GEAR HOBS & MILLING CUTTERS

Hob & Milling cutters for the
gear manufacturing industry

STAR SU IS A WORLD LEADER IN THE CUTTING TOOL INDUSTRY

STAR SU has led the way in developing High Performance Hobbing using Solid Carbide (SC) Hobs and High Speed Steel Hobs with Advanced Coatings in wet and dry cutting applications.

STAR SU pioneered a process for manufacturing precision milling cutters without form grinding after heat treat. This gives our customers the benefits of ground quality tools without the loss of usable life normally seen in ground cutters.

To complement our manufactured products, we have partnered with PWS , Präzisionswerkzeuge - Schmölln, to offer a complete line of gear cutting tools including shaper cutters, shaving cutters, and coarse pitch hobs.

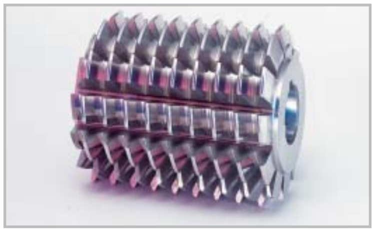
In our effort to stay abreast of today's fast moving gear market, Star SU is an active member of the American Gear Manufacturers Association, holding two committee chairmanships including the hob tolerance committee.

Star SU manufactures hobs

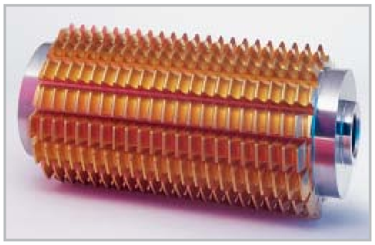
Module (DP) 0.5-17 mm (50.8 – 1.5)

Diameter 20-200 mm (.75-8.0)

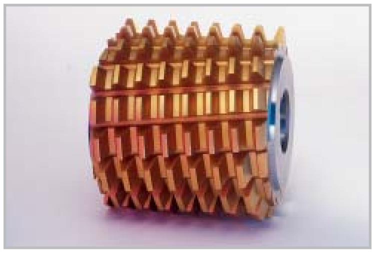
Larger modules available on request.



Single Thread Involute Hobs use straight angled sides for generating gears for maximum accuracy on gear hobbing machines. They are normally specified for processes where no subsequent tooth finishing operations are required, or where improved accuracy before tooth shaving operations is required.

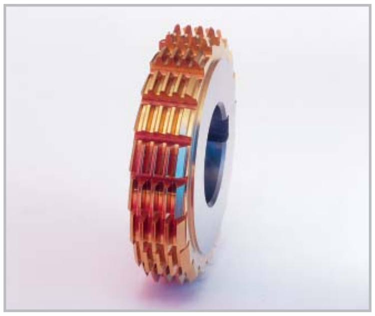


Multiple Thread Involute Hobs are specified for production runs of gears on gear hobbing machines. Finish and accuracy are somewhat less than that of single thread hobs, and tooth shaving operations are normally required. Depending on the lead angle, they will be straight or spiral gash.



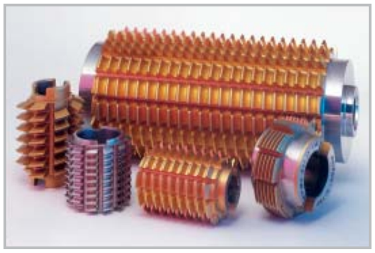
Involute Spline Hobs have straight sides teeth like a gear hob, and are usually of stub tooth depth. They are made in single or multiple thread designs, with diametral pitches ranged from 2.5/5 to 128/256 and pressure angles of 30°, 37.5°, or 45°.

Worm Gear Hobs are part of specific tools that match the worm shaft with sharpening allowance. This plunge cutting tool is manufactured in shell or shank designs with straight or spiral gash. Lead angles up to 45° are available.

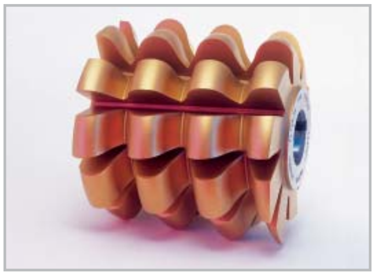


Camshaft Hobs are specially designed involute hobs for plunge cutting the gear on most automotive camshafts. It has clearance chamfers on one of both ends to clear lobe or bearing journals for timing, and topping if necessary.

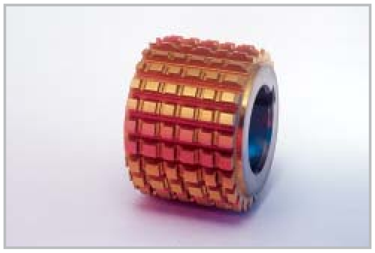
High Speed Steel Hobs with Advanced Coatings close the gap between solid carbide and traditional high speed steel. High Speed Steel Hobs with Advanced Coatings offer improved performance over traditional high speed steel in both wet or dry applications and are available in premium substrates and various coatings.



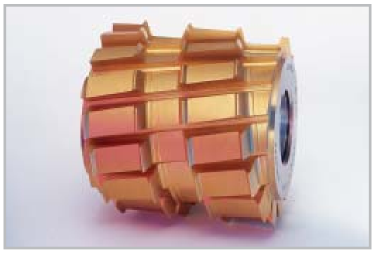
Special Drive Hobs can be designed and manufactured for any special requirement. From OD and face clamping to clutch key ways with special hubs.



