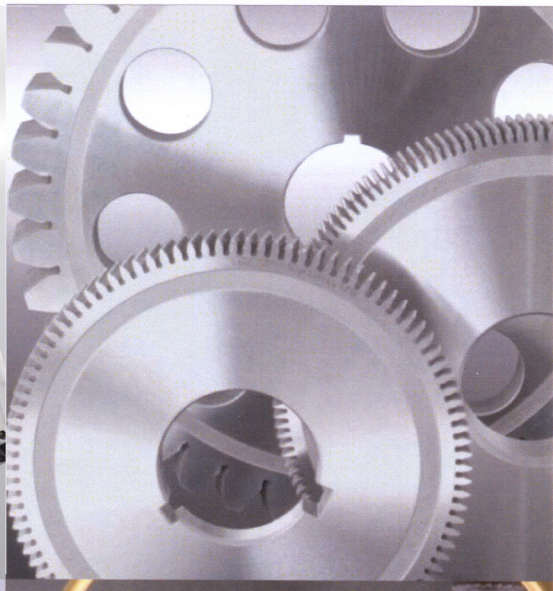
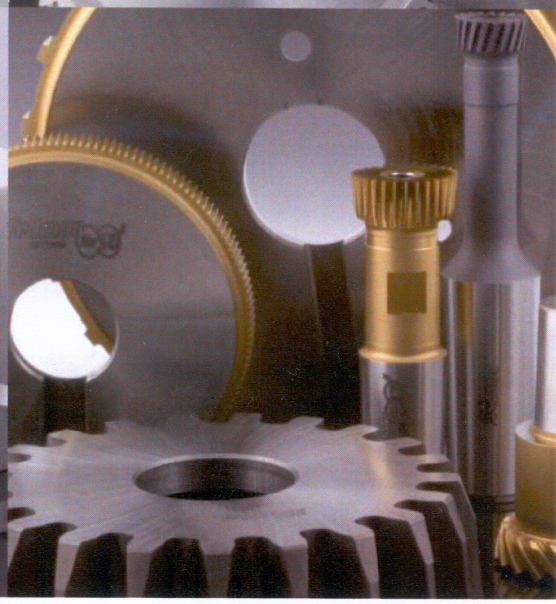
# GENERAL CUTTING TOOLS
## AND SERVICES





# INTRODUCTION

## STAR SU LLC

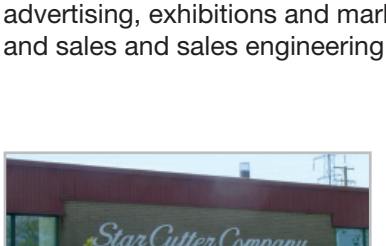
Star SU LLC is a selling cooperative made up of the three (3) partner companies of:

- Star Cut Sales, Inc., Farmington Hills, MI
- SU America, Inc., Hoffman Estates, IL, a unit of Samputensili SpA of Bologna, Italy
- Bourn & Koch Inc., Rockford, IL

Star SU is the go-to-market cooperative managed by a board made up of the senior management of the 3 partner companies. Its purpose is to reduce the cost of getting to the market by consolidating common Human Resource & Benefit administration, IT administration, direct selling personnel, advertising, exhibitions and marketing initiatives and sales and sales engineering management.

The consolidation results in a leaner, more cost effective go-to-market initiative than each company having its own duplicate sales, marketing, HR and IT departments.

Star SU is not a manufacturer's representative. It is the direct sales organization for the 3 partnered companies. As a selling cooperative for the 3 partnered companies, Star SU has 42 direct sales people calling in North America.




## STAR CUTTER COMPANY

Star Cutter Company was founded in 1927 by Howard B. Lawton and Frank Burgess. The company was started in a leased portion of a building on Epworth Boulevard in Detroit, Michigan. During its first year of operation, Star Cutter Company employed nine to ten employees. The main customers at the time were Chrysler and Chevrolet Gear and Axle. From this small beginning, Star Cutter Company has developed into a world leader in the cutting tool industry with eight manufacturing facilities within four manufacturing divisions, which produce seven product lines. Each manufacturing facility specializes in producing a specific type of product or service. This structure provides maximum product quality and control. Headquartered in Farmington Hills, Michigan, Star Cut Sales, Inc. is a wholly owned subsidiary of Star Cutter Company and provides the Michigan central office presence for Star Cutter management and Star SU's selling team. This extended group is an international organization of marketing specialists, service technicians and direct salespeople augmented by manufacturer's agents in the U.S., Canada, Mexico and throughout the world.

## BOURN & KOCH MACHINE TOOL COMPANY

Bourn & Koch Machine Tool Company has manufactured precision machine tool products since 1975, which included the purchase of the Barber-Colman line of gear manufacturing machines. The Rockford plant offers 130,000 square feet of working space and a staff of highly skilled engineers and technicians. Bourn & Koch manufactures new, rebuilds, remanufactures, retrofits and recontrols gear cutting machines, gear inspection machines, gear grinding machines, vertical grinding centers, rotary surface grinding machines, vertical spindle turning centers and multi-spindle screw machines.

## SU AMERICA

SU America is a unit of Samputensili S.p.A., which is the machine tool unit of the Maccaferri Industrial Group, a multinational organization, which operates in various diverse fields around the world, employing over 3,200 people. Samputensili offers a complete range of gear manufacturing equipment and gear tools through three main business units, which focused on a specific field: machine tools, gear cutting tools and rotor technology. Combining the expertise of these three product lines means Samputensili can provide complete manufacturing solutions for various gear technology requirements in the automotive industry, the machine and power tool industry, construction, the mining industry, earth moving equipment manufacturers, hydraulic pump manufacturers, gearbox producers, elevator and crane manufacturers, aerospace, energy, shipbuilding and the medical industry. The company has production facilities in Italy, Germany, Brazil, France, USA, China and Korea and operates through numerous sales offices with representatives around the world.

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Star SU LLC, Hoffman Estates/Illinois

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# 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.

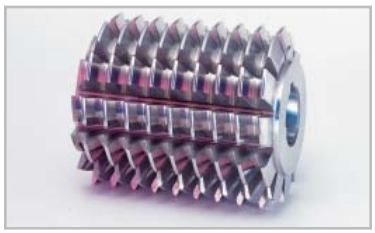
In our effort to stay abreast of today's fast moving gear market, Star SU is an active member of the American Gear Manufacturers Association, holding two committee chairmanships including the hob tolerance committee.

Star SU manufactures hobs

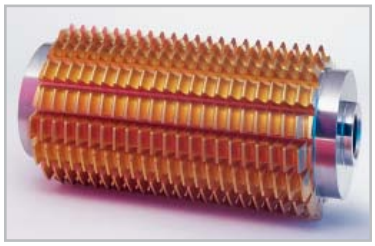
Module (DP) 0.5-17 mm (50.8 – 1.5)

Diameter 20-200 mm (.75-8.0)

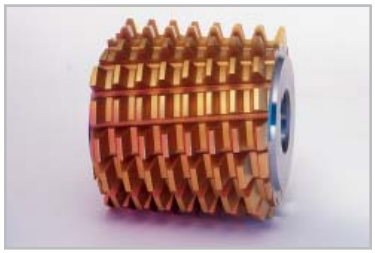
Larger modules available on request.



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.

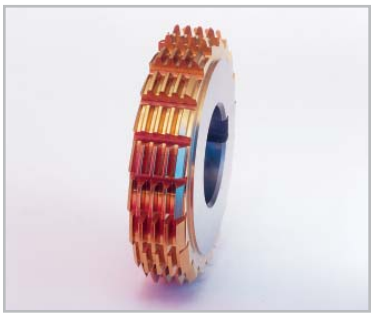


Multiple Thread Involute Hobs are specified for production runs of gears on gear hobbing machines. Finish and accuracy are somewhat less than that of single thread hobs, and tooth shaving operations are normally required. Depending on the lead angle, they will be straight or spiral gash.

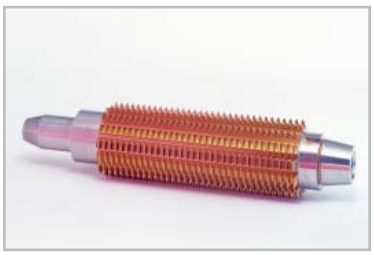


Involute Spline Hobs have straight sides teeth like a gear hob, and are usually of stub tooth depth. They are made in single or multiple thread designs, with diametral pitches ranged from 2.5/5 to 128/256 and pressure angles of 30°, 37.5°, or 45°.

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.

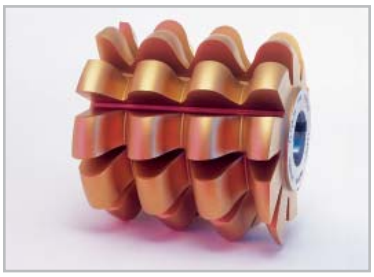


Camshaft Hobs are specially designed involute hobs for plunge cutting the gear on most automotive camshafts. It has clearance chamfers on one of both ends to clear lobe or bearing journals for timing, and topping if necessary.

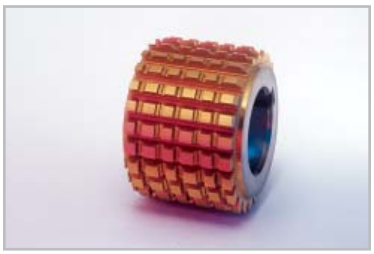


High Speed Steel Hobs with Advanced Coatings close the gap between solid carbide and traditional high speed steel. High Speed Steel Hobs with Advanced Coatings offer improved performance over traditional high speed steel in both wet or dry applications and are available in premium substrates and various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

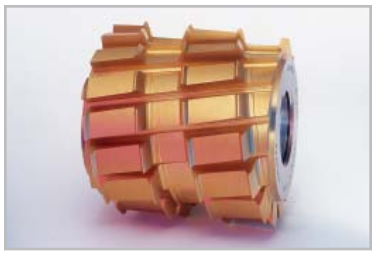
Special Drive Hobs can be designed and manufactured for any special requirement. From OD and face clamping to clutch key ways with special hubs.



