Flank & Major Dia.	Y/N
Only Major Dia.	Y/N

Tolerances as per DIN 3968 (In Micron)

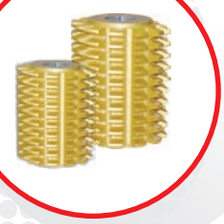
No.	Measured Quantity	Symbol Denoting Variation	Class	Over 0.63 To 1	Over 1 To 1.6	Over 1.6 To 2.5	Over 2.5 To 4	Over 4 To 6.3	Over 6.3 To 10	Over 10 To 16	Over 16 To 25	Over 25 To 40
1	Bore Diameter. 		A	I. S. A. Tolerance Field H_5								
			B	I. S. A. Tolerance Field H_6								
			C	I. S. A. Tolerance Field H_5								
			D	I. S. A. Tolerance Field H_7								
			AA	I. S. A. Tolerance Field H_5								
2	Form Tolerance of Bore.		All Classes	1/2 The Bore Tolerance								
3	Tolerance for Longitudinal of Clutch Drive Keyway.		All Classes	According To DIN 138								
4	Radial Run-out on Both Proof Flanges. Referenced to Bore Axis. 	frp	A	5	5	5	6	8	10	12	16	20
			B	6	6	6	8	10	12	16	20	25
			C	10	10	10	12	16	20	25	32	40
			D									
			AA	5	5	5	5	5	5	6	6	8
				The Highest Points Measured On The Two Proof Flanges Must Not Be More Than 90° Apart.								
5	Axial Run-out on Hub Faces Referenced to Bore Axis. 	fps	A	3	3	3	5	5	8	8	10	10
			B	4	4	4	6	6	10	10	12	12
			C	6	6	6	10	10	16	16	20	20
			D	10	10	10	16	16	25	25	32	32
			AA	3	3	3	3	3	4	5	5	6
6	Radial Run-out on Tooth Tips Referanced to Bore Axis 	frk	A	12	16	20	25	32	40	50	63	80
			B	25	32	40	50	63	80	100	125	160
			C	50	63	80	100	125	160	200	250	315
			D	100	125	160	200	250	315	400	500	630
			AA	10	10	12	16	20	25	32	40	50

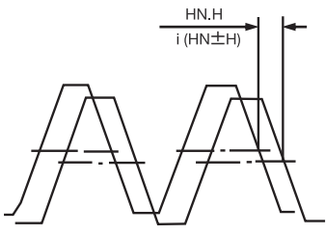
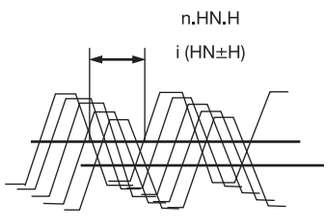
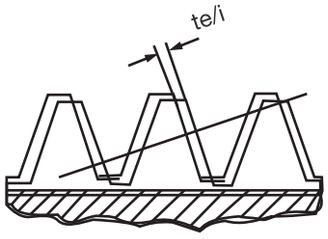
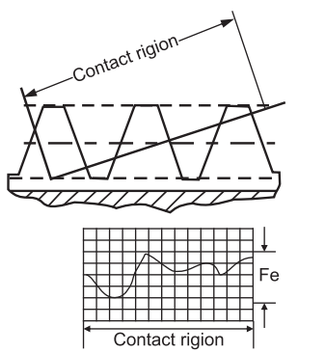
Tolerances as per DIN 3968 (In Micron)

7	Form & Positional Variation of Cutting Faces  Distance U is Amount by Which Design Line is Distant Form Plane of Hob Axis (Zero, When Rake Angle is 0°)  	FfN	A	12	16	20	25	32	40	50	63	80
			B	25	32	40	50	63	80	100	125	160
			C	50	63	80	100	125	160	200	250	315
			D	100	125	160	200	250	315	400	500	630
			AA	10	10	12	16	20	25	32	40	50
8	Individual Pitch Measured at Half The Tooth Height   	FtN	A	±12	±16	±20	±25	±32	±40	±50	±63	±80
			B	±25	±32	±40	±50	±63	±80	±100	±125	±160
			C	±50	±63	±80	±100	±125	±160	±200	±250	±315
			D	±100	±125	±160	±200	±250	±315	±400	±500	±630
			AA	±10	±10	±12	±16	±20	±25	±32	±32	±50
9	Tooth to Tooth Pitch Measured at Half Tooth Height  	fun	A	12	16	20	25	32	40	50	63	80
			B	25	32	40	50	63	80	100	125	160
			C	50	63	80	100	125	160	200	250	315
			D	100	125	160	200	250	315	400	500	600
			AA	10	10	12	16	20	25	32	40	50