Sprocket Hobs are specially designed to produce accurate finishes on several chain sprocket tooth forms. Like spline hobs, they produce the correct tooth form at only one depth of cut, so tooth form accuracy is extremely important. Sprocket hobs are available in single and multiple thread designs.

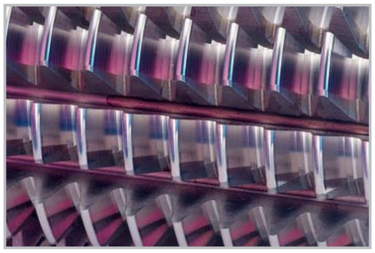


Special Form Hobs are produced for a wide variety of tooth forms such as square shafts, as well as conjugate forms for pump gear that transmit motion. Generally, these special hobs generate the correct tooth form at only one depth, so accuracy is critical.



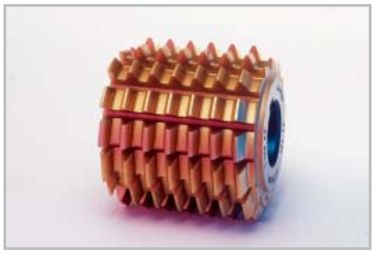
Straight Key Spline Hobs with Lugs is a special feature that can be included on the hob to produce root clearance when necessary. Other special features, such as clearance grooves for shoulder clearance can be added to any of the spline hobs.

Solid Carbide Hobs can be used in shell or shank design to cut gears with or without coolant, and are available in keyway and clutch drive designs.



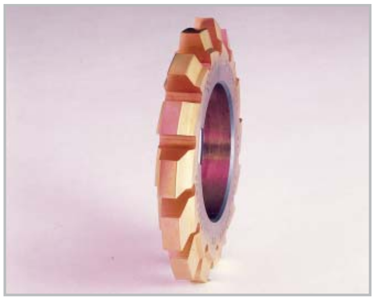
PWS Precision Quality coarse pitch, large body hobs, are now available in tooth sizes from module 20 (1.25 DP) to module 40 (.635 DP) up to 430 mm (17”) in diameter.

Shank hobs are designed for today’s high cutting velocity tools with extra long active cutting lengths. They are designed for most hobbing machines in today’s hobbing machine market.

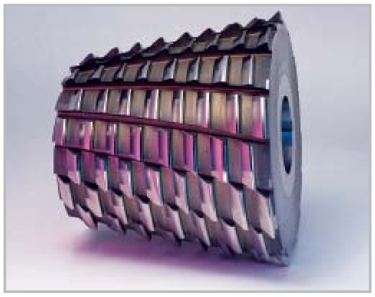


Straight or tapered key spline hobs have specially curved tooth forms and are made in single and multiple thread types. They are used to produce at only one depth of cut.

Star SU manufactures accurate, long-lasting, form-relieved milling cutters for a wide variety of applications. Every tool is a custom design for a specific application.

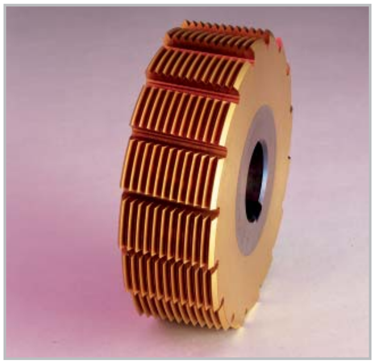


Single & Duplex Milling Cutters are available for most tooth forms from standard involutes and sprockets to special splines and worm cutters.

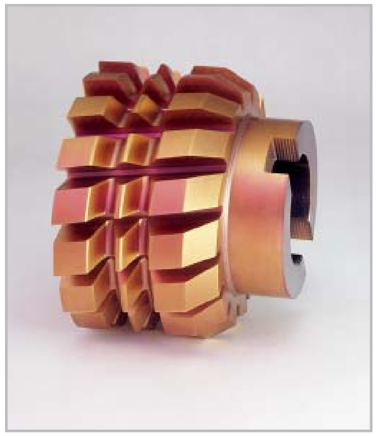


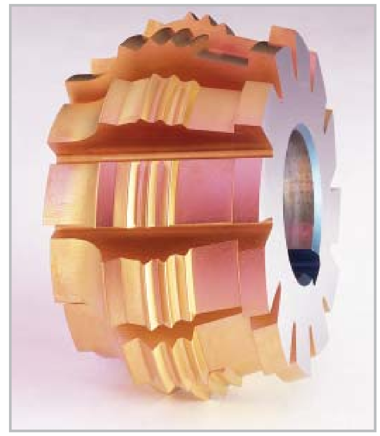
Saw Blade Milling Cutters for hack, band, or circular saw blades come in single or variable pitch, straight or tapered outside diameters, single cutters up to 13.5” long or interlocked sets, accurate unground or hard finished.

Multiple Thread Milling Cutters are of two basic designs, shell type and shank type. Both types are form relieved and may be sharpened by grinding the straight or spiral gash of the cutter, without changing their forms. Both types can be supplied with special thread forms, as well as standard straight, taper or pipe threads, to cut internal and external threads.