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.

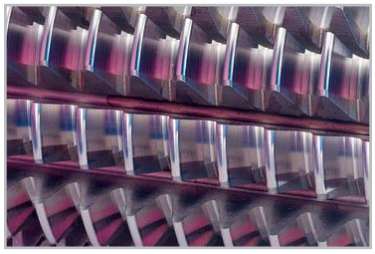


Special Form Hobs are produced for a wide variety of tooth forms such as square shafts, as well as conjugate forms for pump gear that transmit motion. Generally, these special hobs generate the correct tooth form at only one depth, so accuracy is critical.



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.

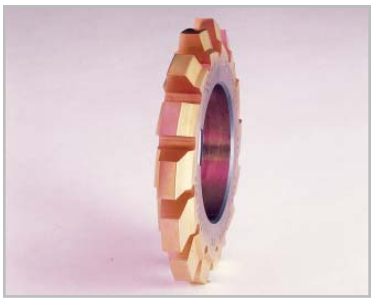


PWS Precision Quality coarse pitch, large body hobs, are now available in tooth sizes from module 20 (1.25 DP) to module 40 (.635 DP) up to 430 mm (17”) in diameter.

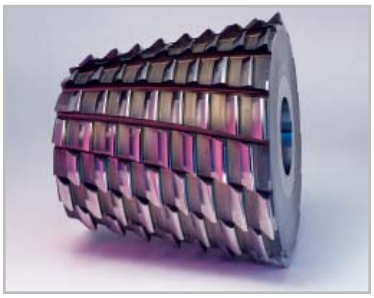
Shank hobs are designed for today’s high cutting velocity tools with extra long active cutting lengths. They are designed for most hobbing machines in today’s hobbing machine market.

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.

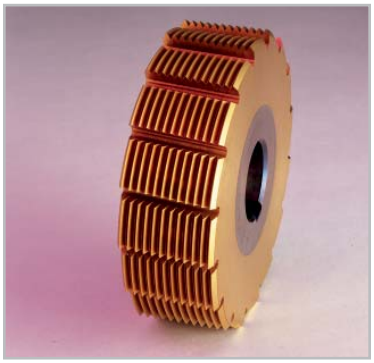


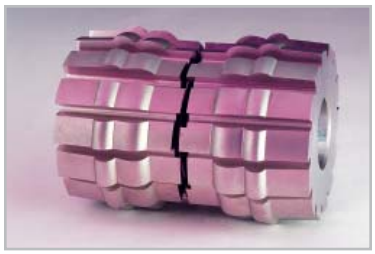
Single & Duplex Milling Cutters are available for most tooth forms from standard involutes and sprockets to special splines and worm cutters.



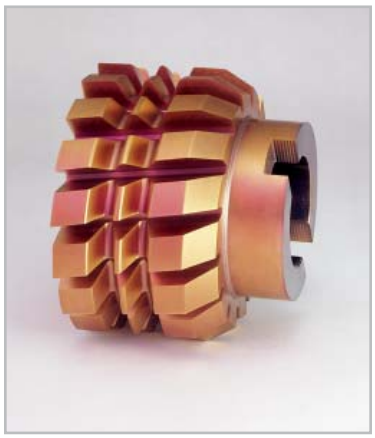
Saw Blade Milling Cutters for hack, band, or circular saw blades come in single or variable pitch, straight or tapered outside diameters, single cutters up to 13.5” long or interlocked sets, accurate unground or hard finished.

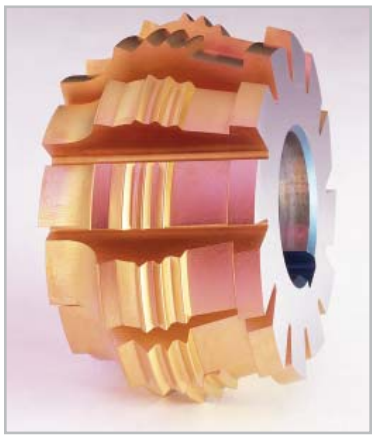
Multiple Thread Milling Cutters are of two basic designs, shell type and shank type. Both types are form relieved and may be sharpened by grinding the straight or spiral gash of the cutter, without changing their forms. Both types can be supplied with special thread forms, as well as standard straight,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

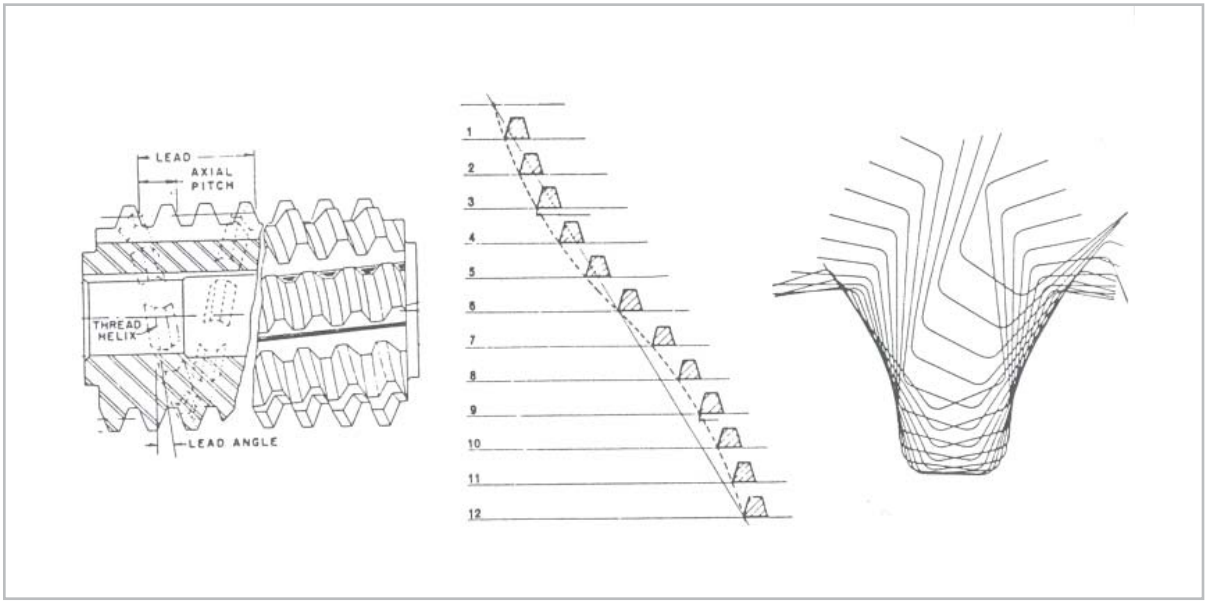



Figure 1. A single thread, 12 gash hob, in one revolution, envelopes a tooth space with a series of polygonal cuts.

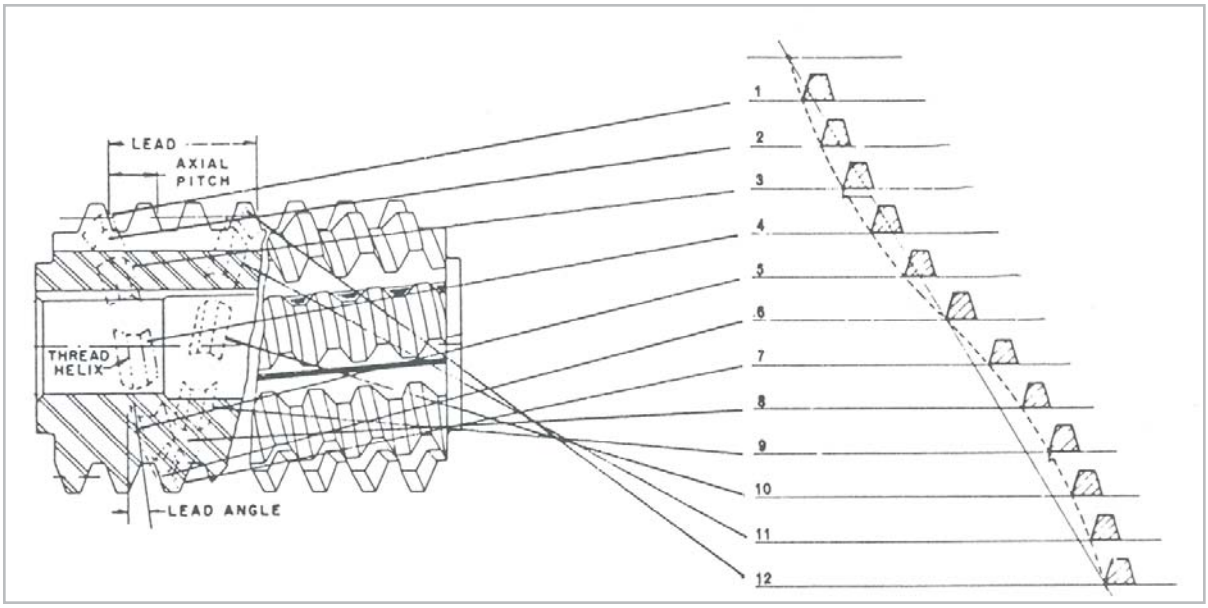



Figure 2. The unwound generating helix of a 12 gash single thread hob is shown here with a deviation of the cutting edges (dotted line = thread lead error) from the nominal (solid straight line).