10	Cumulative Pitch Measured at Half Tooth Height 	ftN	A	25	32	40	50	63	80	100	125	160
			B	50	63	80	100	125	160	200	250	315
			C	100	125	160	200	250	315	400	500	630
			D	200	250	315	400	500	630	800	1000	1250
			AA	20	20	25	32	40	50	63	80	100
			The Tolerances Are Referenced To The Pitch Error That Is To Say To The Largest Cumulative Pitch Error Measured On The Hob Tested.									
11	Gash Lead over 100MM Hob Length, Referred to Ref. Cylinder 	fHN	A	±70								
			B	±100								
			C	±140								
			D	±200								
			AA	±50								
12	Form Error Of Cutting Edge 	Ffs	A	10	11	12	14	16	20	25	32	40
			B	20	22	25	28	32	40	50	63	80
			C	40	45	50	56	63	80	100	125	160
			D									
			AA	6	6	6	8	10	12	14	18	22
13	Tooth Thickness on Reference Cylinder 	fs	A	-25	-28	-32	-36	-40	-50	-63	-80	-100
			B	-50	-56	-63	-71	-80	-100	-125	-160	-200
			C	-100	-112	-125	-140	-160	-200	-250	-320	-400
			D	-100	-112	-125	-140	-160	-200	-250	-320	-400
			AA	-16	-16	-16	-20	-25	-32	-40	-50	-63

Tolerances as per DIN 3968 (In Micron)



14	Hob Lead from cutting Edge to cutting Edge in the Direction of Hand 	fHF	A	±6	±7	±8	±9	±10	±12	±32	±20	±25
			B	±12	±14	±16	±18	±20	±25	±32	±40	±50
			C	±25	±28	±32	±36	±40	±50	±63	±80	±100
			D	±50	±56	±63	±71	±80	±100	±125	±160	±200
			AA	±4	±4	±4	±5	±6	±8	±10	±12	±16
			Where, HN - Lead Of Gashes Or Tooth Rows. H - Hob Lead (Helix), i-No. Of Gashes Or Tooth Rows, The Sign In The Brackets Is + If The Gash Lead & The Hob Lead Are In Opposite Direction & - If They Are In the Same Direction.									
15	Hob lead in the direction of hand between any two cutting edges on the same thread. 	F_{HF}	A	10	11	12	14	16	20	25	32	40
			B	20	22	25	28	32	40	50	63	80
			C	40	45	50	56	63	80	100	125	160
			D	80	90	100	112	125	160	200	250	320
			AA	6	6	6	8	10	12	14	18	22
			Where, HN - Lead Of Gashes Or Tooth Rows. H - Hob Lead (Helix), i-No. Of Gashes Or Tooth Rows, n - No. of cutting edges over which the measurement is made. The Sign In The Brackets is +ve if The Gash Lead & Hob Lead Are In Opposite Direction & - ve if they are in Same Direction.									
16	Base pitch element Measured from cutting edge to cutting edge 	fe	A	±6	±7	±8	±9	±10	±12	±16	±20	±25
			B	±12	±14	±16	±18	±20	±25	±32	±40	±50
			C	±25	±28	±32	±36	±40	±50	±63	±80	±100
			D									
			AA	±4	±4	±4	±5	±6	±8	±10	±12	±16
			Where. te - Base pitch i - No of gashes or tooth rows									
17	Base pitch element within a Contact region 	Fe	A	12	14	16	18	20	25	32	40	50
			B	25	28	32	36	40	50	63	80	100
			C	50	56	63	71	80	100	125	160	200
			D									
			AA	8	8	8	10	12	16	20	25	32

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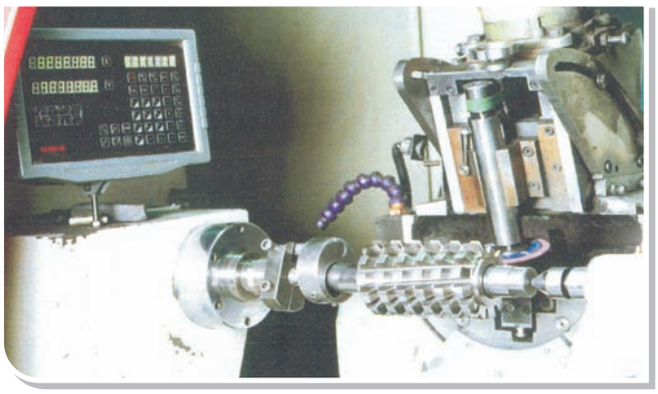
STATE OF THE ART MANUFACTURING & TESTING FACILITIES

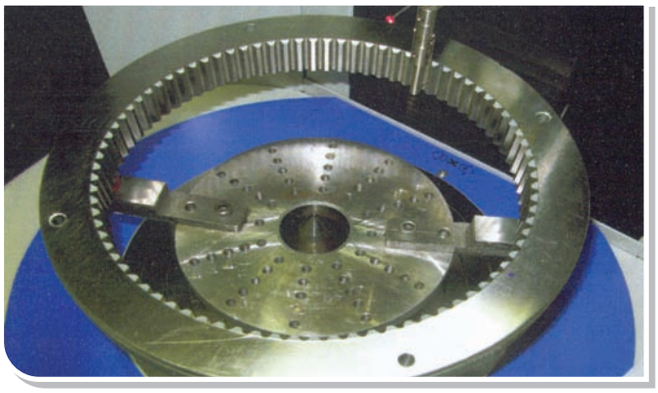
6 AXIS RELIEF GRINDING MACHINE

CNC RELIEVING LATHE



CNC HOB SHARPENING

HOB INSPECTION



SPLINE RING GUAGE INSPECTION

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Excluding Design
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