Special Form cutters are manufactured in a wide range of configurations…straight and spiral gash designs for cutting gear racks, serration form cutters for chuck jaws and steering gear segments, as well as a wide variety of special form relieved cutters for producing items such as pliers, clipper guides, concave and convex form, and tool bits. The drives range from simple keyway bores to complex hubs and shanks.





When ordering special cutters, a detailed drawing of the part to be cut should be furnished. Your information MUST include the following data.

CUSTOMER DATA

Star-SUCustomer-No.(opt.): ____________

Company name: ____________

Department: ____________

Request by (first/last name): ____________

Tel.: ____________

Fax.: ____________

E-mail: ____________

☐ Quotation ☐ Order

PART DATA

Star-SU part-ID-no. (opt.): ____________

Workpiece drawing no: ____________

Workpiece type ☐ External ☐ Internal

Number of teeth ____________

Diametral pitch (DP) ________ Module ________

if helical, please specifiy ☐ Normal ☐ Transverse

Pressure angle ____________

if helical, please specify ☐ Normal ☐ Transverse

Major dia. ________ Minor dia. ________

Helix angle ________ Lead ________

Hand of helix ☐ Right ☐ Left

Depth of cut ____________

T.I.F. diameter ____________

Tolerance ____________

Root fillet radius ____________

Cutting operation ☐ Rough ☐ Finish

☐ Pre-shave* ☐ Pre-grind ☐ Pre-finish

*supply pre-shave shape including undercut!

Chordal Addendum ____________

Tooth thickness ____________

Measuring over pin/balls ____________

Pin/ball diameter ____________

Span reading ________ No of teeth ________

Material to be cut ____________

Hardness at time of cutting ________ HBN __ HRC

MATING PART

Part number ____________

Number of teeth ____________

Major dia. ________ minor dia. ________

Center Distance ____________

Backlash ____________

CUTTER DATA

Star-SU-tool-ID-no.(opt.): ____________

Tool drawing no: ____________

Type of Hob ☐ Shell ☐ Shank* ☐ Multi Thread*

Diameter ____________

Hole size ____________

Type of keyway ____________

***If special cutter specify application (e.g. chain sprockets, cams, splines, timing gears, etc.) ________

Profile modifications
☐ Corner radius
☐ Chamfer or semi-topping
☐ Protuberance
☐ Modified flank for tip relief
☐ Modified pressure angle
☐ Full topping

ANSI/AGMA quality class: ☐ Unground ☐ A ☐ AA

Specify special quality: ____________

Material: ☐ M4 ☐ Rex45 ☐ Rex54 ☐ Rex76 ☐ T-15

Other materials are available on request.

Coating: ☐ TiN ☐ TiCN ☐ TiAIN

Specify other coating: ____________

Number of pieces: ____________

Remarks: ____________

____

____

____

Please send the completed form to:
Fax: 847-649-0112
Tel: 847-649-1450 E-mail: sales@star-su.com

THE NATURE OF THE ENVELOPING CUT

Deviations from the theoretical or design generating helix of the hob effect the polygonal path of the enveloping cut along the gear tooth profile (as shown in figures 1 and 2). In figures 1 and 2, a single thread hob is shown, illustrating how in one revolution of the hob each of the individual cutting edges removes metal from the tooth space along the line of action, enveloping the profile. The profile is made up of a series of individul cuts. The more cutting edges in a hob the finer the network of enveloping cuts. The fewer the number of cutting edges in the hob, the rougher the involute profile.

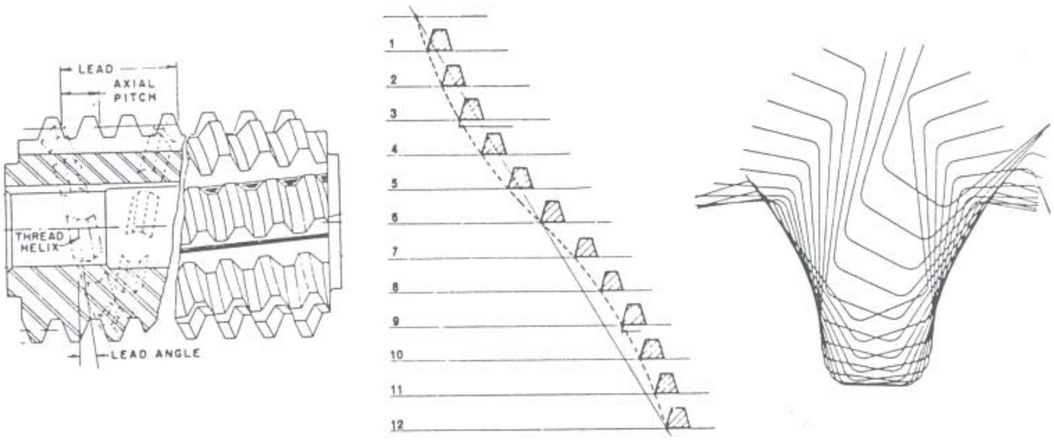


Figure 1. A single thread, 12 gash hob, in one revolution, envelopes a tooth space with a series of polygonal cuts.