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

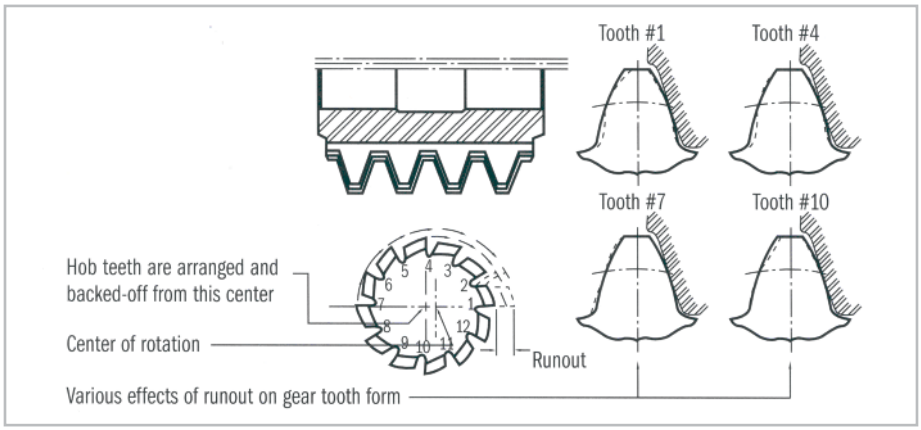



Figure 3. The effect of uniform runout over the entire hob.

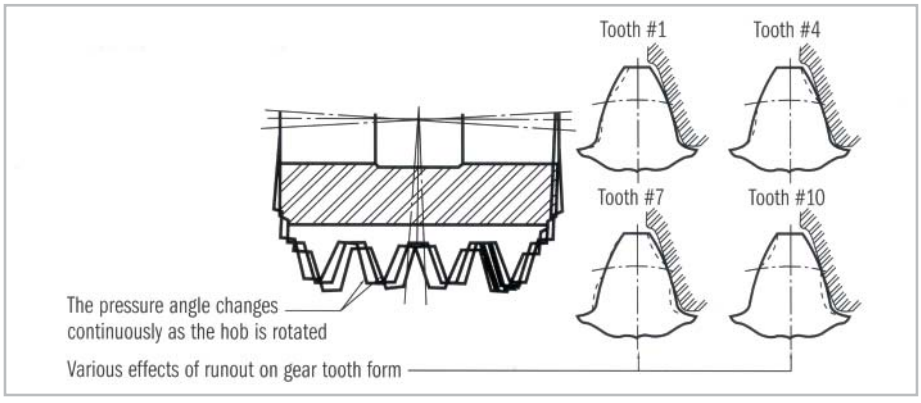



Figure 4. The effect of runout on each side of the hob 180° apart.

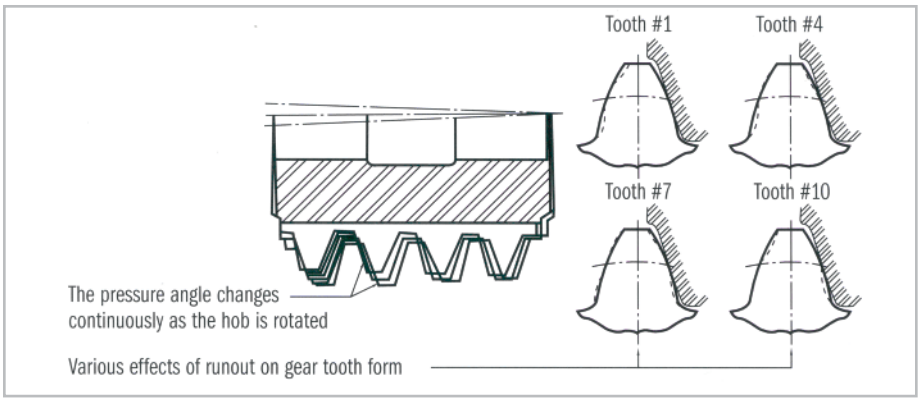



Figure 5. The effect of hob runout on one side of the hob only.

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)

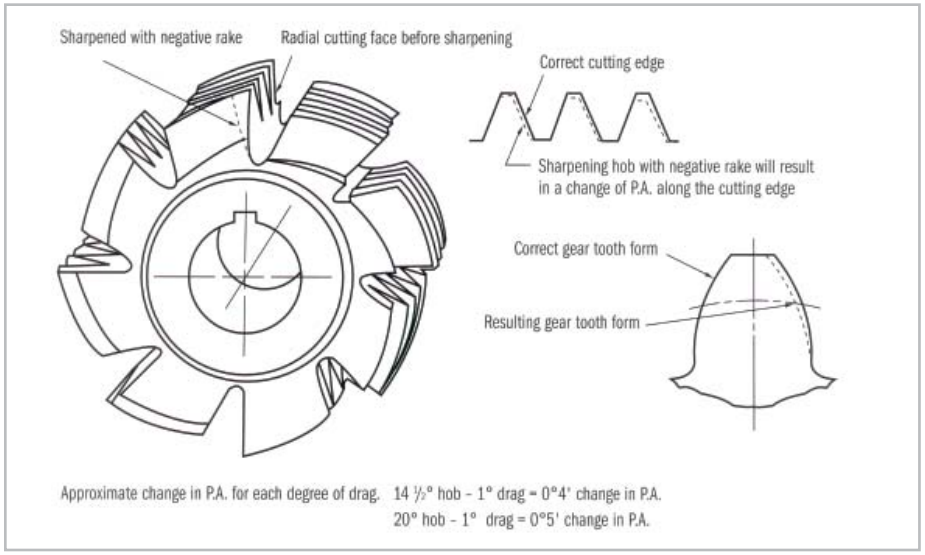



Figure 6. Effect on profile of a hob resharpened with negative rake when the cutting face should be sharpened radial.

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).

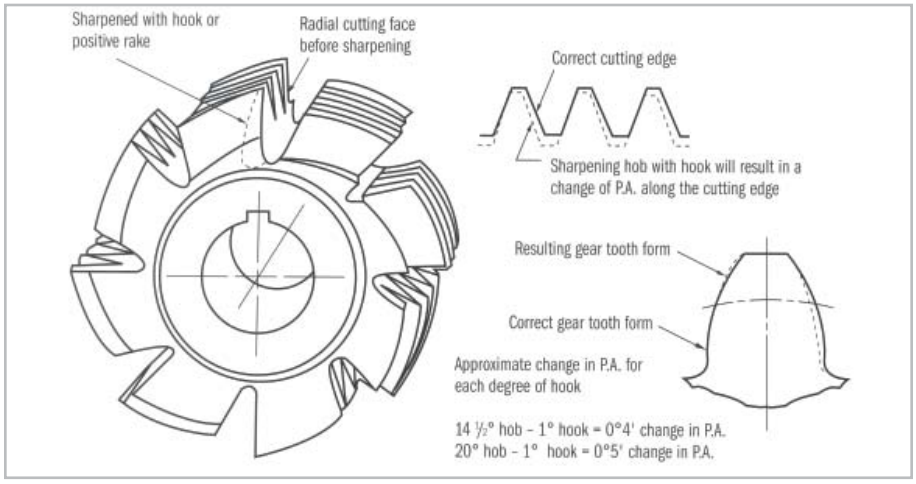



Figure 7. Effect on profile of a hob resharpened with positive rake when the cutting face should be sharpened radial.

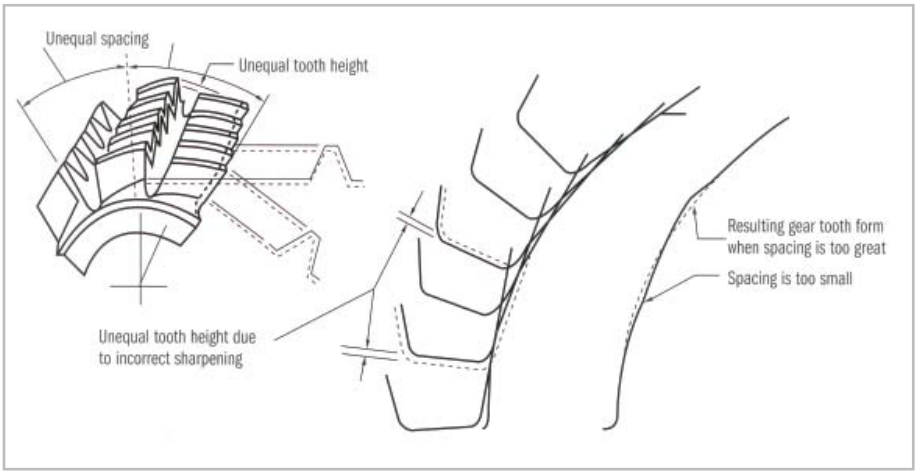



Figure 8. Effect on profile of a hob resharpened with cutting faces unequally spaced, creating accumulated flute spacing error.

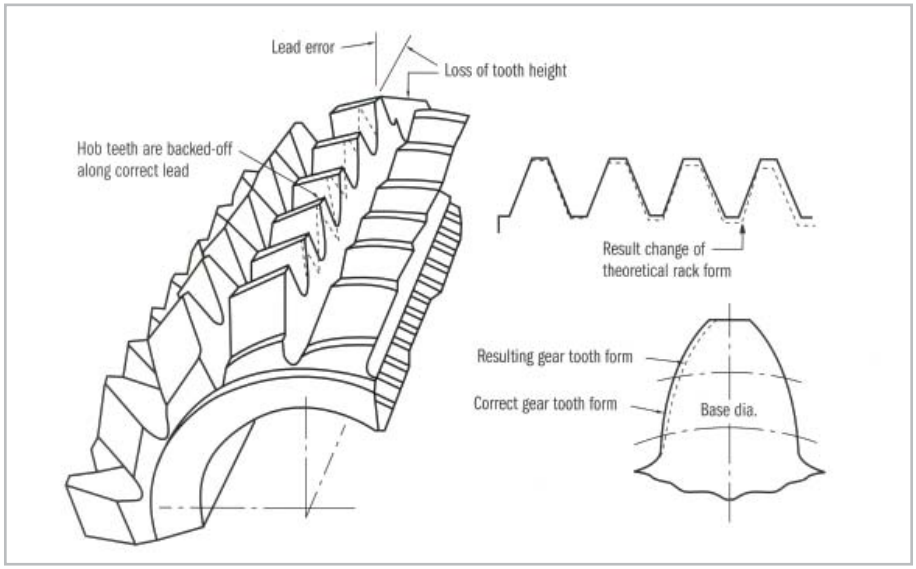



Figure 9. Effect on size of workpiece when hob is resharpened with the incorrect lead. The loss of tooth height from one end of the hob to the other results in a change of size on the workpiece as the hob is shifted across its usable life.

## 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 | |
| | C | 70 | 50 | 30 | 28 | 20 | 18 | 16 | 14 | 14 | 12 | 8 |
| 2-4 Thread | 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 | |
| | B | 180 | 150 | 130 | 120 | 100 | 90 | 80 | 70 | 45 | 35 | |
| 1 Thread | 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

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Star SU LLC, Hoffman Estates/Illinois




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# GEAR SHAPER CUTTERS

Disk type and shank type shaping
cutters for gear shapers

## DISC TYPE, SPUR AND HELICAL, INVOLUTE GEARS

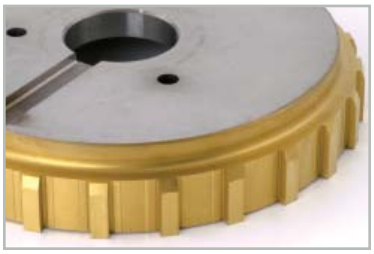
The most common body type of gear shaper cutters, in the form of a disk with a precision central mounting hole. Disc type cutters are made either with a shoulder or a flat back.

## DEEP COUNTERBORE

Similar in design to a disk type cutter, the deep counterbore has an increased height (or axial length). This design is typically made to “reach” a gear element without interfering with the fixture, or to keep the retaining nut nested behind the cutting face throughout the life of the cutter.

## TAPER SHANK TYPE

A shaper cutter designed with an integral taper or straight shank which mounts directly in the machine cutter spindle, or in an adaptor to the machine cutter spindle.



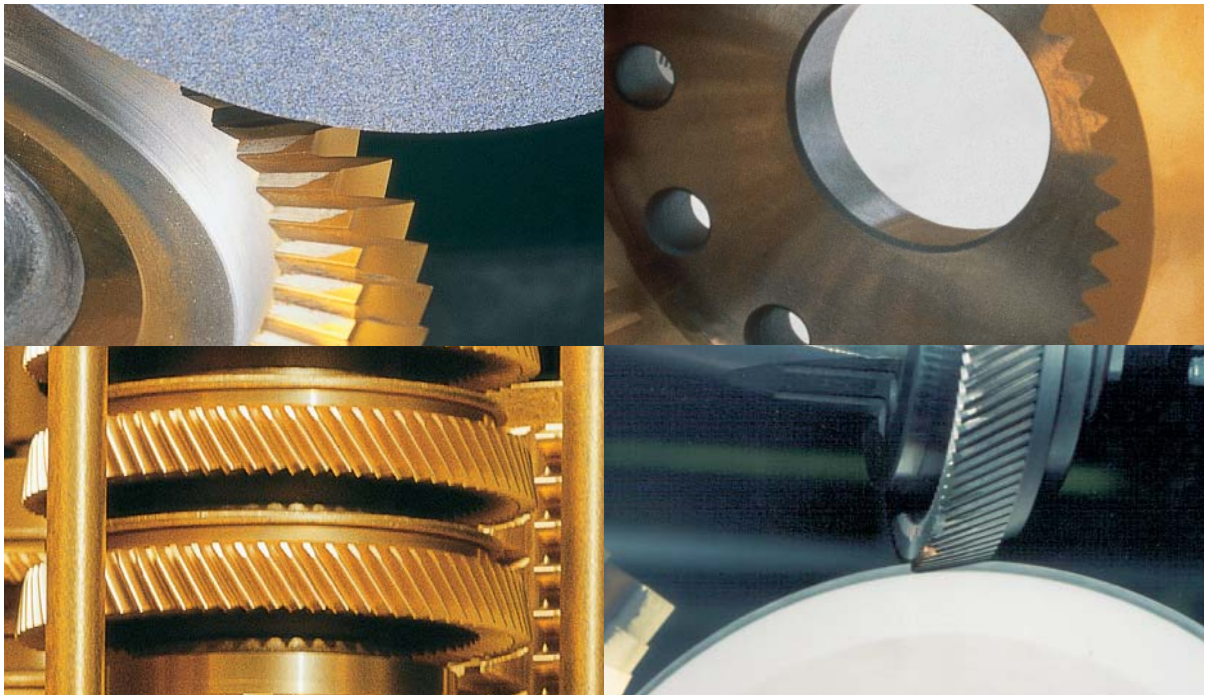
## NON INVOLUTE GENERATING

## INTERRUPTED TOOTH SPACING

## HELICAL TYPE

## HUB TYPE

A design style, usually offered between standard shank and disk cutter diameter sizes, that can be mounted to a machine cutter spindle having no taper hole without the use of an adapter.



## SHAPING THE FUTURE

Fellows gear shaper cutters have been available since the development of the first Fellows gear shaping machine by E. R. Fellows in 1896.

Fellows gear shaper cutters are now manufactured by Star SU, purchaser of the Fellows cutter division.

## UNIQUE DESIGN CAPABILITIES

Star SU offers a unique computer design capability by integrating Fellows rich cutter design experience in modern computer systems.

The system provides both customer and manufacturing data from a single input source reducing potential errors.

## COMPLETE SHAPING TECHNOLOGY SOLUTION

Star SU has partnered with Bourn & Koch, purchaser of the Fellows machine division assets, to provide complete gear shaping application solutions worldwide.

Star SU manufactures gear shaper cutters in the United States, Italy, France, and Brazil to better serve the market place.

## CUTTER TYPES

- Spur and helical, involute and non-involute
- Disc type
- Deep counterbore type

The above cutters are avilable in the following range of dimensions:

– Module (DP) range 0.5 - 8 mm (50 - 3.175")
– Min pitch diameter 20 mm (0.787")
– Max whole depth 19 mm (0.75")
– Max diameter 250 mm (9.84")

- Taper shank type

Available in four sizes:

| | |
|---|---|
| – 1.0625" | .6235" tp |
| – 0.700" | # 2 Morse |
| – 0.475" | # 1 Morse |
| – 0.250" | # 2 Jarno |

- Internal type
- Special cutters

For chain sprockets, cams, splines, timing gears and large module cutters

Star SU designs and manufactures special cutters for both involute and non-involute applications. Special cutters are available as precision ground cutters for finishing, pre-shaving, pre-grinding and roughing operations and as unground cutters for a variety of chain sprockets.

Our special cutters can be supplied with the following profile modifications:

– Chamfer or semi-topping
– Protuberance
– Modified flank for tip relief
– Modified pressure angle
– Full topping
– Combinations of modifications above

To order special cutters you may use the included order sheet

## MATERIALS

We offer many types of high speed steels from stock. Depending on the application, standard or premium grade material is used. Our most popular grades are:

- M4
- CPM Rex 45, 54 and 76
- T-15
- ASP-steels can be supplied on request.

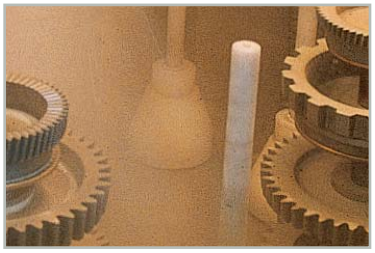
## COATING/STRIPPING/RECOATING SERVICES

Our Blazer coatings reduce abrasion and can increase corrosion resistance and tool life up to 5-10 times depending on the application.

- TiN
- TiCN
- TiAlN
- Other coatings can be supplied on request.

## RESHARPENING SERVICES

Our service centers in Michigan, Ohio, Illinois, South Carolina, and Saltillo provide you with what you really need: fast turnaround of high-precision sharpenings. In many areas pickup and delivery services are available.



GEAR SHAPER CUTTERS

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 SU Customer-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 cutter ☐ Disc ☐ Deep counterbore
☐ Shank* ☐ Internal**
☐ Special profile***

Diameter _____
Hole size _____
Type of keyway _____

*If shank cutter, specify ☐ Taper size ☐ Tapped hole
☐ Flange

**If internal cutter, specify _____
Face width _____
Clearance required for clamping fixture _____
Depth of recess, if teeth are recessed _____
below top surface of blank _____

***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

Specify special quality: _____

Material: ☐ M4 ☐ Rex45 ☐ Rex54
☐ Rex76 ☐ T-15
Other materials are available on request.

Coating: ☐ TiN ☐ TiCN ☐ TiAlN
Specify other coating: _____

Number of pieces: _____

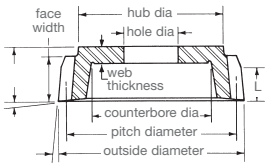
Remarks: _____

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

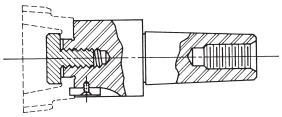
# DEFINE YOUR CUTTER REQUIREMENTS

## CUTTER TYPES

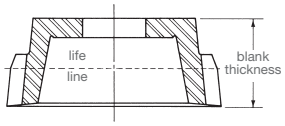
### DISC TYPE
The most common type, normally installed directly on the cutter spindle.