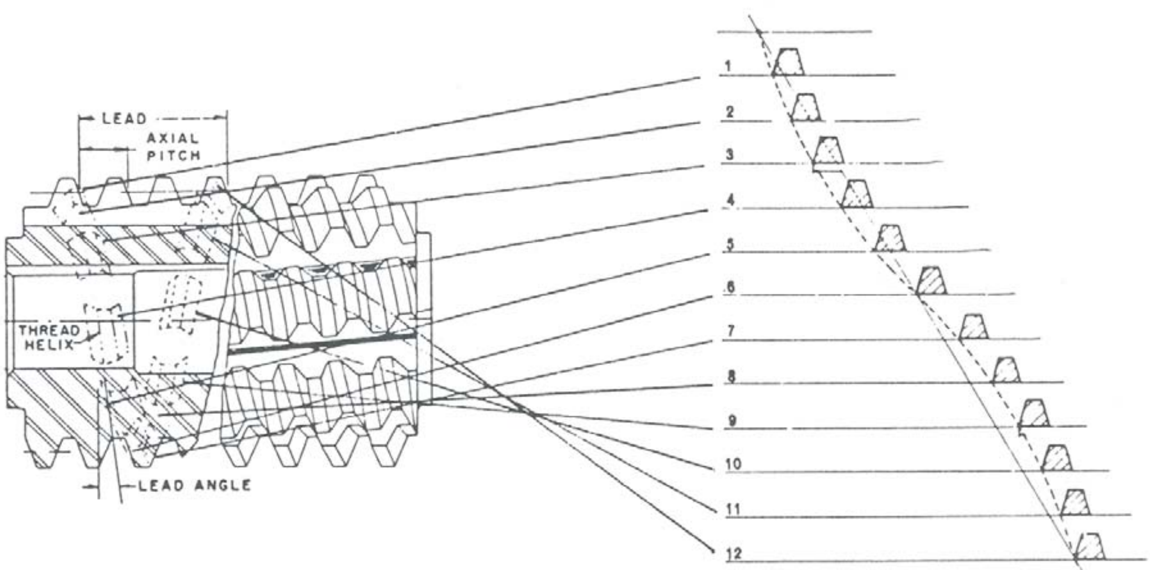


Figure 2. The unwound generating helix of a 12 gash single thread hob is shown here with a deviation of the cutting edges (dotted line = thread lead error) from the nominal (solid straight line).

If the hob is manufactured with deviations along its generating helix (thread error) or is resharpened, so as to displace one or more cutting edges from the nominal pitch cylinder of the hob, the effect is a deviation in the network of enveloping cuts. This deviation manifests itself as a profile error.

Incorrect resharpening of the hob produces deviations in the design geometry which effect the basic rack tooth form, the position of one cutting edge to another, the rake of hob cutting edge, and the lad of the gash (whether the hob is straight gash or spiral gash). These deviations are reproduced, in varying magnitudes, on the involute profile of the gear.

Mounting a theoretically perfect hob on an eccentrically running arbor causes the hob cutting edges to advance and retract in one revolution. This causes an advance and retreat of the network of enveloping cuts from the nominal, producing a "wandering" involute profile.

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 3, 4 and 5 illustrate the effects three types of hob runout have upon the gear tooth form. These effects are created, most often, by:

1) Failure to true up the hob arbor
2) Failure to true up the hob on the hob arbor by indicating the hub indicating bands on the ends of the hob
3) Bent hob arbor
4) Oversize hob bore or undersize hob arbor
5) Non-parallel hob clamping spacers
6) Misaligned or worn outboard support bearing for the hob arbor

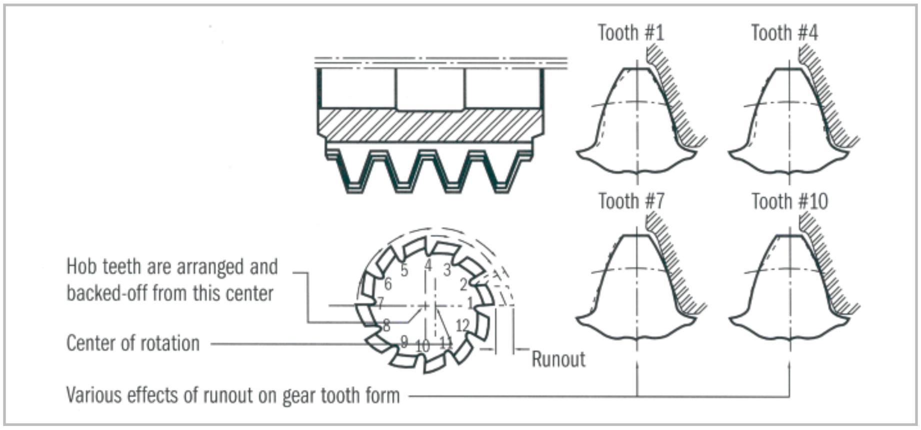


Figure 3. The effect of uniform runout over the entire hob.