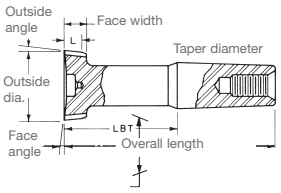

### DISC TYPE ON ADAPTER
Disc type cutters are also used on adapters, especially when the size required is between a disc and taper shank cutter.



### DEEP COUNTERBORE TYPE
Similar to disk type, except the blank thickness is increased to position the cutter holding nut or screw above the cutter's lifeline. Normally used for cutting internals, cluster or shoulder gears.




### TAPER SHANK TYPE
Generally used in cutting small pitch diameter internal parts. The cutter length below the taper must be adequate for the face width of the gear to be cut, plus the required overtravel at the bottom of the machine stroke and available life in the cutter. The workholding fixture or a recess of the gear teeth in the blank may require extra length. Taper shank type cutters are made in four taper sizes, as measured at the large end of the taper:

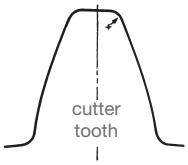



| Taper diameter | Taper type |
|---|---|
| 1.0625" | .6235" tpf |
| .700" | # 2 Morse |
| .475" | # 1 Morse |
| .250" | # 2 Jarno |

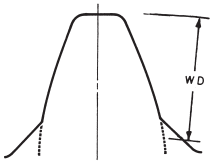
Pitch diameter of the cutter should approximate the diameter of the taper. Flutes can be added to long cutters of small pitch diameter to minimize deflection when cutting.

## PROFILE MODIFICATIONS
(SHAPER CUTTER TOOTH SHOWN)

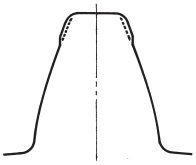
### CORNER RADIUS
Corners of cutter teeth are radiused to produce a controlled fillet in the root corners of the gear being generated - adds strength to gear and improves tool life.



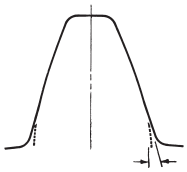

### CHAMFER OR SEMITOPPING
Root of cutter is filled in to generate a sharp corner break or chamfer on the tips of the gear - minimizes tip build-up during heat treatment due to nicks incurred during handling.



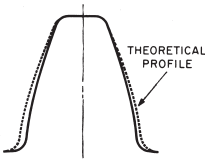

### PROTUBERANCE
Cutter tooth profile is built up on the cutter tip to provide an undercut near the root of the gear being generated - provides relief for subsequent finishing operations.



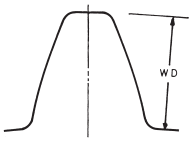
### MODIFIED FLANK FOR TIP RELIEF
Root of cutter is filled more gradually than chamfering cutter - removes a small amount of profile form tops of gear teeth - often desireable in high speed gears to minimize noise and tip bearing resulting from tooth deflection under loads.



### MODIFIED PRESSURE ANGLE
The cutter tooth profile is ground to a slightly lower pressure angle to provide for a constantly increasing amount of stock from root to tip of the gear generated - another method of providing relief for subsequent finsihing operations.




### FULL TOPPING
The cutter tooth is ground equal to the whole depth (WD) of the gear tooth. The outside diameter of the gear is "topped" to size when the teeth are cut.



GEAR SHAPER CUTTERS

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Hoffman Estates, IL 60192
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Tel.: 847 649 1450
Fax: 847 649 0112
sales@star-su.com

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23461 Industrial Park Drive
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Star SU LLC, Hoffman Estates/Illinois

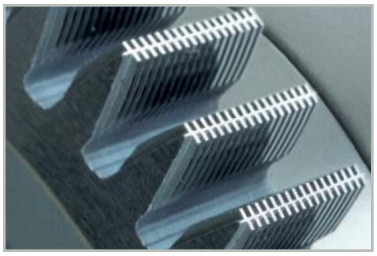


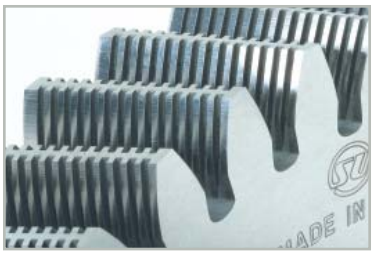

WWW.STAR-SU.COM

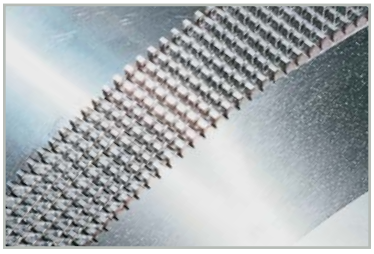
StarSU_GearShaperCutters_8-06

# GEAR SHAVING TOOLS

Gear shaving tools for finishing
pre-hobbed or pre-shaped gears







***From top to bottom:***
Shaving using the plunge method; Shaving using the transverse method; Shaving using the plunge method and a very small module cutter - a diagonal shaving cutter with lightening bores.

## TYPES OF SHAVING CUTTERS

As one of the largest producers of cutting tools worldwide and with particular expertise in shaving technology, we offer a wide range of shaving cutter types:

- Transverse
- Diagonal
- Diagonal-underpass
- Underpass
- Tangential
- Plunge
- Internal/external shaving
- Unground or finished shaving cutters

* All tools are supplied with inspection and lead test charts

## DIMENSIONS

- Module 0,7 - 10 mm*
- Max. width 65 mm
- Outside diameter 70 - 330 mm

*All shaving cutter serrations from 0.7 up to 0.99 are formed by turning.

## MATERIAL

It is possible to choose from different conventional HSS or powder steels.

- M2
- ASP 2023
- ASP 2030

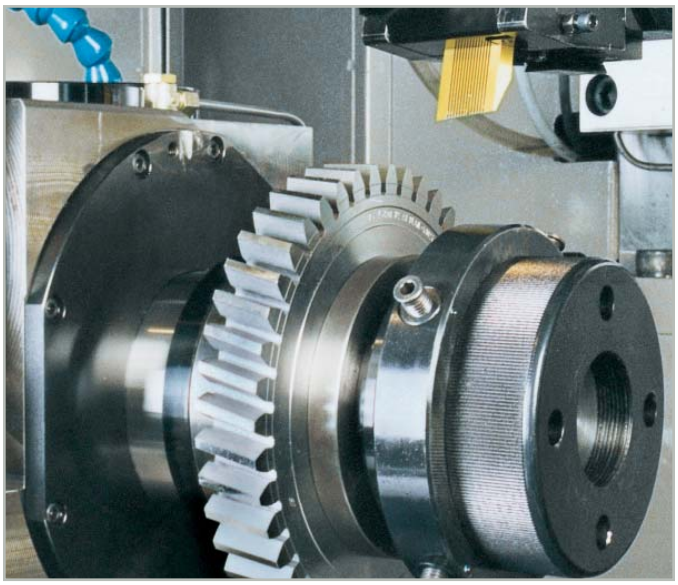
## SERVICE

From design to delivery, all processes are carried out in-house and Samputensili shaving cutters are manufactured on our own process machines.

Our service centers in Europe and the United States regrind all types of shaving cutters - regardless of who produces them - on the very latest grinding machines available.

In certain areas collection and delivery services are available. We can even offer complete CMS (Commodity Management System) solutions. We would be delighted to answer any specific questions on tool management or tool application parameters you may have.

## PRODUCTION TECHNOLOGY FROM SAMPUTENSILI



In 1949, Samputensili started the production of gear cutting tools. At that time, quality requirements were not satisfied by the production machinery available on the market. It was from this demand that Samputensili began developing its own manufacturing solutions for high precision gear tooling.

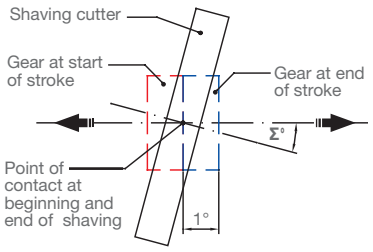
These production requirements led to many technological innovations, including our shaving technology which began in the early 1960's.

Today, the most critical operations in terms of quality are performed on Samputensili process machinery, which is now into its fourth generation of development. Samputensili also produces special production tooling in-house to guarantee high quality standards maintaining control of costs.

***From top to bottom:***
A Samputensili developed serrating machine is used to cut serrations on shaving cutters to the strictest tolerances.
The Samputensili S 400 GS shaving cutter and master gear profile grinding machine used as part of the production process and for tool resharpening.
Customers may purchase this machine to resharpen tools in-house. The machine is equipped with direct drive torque motors and an integrated on-machine measuring system.

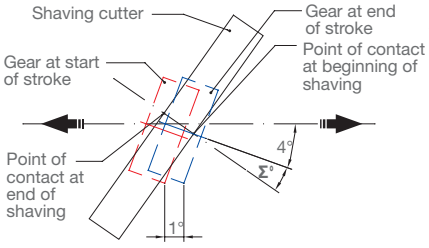
Samputensili serrating tools which are used on our serrating machines

## TRANSVERSE SHAVING



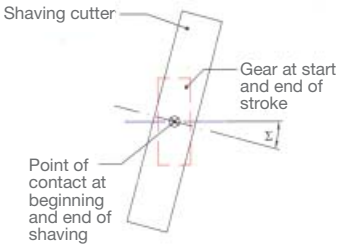

The gear to be shaved reciprocates in the direction of its own axis while the gear and the tool are in mesh. With each reciprocation, a small amount of radial feeding of the shaving cutter occurs. The theoretical table stroke is as long as the face width of the gear to be shaved, and it is recommended to calculate 1 extra stroke per module in order to guarantee clean shaving of the edges. As illustrated in the above figure, this method is unsuitable for shaving shoulder gears.