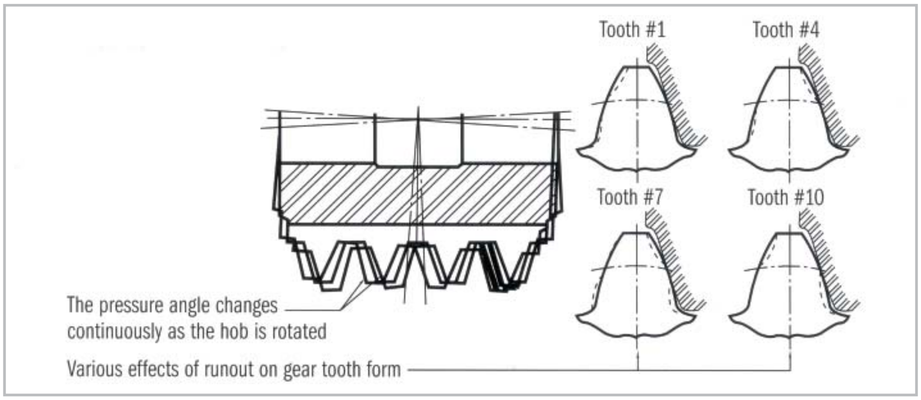


Figure 4. The effect of runout on each side of the hob 180° apart.

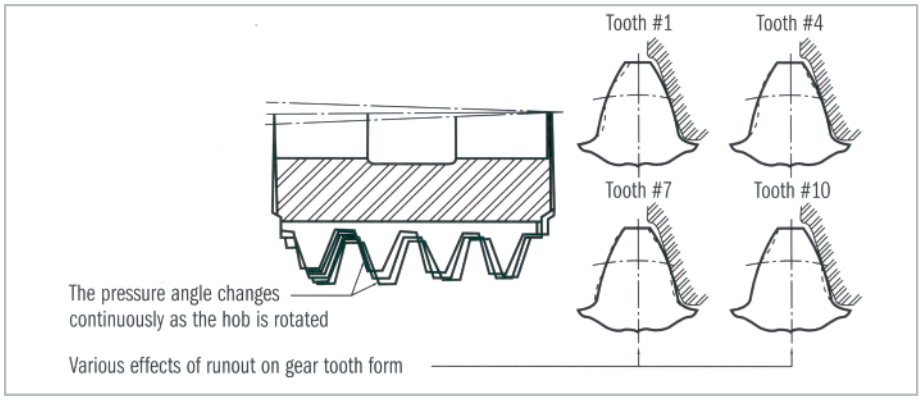


Figure 5. The effect of hob runout on one side of the hob only.

Often hob runout error is introduced at the first hob resharpening. If a hob is mounted carelessly – that is, without truing - on the sharpening arbor, runout can be sharpened into the hob by sharpening off progressively greater amounts of material from the hob gashes for half of its rotation. The sources of this error in the sharpener are similar to those in the hobber.

In some precision gear manufacturing shops the hob is sharpened on the hob arbor after careful alignment to insure optimum gear tooth profile accuracy.

THE EFFECT OF HOB RESHARPENING 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:

1) Hob cutting faces are sharpened with negative rake (Figure 6)
2) Hob cutting faces are sharpened with positive rake (Figure 7)
3) Hob cutting faces are sharpened by unequal amounts resulting in uneven flute spacing (Figure 8)

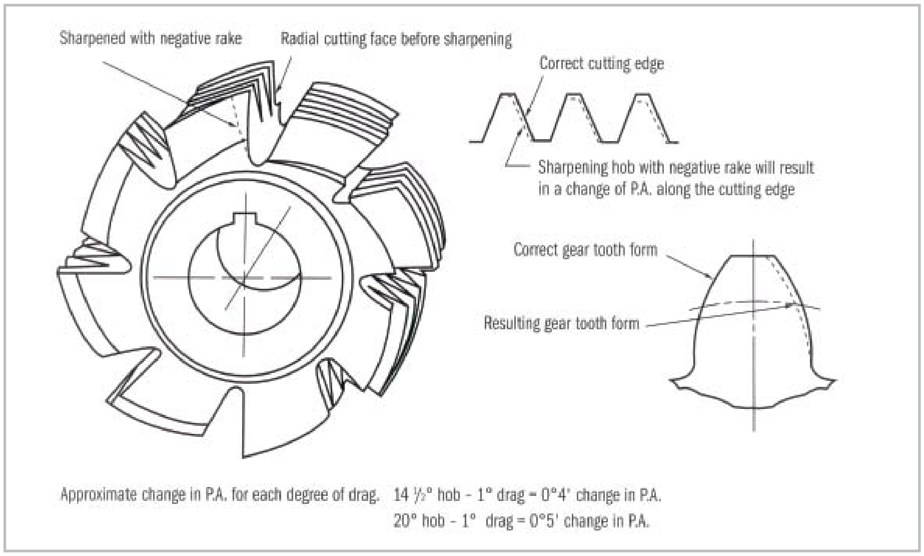


Figure 6. Effect on profile of a hob resharpened with negative rake when the cutting face should be sharpened radial.

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 workpiece will be evident (Figure 9).

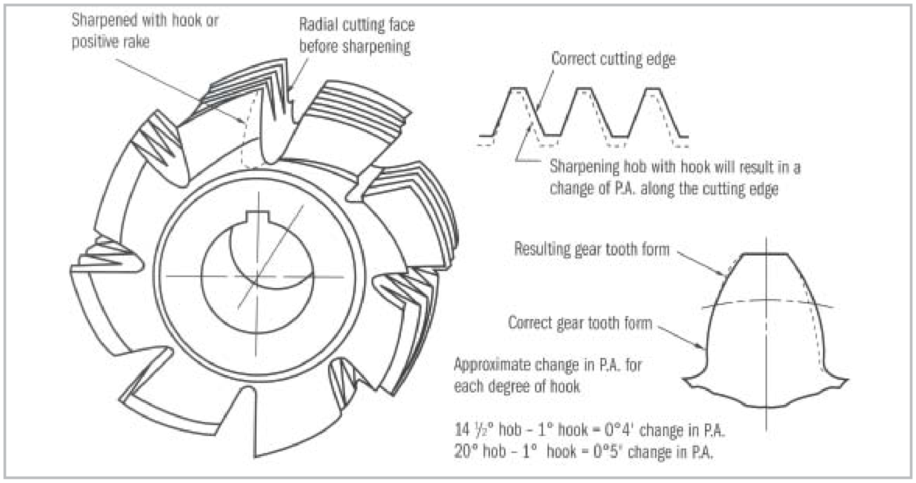


Figure 7. Effect on profile of a hob resharpened with positive rake when the cutting face should be sharpened radial.

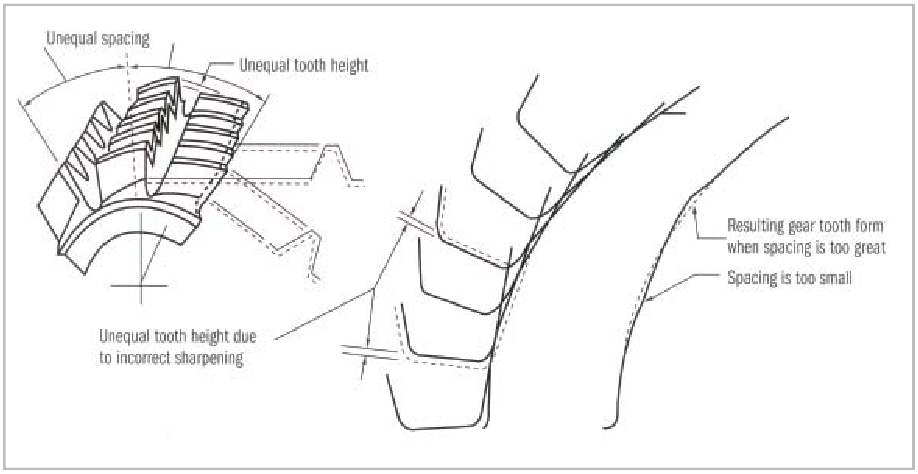


Figure 8. Effect on profile of a hob resharpened with cutting faces unequally spaced, creating accumulated flute spacing error.

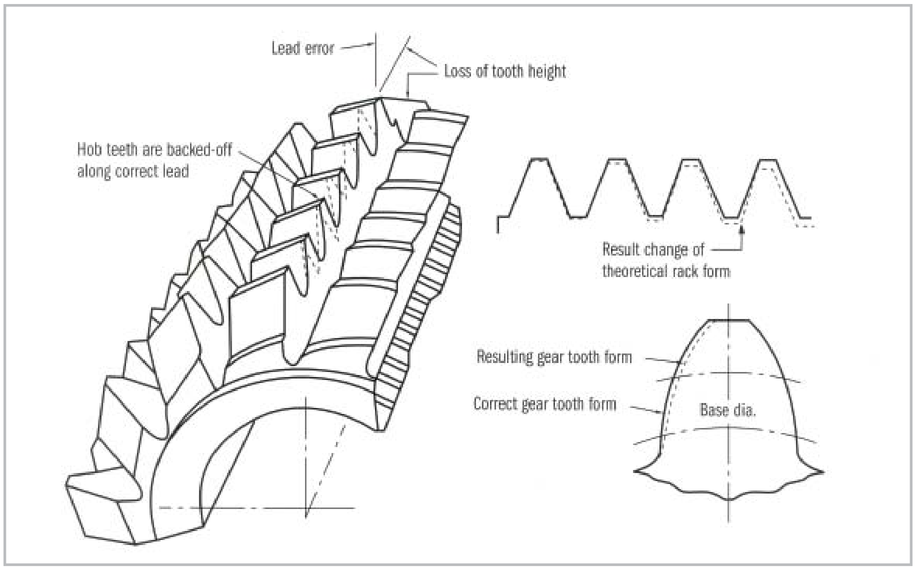


Figure 9. Effect on size of workpiece when hob is resharpened with the incorrect lead. The loss of tooth height from one end of the hob to the other results in a change of size on the workpiece as the hob is shifted across its usable life.