## DIAGONAL SHAVING



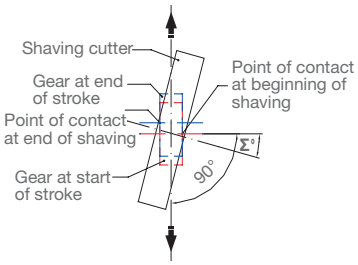

The gear to be shaved reciprocates obliquely in relation to its own axis while the gear and the tool are in mesh. The diagonal angle is achieved either by positioning the workpiece table obliquely or by interpolating two machine axes. With each reciprocation, radial feeding of the shaving cutter occurs. In general the diagonal angle can be between 0 and 40 degrees but should not be above 25 degrees for reasons of wear.

## PLUNGE SHAVING



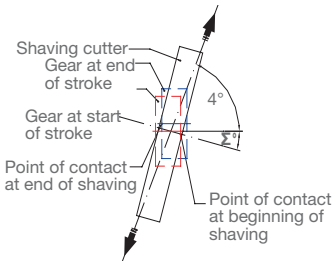

With this method there is no worktable translation but only a radial feed of the workpiece against the shaving cutter. The shaving cutter must be wider than the gear to be shaved, and the serrations of the shaving cutter must be in the form of a helix in order to produce the relative tooth flank feed. Plunge shaving is particularly suited to shaving shoulder gears. In this case, however, all tooth modifications must be made to the shaving cutter, as it will not be possible to realise them through axial movements on the machine.

## UNDERPASS SHAVING



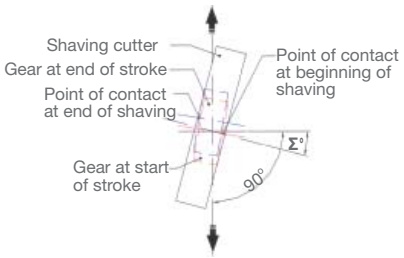

Underpass shaving is basically the same as diagonal shaving but with a diagonal angle of 90 degrees. With underpass shaving there is no axial table reciprocation. Instead, the workpiece reciprocates perpendicularly to its own axis. The shaving cutter must be wider than the gear to be shaved and its serrations must be placed on a helix. All tooth corrections must be made to the shaving cutter, as it will not be possible to realize them through axial movements on the machine.

## DIAGONAL-UNDERPASS SHAVING(*)




Diagonal-Underpass shaving is diagonal shaving but with a very large oblique angle. With each reciprocation radial feeding of the shaving cutter occurs. The oblique angle is in general between 40 and 90 degrees. Since the oblique angle may be very large, this method is also suitable for shaving shoulder gears, but it is important to use shaving cutters with similar characteristics to plunge-type shaving cutters.

## TANGENTIAL SHAVING (*)




With tangential shaving the oblique angle is between 60 and 90 degrees. The table stroke is in the direction of a tangent. The shaving cutter must be wider than the gear to be shaved and its serrations must be placed on a helix in order to produce the relative tooth flank feed. Furthermore, all tooth modifications must be made to the shaving cutter, as it will not be possible to realize them through axial movements on the machine.

*(*) these shaving methods are only application variants but are particularly used in the automotive industry.*

# FAX QUOTE/ORDER FORM

Customer No: _____
First/last name: _____
Company: _____
Department: _____
Tel: _____
Fax: _____
E-mail: _____
☐ Inquiry ☐ Order

SU-ID-No. : _____
Workpiece drawing no: _____
Tool drawing no: _____
Shaving method:
☐ Transverse
☐ Diagonal
☐ Diagonal-Underpass
☐ Tangential
☐ Plunge

Shaving cutter type:
☐ For external gears
☐ For internal gears

Shaving cutter data
No. of teeth: _____
Normal module: _____
Pressure angle: _____
Helix angle: _____
Direction of helix: ☐ Right ☐ Left
Width _____

Workpiece data
No. of teeth _____
Normal module: _____
Pressure angle: _____
Helix angle: _____
Direction of helix: ☐ Right ☐ Left
Outside diameter: _____
Width: _____

For shoulder gears
Shoulder diameter: _____
Distance from gear: _____

Tool clamping
Bore ☐ Ø 63,50 ☐ Ø 100,00
☐ Other _____
☐ Longitudinal keyway
DIN138 ☐ Centering hole
Hole diameter: _____
Hole centre distance: _____

Orders without drawing
Outside diameter: _____
Root diameter: _____
Tooth depth: _____
Start of active profile: _____
End of active profile: _____

Pre-shaving tool data
Start of active profile: _____
End of active profile: _____
Start of root radius: _____
Start of undercut: _____

Quality:
☐ Unground
☐ Finished
☐ Involute unground
☐ Outside diam. unground

Material (High alloy ASP-Steels):
☐ M 2 (HSS-E)
☐ ASP 23 (PM)
☐ ASP 30 (PM)
☐ Other _____

Quantity:
☐ 1 piece ☐ 2 pieces
☐ 3 pieces ☐ 4 pieces
☐ 5 pieces ____ pieces

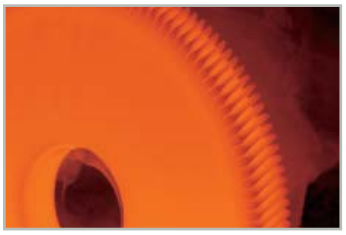
Remarks: _____

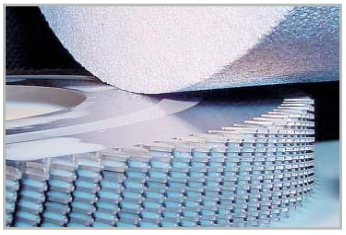
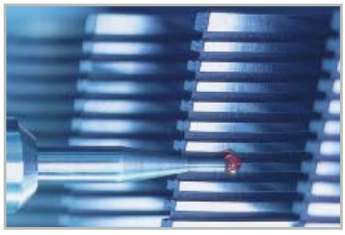
Please send the completed form to:
Fax: 847-649-0112
Tel: 847-649-1450 E-mail: sales@star-su.com









## CERTIFIED EFFICIENCY

At Star SU, we produce shaving production machinery at above average speeds, with high precision and quality standards. All steps in the production process, from the cutting of the base cylinder to final quality inspection are optimized. The strict compliane with our precise, and well- defined, quality system is guaranteed by UNI EN ISO 9001 quality certification, which we have held since 1996.

***Photos to left:***
A wide range of materials are available at all times - cutting base cylinder to size

Turning of a shaving cutter body

Engraving shaving cutter data

Pre-milling of teeth

Quality checks after each process - complete shaving cutter geometry inspection

Serration of shaving cutter grooves

Hardening of a shaving cutter in salt baths to minimize distortion

Bore and face grinding

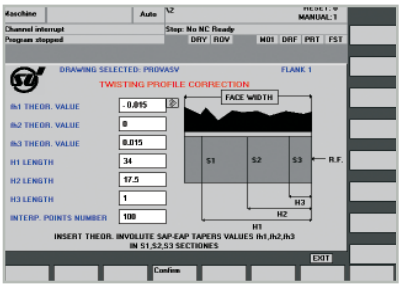
Final quality inspection

***Below:***
A book about gear shaving

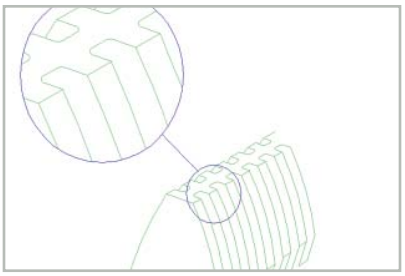
## DESIGN AND SERVICE

1.

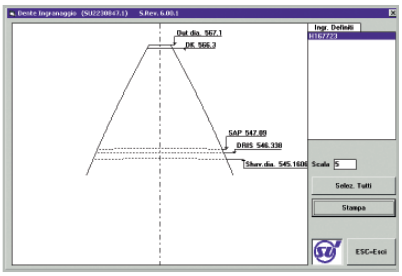
2.




3..



4.




1. Star SU software for the design and optimization of shaving cutter applications
2. Samputensili software for twisting profile corrections on Samputensili shaving cutter grinding machines
3. Samputensili software for the design and optimization of serration positioning
4. Samputensili post shaving gear simulation software

## STAR SU SOFTWARE SOLUTIONS ARE THE CORNERSTONE OF OUR MISSION TO PROVIDE GOOD SERVICE

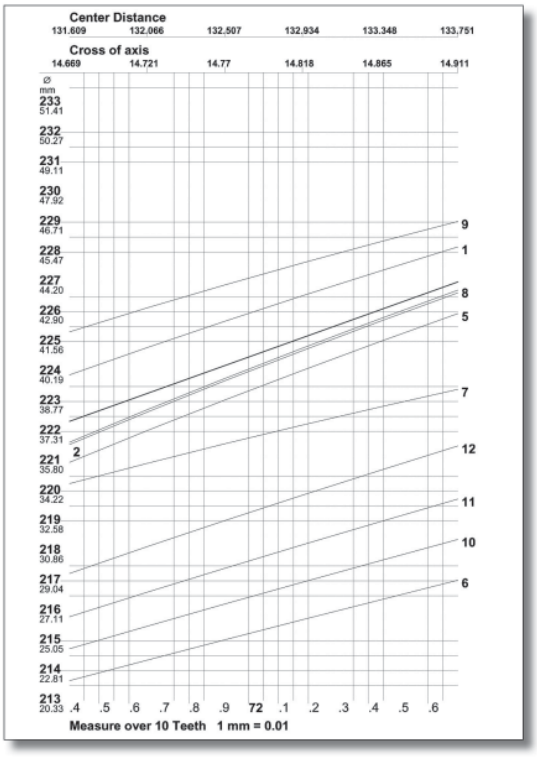
Tool design and optimzation are based on decades of experience of our shaving cutter design engineers. Unique software developments implemented on our shaving cutter grinding machine, combined with our test programs, means highly precise and efficient re-sharpening of your tools.