ANSI/AGMA 1102-A03 Tolerance Specifications for Single & Multiple Thread Hobs

Diametral Pitch		1 Thru 1.999	2 Thru 2.999	3 Thru 3.999	4 Thru 4.999	5 Thru 5.999	6 Thru 8.999	9 Thru 12.999	13 Thru 19.999	20 Thru 29.999	30 Thru 50.999	51 and Finer
Runout (1-4 Thread)	Class											
Hub Face*	AA			2	2	2	1	1	1	1	1	1
	A	8	5	2	2	2	2	2	2	2	2	2
	B	10	8	4	4	3	3	2	2	2	2	
	C	10	8	4	4	3	3	2	2	2	2	2
	D	10	8	5	5	4	4	3	3	3	3	
Hub Diameter*	AA			2	2	2	1	1	1	1	1	1
	A	10	5	4	3	3	3	2	2	2	2	2
	B	12	8	6	5	4	4	3	2	2	2	
	C	12	8	6	5	4	4	3	2	2	2	2
	D	15	10	8	8	6	6	5	5	4	3	
Outside Diameter*	AA			5	4	3	3	3	3	2	2	2
	A	30	20	15	15	10	10	10	10	10	7	5
	B	40	30	25	20	15	15	15	10	10	7	
	C	50	45	40	25	20	17	17	12	12	10	8
	D	60	55	50	45	35	35	30	25	20	15	
Lead Variation	Class											
Tooth To Tooth*	AA			4	3	2	1.7	1.7	1.7	1.7	1.5	2
	A	7	5	4	3	2	2	2	2	2	2	5
1Thread	B	10	8	6	4	3	3	3	3	3	2	
	C	15	12	8	6	5	4	4	4	4	3	8
	D	25	20	16	14	12	10	10	8	6	5	
	A	8	6	5	4	3	3	3	3	2	2	2
2 Thread	B	12	10	7	6	5	5	5	4	3	2	
	C	18	14	10	9	7	6	6	5	5	3	3
	D	27	22	18	16	14	12	11	9	8	6	
	A	9	7	6	4	4	4	3	3	3	2	2
3 Thread	B	14	12	8	7	6	6	5	5	4	3	
	C	21	16	12	10	8	7	6	5	5	4	3
	D	29	24	20	18	16	14	12	10	9	7	
	A	10	7	6	5	4	4	4	3	3	3	2
4 Thread	B	16	13	9	8	7	6	6	5	4	4	
	C	24	18	13	11	9	7	7	6	5	4	4
	D	31	26	22	20	18	16	13	11	10	8	

ANSI/AGMA 1102-A03 Tolerance Specifications for Single & Multiple Thread Hobs *(continued)*

Diametral Pitch		1 Thru 1.999	2 Thru 2.999	3 Thru 3.999	4 Thru 4.999	5 Thru 5.999	6 Thru 8.999	9 Thru 12.999	13 Thru 19.999	20 Thru 29.999	30 Thru 50.999	51 and Finer
Lead Variation *(continued)*	Class											
Any One Axial Pitch*	AA			8	6	4	3	3	2	2	1.5	1.5
	A	25	18	10	8	6	5	5	4	4	3	3
1Thread	B	35	25	17	11	9	7	7	6	6	4	
	C	45	35	22	14	11	9	9	8	8	8	6
	D	60	60	40	30	25	20	20	18	16	14	
	A	25	20	10	8	6	5	5	4	4	3	3
2-4 Thread	B	35	30	17	12	10	8	8	7	7	4	
	C	45	35	22	18	15	12	12	10	10	8	6
	D	60	50	40	30	25	20	20	18	16	14	
Any Three Axial Pitches	AA			12	9	6	5	5	4	4	3	3
	A	38	26	15	12	9	8	8	7	7	5	5
	B	53	38	22	16	12	11	10	9	9	7	
1 Thread	C	70	50	30	21	16	14	13	12	12	12	8
	D	120	100	80	60	50	40	35	25	20	16	
Any Three Axial Pitches*	A	38	30	15	12	9	8	8	7	7	5	5
	B	53	38	22	20	15	12	12	10	10	7	
2-4 Thread	C	70	50	30	28	20	18	16	14	14	12	8
	D	120	100	80	60	50	40	35	25	22	18	
Adjacent Thread To Thread Spacing*	A	11	9	8	7	6	5	4	3	3	3	3
	B	14	12	11	10	9	8	6	5	5	5	
	C	20	17	15	13	11	10	9	8	7	6	5
2 Thread	D	26	22	19	17	15	13	12	11	10	9	
	A	13	11	10	8	7	6	5	4	4	4	3
3 Thread	B	16	14	12	11	10	9	7	7	6	6	
	C	22	19	16	14	13	11	10	9	8	7	6
	D	28	24	20	18	16	15	13	12	11	10	
	A	15	13	12	9	8	7	6	5	4	4	3
4 Thread	B	18	16	14	12	11	10	8	7	7	6	
	C	24	21	18	15	14	12	11	10	9	8	7
	D	30	26	22	20	18	16	14	13	12	11	

ANSI/AGMA 1102-A03 Tolerance Specifications for Single & Multiple Thread Hobs *(continued)*