## WOULD YOU LIKE TO RESHARPEN YOUR OWN TOOLS?

No problem. Samputensili delivers each tool with a user-friendly resharpening diagram, enabling you to monitor the life cycle of your tool and directly control the resharpening process, provided you have the right equipment for this high quality process.

Our expert engineers are always ready to support you with assistance or advice. For those customers who would rather take advantage of our wide range of tooling services, we can guarantee the highest possible quality standards of resharpening using modern Samputensili grinding machines.

1. Points that touch the root diameter of the gear
2. Points that touch the root radius of the gear
3. Points that produce the start of the undercut after shaving
4. Points that produce the start of the undercut after milling
5. Points that generate the start of the active profile (SAP)
6. Points that generate the end of the active profile (EAP)
7. Lines of even contact 4-2-4
8. Lines of even contact 4-4-4-4
9. Lines of even contact 6-4-6-4-6



GEAR SHAVING TOOLS

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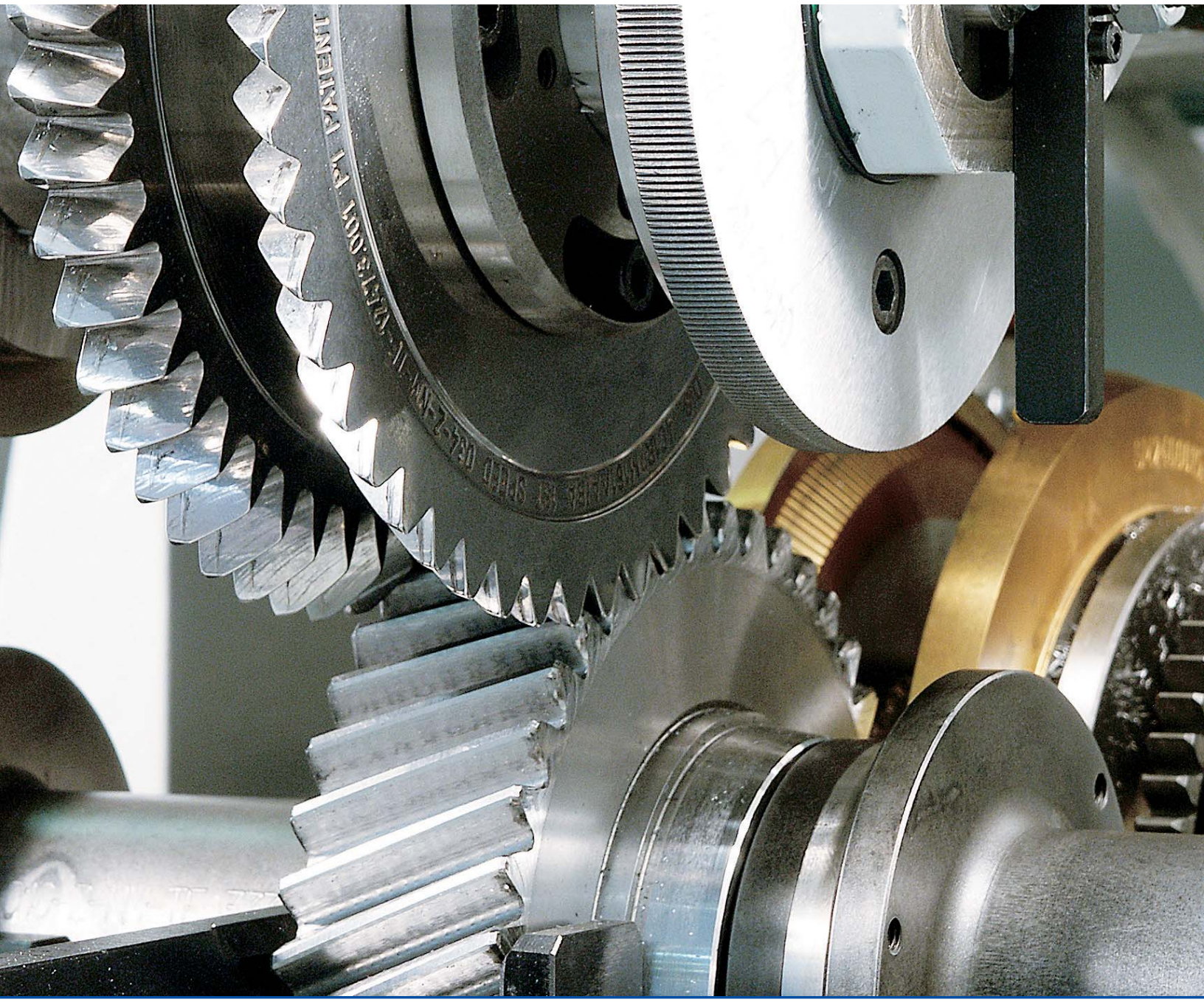
# GEAR CHAMFER & DEBURRING TOOLS



Tools for high production gear deburring,
chamfering, and roll chamfering

## CALCULATING THE PROFILE AND TECHNICAL ASSISTANCE

Software solutions developed in collaboration with leading technical institutes enable us to design any chamfering and deburring tool quickly and reliably. Your individual production requirements are analyzed thoroughly to provide you with the best manufacturing solutions possible.

## CHAMFERING, DEBURRING AND CHAMFER-ROLLER TOOLS

From left to right:
A 1000 type deburring tool
P type deburring tool
PR type deburring tool
PR 1000 type deburring tool
P and T 1000 type deburring tools
SPR 1000 type deburring tool

### CHAMFERING TOOLS

- for spur or helical gears
- for straight or inclined gear lateral surfaces

### DEBURRING TOOLS

- P type (standard tool for straight gear lateral surfaces)
- P 1000 type (like P type but grooved)
- PR type (with alternate sections for straight gear lateral surfaces radiused to the root)
- PR 1000 type (grooved tool fostraight gear lateral surfaces radiused to the root)
- A 1000 type (grooved tool for inclined gear lateral surfaces)
- AR 1000 type (same as A 1000 type but radiused to the root)
- SPR 1000 type (special tool for chain sprockets)
- T 1000 (grooved tool for chamfering turning chamfers on the tooth tip)

### CHAMFER-ROLLER TOOLS

- to machine the gear tooth profile
- to remove the secondary burr

Workpiece after hobbing

Workpiece after chamfering and deburring

## WHY CHAMFER AND DEBURR?

- a burr which is not removed may break off during machining and lead to damage of bearings or gears in gearboxes.
- over-carbonizing may also result in too much pressure being exerted on the sharp gear lateral surfaces and therefore in potential breakage.
- a hardened burr may, in the event of a subsequent finishing operation, lead to premature wear of the tool. Removing the burr, however, prolongs the life of the finishing tool significantly.
- removal of very sharp burrs reduces the risk of injury when handling tools.

### BASIC TYPES OF CHAMFERS

Parallel chamfer of both flanks and of the root radius

Comma type chamfer of both flanks without chamfering of the root radius

Chamfering of one flank without chamfering of the root radius

Comma type chamfering of both flanks and of the root radius

| FINISHING OPTIONS | SOLUTIONS |
|---|---|
| None (finish hobbed or shaped) | Chamferring/ deburring |
| Shaving | Chamferring/ deburring |
| Grinding with ceramic form wheels/worm wheels | Chamfer-rolling and deburring (recommended) or just chamfering and deburring |
| Grinding with CBN form wheels/ worm wheels | Chamfer-rolling and deburring |
| Honing | Chamfer-rolling and deburring |

## POSSIBLE COMBINATIONS

### CHAMFERING AND DEBURRING

- use of two tool heads
- subsequent operation: shaving or profile grinding

### CHAMFERING AND DEBURRING AND ROLLING

- use of three tool heads, one for each single tool
- rolling tool used as a third single tool with surface contact between rolling tool and workpiece flank.
- subsequent operation – Continuous generating grinding, shave grinding

### CHAMFERING & DEBURRING AND ROLLING

- use of two tool heads, chamfer-deburring tool on one tool head and rolling tool on a second tool head.
- subsequent operation – Continuous generating grinding, shave grinding
- requirements: without step, no use of any 1000 type deburring tools

### CHAMFERING & DEBURRING

- monoblock solution
- use of one tool head mounted with a combined chamfer-deburring tool
- requirements: without step, no use of any 1000 type deburring tools
- subsequent operation: shaving or profile grinding

### CHAMFERING & ROLLING & DEBURRING

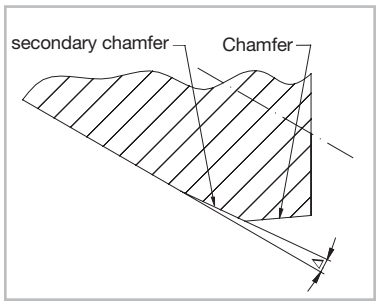
- use of two tool heads, chamfering tool with integrated rolling tool on one tool head and deburring tool on a second tool head.
- subsequent operation – Continuous generating grinding, shave grinding

### CHAMFERING & DEBURRING & ROLLING

- monoblock solution
- use of one tool head mounted with a chamfer-roller tool with a combined deburring tool.
- requirements: without step, no use of any 1000 type deburring tools
- subsequent operation – Continuous generating grinding, shave grinding

Set of rolling tools on one toll head

## COMBINED CHAMFER-ROLLER TOOL




Rolling is performed by a localized “leveling out” action which may be described as a second chamfer with a chamfering angle D of about 1°cartridge inventories.

With the patented Samputensili chamfer-roller tool, you can chamfer and roll your gears at the same time. The secondary burr that is generated during chamfering is consequently removed in the very same operation.

By combining both processes, the machine utilizes just one tool head leaving the second tool head free for another operation.