Diametral Pitch		1 Thru 1.999	2 Thru 2.999	3 Thru 3.999	4 Thru 4.999	5 Thru 5.999	6 Thru 8.999	9 Thru 12.999	13 Thru 19.999	20 Thru 29.999	30 Thru 50.999	51 and Finer
Tooth Profile	Class											
Pressure Angle	AA			2	2	1.7	1.7	1.7	1.7	1.7	1.5	1.5
Or Profile*	A	10	5	3	3	2	2	2	2	2	2	2
1Thread	B	16	8	5	5	4	3	3	3	3	2	
	C	25	15	10	5	4	3	3	3	3	3	3
	D	80	55	30	18	12	8	8	6	5	4	
	A	12	7	5	4	3	3	2	2	2	2	2
2 Thread	B	18	10	7	5	5	4	3	3	3	2	
	C	27	16	11	7	5	4	3	3	3	3	3
	D	80	55	30	18	12	8	8	7	6	5	
	A	15	8	5	4	3	3	3	2	2	2	2
3-4 Thread	B	20	10	7	5	5	4	4	3	3	2	
	C	27	16	11	7	5	4	4	3	3	3	3
	D	80	55	30	18	12	8	8	7	6	5	
Start of Approach	AA			100	80	70	60	60	40	40	30	
(Plus or Minus)	A	200	180	160	140	120	100	80	60	40	30	
	B	220	200	180	160	140	120	100	80	50	40	
1 Thread	C	220	200	180	160	140	120	100	80	60	50	
	D	260	240	220	200	180	160	140	120	100	80	
	A	200	180	160	140	120	100	80	60	50	40	
2-4 Thread	B	220	200	180	160	140	120	100	80	60	50	
	C	220	200	180	160	140	120	100	80	60	50	
	D	260	240	220	200	180	160	140	120	100	80	
Symmetry of Approach*	AA			70	60	50	40	40	25	25	25	
	A	150	130	120	100	90	80	60	50	35	25	
1 Thread	B	180	150	130	120	100	90	80	70	45	35	
	C	180	150	130	120	100	90	80	70	55	45	
	D	200	180	160	140	120	110	100	90	80	60	
	A	150	130	120	10	90	80	60	50	40	30	
2-4 Thread	B	180	150	130	120	100	90	80	70	60	50	
	C	180	150	130	120	100	90	80	70	60	50	
	D	200	180	160	140	120	110	100	90	80	60	
Tooth Thickness	AA			15	15	10	10	10	10	10	5	5
(Minus Only)	A	30	20	15	15	10	10	10	10	10	5	5
	B	30	20	15	15	10	10	10	10	10	5	
1-4 Thread	C	35	25	20	20	15	15	15	15	15	10	10
	D	40	35	30	25	20	20	20	20	20	15	

ANSI/AGMA 1102-A03 Tolerance Specifications for Single & Multiple Thread Hobs *(continued)*

Diametral Pitch		1 Thru 1.999	2 Thru 2.999	3 Thru 3.999	4 Thru 4.999	5 Thru 5.999	6 Thru 8.999	9 Thru 12.999	13 Thru 19.999	20 Thru 29.999	30 Thru 50.999	51 and Finer
Sharpening (1-4 Thread)	Class											
Spacinig Between Adjacent Flutes*	AA			20	15	10	8	8	6	6	6	6
	A	40	30	25	20	15	10	10	10	10	10	10
	B	50	45	40	30	20	15	15	10	10	10	
	C	50	45	40	30	20	15	15	10	10	10	10
	D	60	60	50	50	30	25	25	20	17	17	
Spacinig Between Non-Adjacent Flutes*	AA			40	35	25	15	15	15	15	15	15
	A	80	60	50	40	30	30	30	25	25	20	20
	B	100	90	80	60	50	50	50	40	35	30	
	C	100	90	80	60	50	50	50	40	35	30	30
	D	120	120	100	100	80	80	70	60	50	40	
Cutting Faces Radial To Cutting Depth*	AA			10	8	6	5	5	3	3	3	3
	A	30	15	10	8	6	5	5	3	3	3	3
	B	50	25	15	10	8	7	7	5	5	5	
	C	50	25	15	10	8	7	7	5	5	5	5
	D	100	75	50	40	30	20	20	15	15	10	
	Class	Face Width		0 to 1”		1” to 2”		2” to 4”		4” to 7”		7” and up
Accuracy Of Flutes, Straight and Helical	AA			8		10		15		20		20
	A			10		15		25		30		50
	B			10		15		25		30		50
	C			10		15		25		30		50
	D			15		23		38		45		75
Runout (1-4 Thread)												
Bore (1-4 Thread)	Class											
			Bore Diameter			2.500”	2.000”	1.500”	1.250”	.750”	.500” and smaller	
Diameter, Straight Bore (Plus Only)	AA								2	2	2	
	A					8	8	5	2	2	2	
	B					10	10	8	3	2	2	
	C					10	10	8	3	2	2	
	D					10	10	10	5	4	3	
	Class		All Diameters				Length					
Symmetry of Approach* 1 Thread	AA							75				
	A							75				
	B							75				
	C							60				
	D							50				
	Class		All Tapers				Circumference				Length	
Percent of Bearing Contact, Taper Bore	AA							95			75	
	A							90			60	
	B							90			60	
	C							90			60	

Consult the ANSI/AGMA Specification for values for AAA ultra precision hobs

GEAR HOBS & MILLING CUTTERS

Star SU LLC
5200 Prairie Stone Parkway, Suite 100
Hoffman Estates, IL 60192
USA
Tel.: 847 649 1450
Fax: 847 649 0112
sales@star-su.com

Star SU LLC
Sales Office Michigan
23461 Industrial Park Drive
Farmington Hills, MI 48335-2855
USA
Tel.: 248 474 8200
Fax: 248 474 9518
sales@star-su.com

Star SU LLC, Hoffman Estates/Illinois

WWW.STAR-SU.COM

StarSU_GearHobs&MillingCutters_8-06