For workpieces
- with parallel chamfers
- with comma type chamfers
- without any step

## CHAIN SPROCKET DEBURRING AND ROLLING TOOLS

Machining a chain sprocket

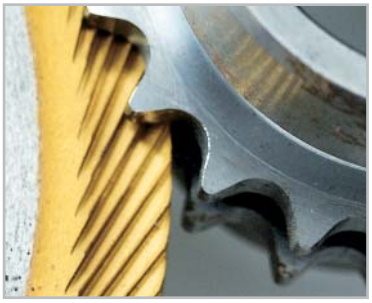
### CHAIN SPROCKET DEBURRING TOOLS

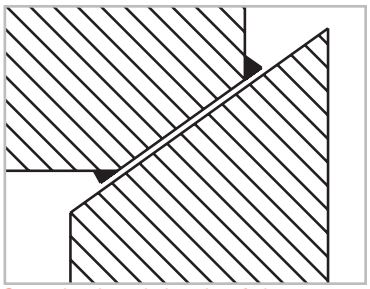
Developed exclusively to deburr chain sprockets, the specially adapted form of the SPR 1000 type has exactly the same profile as the flank radius of the gear tooth, and therefore removes the formation of burrs on the lateral surfaces of the gear teeth.

### CHAIN SPROCKET ROLLER TOOLS

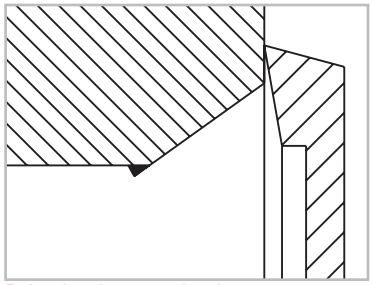
The form of chain sprocket roller tools also has exactly the same profile as the gear tooth profile. The special tapered form of the tool tooth prevents the build-up of material along the gear tooth profile, which can form during the contemporary deburring operation.

These tools are ideal for Samputensili chamfering machines with motorized tool heads but they can be used on any standard chamfering machine without difficulty, as a pair of driving gears is used to vary the rotation speed of the tools compared to that of the workpiece.

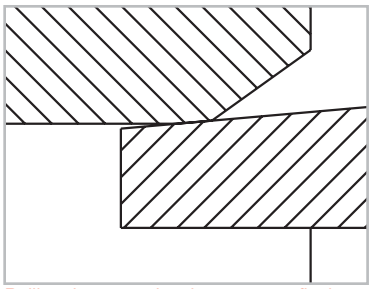




Secondary burr during chamfering



Deburring the secondary burr on gear lateral surfaces



Rolling the secondary burr on gear flanks

## WHY ROLL?

The buildup of material during chamfering on the gear lateral surfaces is removed during the deburr operation. The rolling operation, on the other hand, serves to remove the buildup of material on the tooth flanks (secondary burr) which is caused by plastic deformation during chamfering.

## PROBLEMS IN SUBSEQUENT OPERATIONS

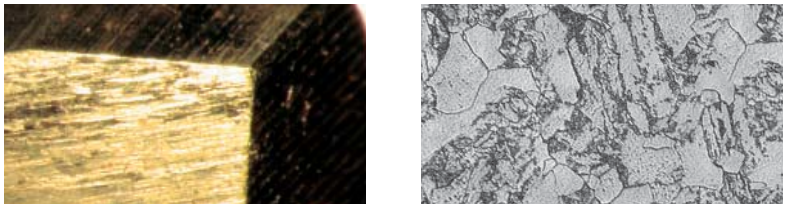
As a rule, burrs which are larger than 0.05 to 0.07 mm can create problems during subsequent phases of production, leading to shorter tool life and often the tool itself may be endangered. In this case, a rolling operation is strongly recommended and is at times crucial.

## HEAT DEFORMATION = HARDENING CREVICES?

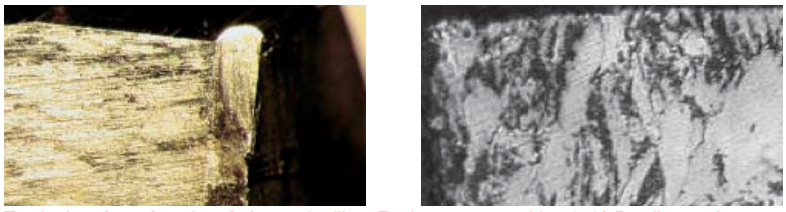
If tools are chamfered and rolled when they are soft, a change in structure, in the form of compression, may occur. The leveling out of the secondary burr during rolling causes the material to sink.

Our research shows that hardening crevices do not appear after heat deformation.

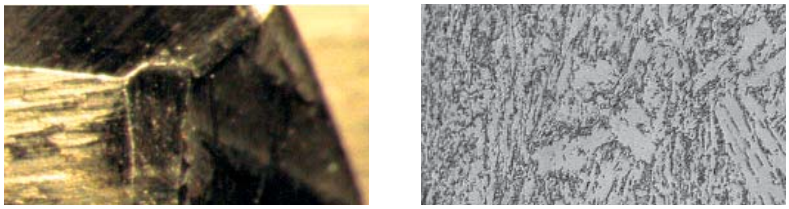
After heat treatment, no crevices form in the rolled zone and the structure of material is normal, according to the properties of the steel itself.



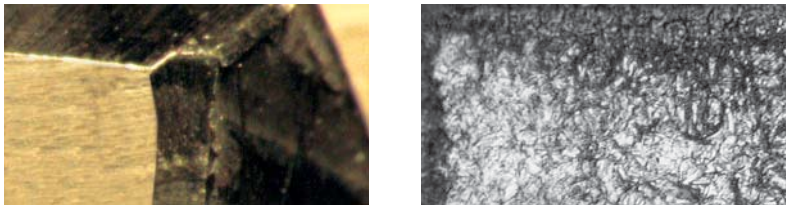
Not heat treated, 2% Nital tested, Ferrite structure with a 25% Pearlite portion



Tooth chamfers after chamfering and rolling, Ferrite structure with a 25% Pearlite portion, compressed due to the pressure exerted by the chamfering tool



Tooth chamfering after chamfer, Nital tested, Ferrite structure with a 25% Pearlite portion, compressed due to the pressure exerted by the chamfering tool



Tooth chamfers after chamfering, rolling and hardening, Nital tested, martensitic structure with a 6-7% austenitic portion

## CERTIFIED EFFICIENCY

FROM LEFT TO RIGHT:

1. Designing a tool with CAD systems to customer specifications.

2. Sawing a base cylinder according to the specifications of our engineering team on CNC machinery.

3. Turning of the profile and bore to the strictest tolerances in order to guarantee the best possible quality of subsequent operations.

4. Engraving tool data which is necessary to constantly monitor the tool throughout the production cycle.

5. Milling on CNC machinery.

6. Hardening in salt baths to prevent deformation. P type deburring tools normally have a hardness level from 64-65 HRC.

Higher hardness levels are obtainable for all tools. The hardness level for chamfering tools is usually around 61-62 HRC.

7. and 8. High precision bore and face grinding. The accuracy of the subsequent profile grinding may be strongly influenced by how the tool is clamped.

9. Grinding of each flank of a special profile on Samputensili developed process machinery.

10. “Super-Finishing” of the sharp tooth flank edges. The very fine rounding off of tooth flank edges prolongs the actual life of the tool as the force exerted on the tooth face is more evenly distributed. Also this operation significantly reduces risk of injury when handling tools.

11. Continuous quality inspection throughout the whole manufacturing cycle.

12. All deburring tool types have a standard TiN coating. Chamfer-roller tools do not actually perform any cutting operation and therefore do not require any coating as a rule.

13. Tools ready for dispatch.

1


2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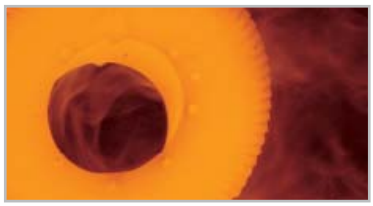

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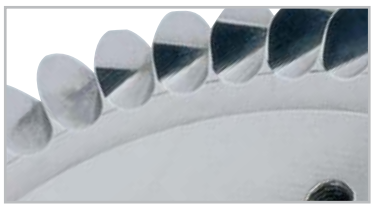

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12



13


DIVISIONE UTENSILI E SERVIZI
BVQI
SINCERT
UNI EN ISO 9001
TOOLS AND SERVICE DIVISIONS

# FAX QUOTE/ORDER FORM

Customer No: _____

First/last name: _____

Company: _____

Department: _____

Tel: _____

Fax: _____

E-mail: _____

☐ Inquiry ☐ Order

SU-ID-No. : _____

Workpiece drawing no: _____

Tool drawing no: _____

Tool Type:
- ☐ Chamfering tool
- ☐ Chamfer-roller tooll
- ☐ Rolling tool
- ☐ Deburring tool
- ☐ Chain sprocket rolling tool
- ☐ Chain sprocket deburring tool

Workpiece data

No. of teeth ($z_2$): _____

Normal module ($mn_2$): _____

Pitch*: _____

Roller diameter*: _____

* only for chain sprockets

Pressure angle (a): _____

Helix angle ($ß_2$): _____

Direction of helix: ☐ Right ☐ Left

Outside diameter ($da_2$): _____

Root Diameter ($df_2$) _____

Data refers to*:
- ☐ Pre-finishing operation
- ☐ Finishing operation

*Tooth width (W): _____

Measured n° of teeth: _____

*Dim. between rollers: _____

Roller-Ø: _____

*Dim. between balls: _____

Ball-Ø: _____

Usable root -Ø( dnf): _____

Workpiece finishing:
- ☐ None (hobbed only)
- ☐ Shaving
- ☐ Grinding (CBN)
- ☐ Grinding (ceramic)
- ☐ Honing (CBN)
- ☐ Honing (ceramic)

Please also provide the following:

Geometric drawing of the turned workpiece with indication of desired chamfers ☐ Drawing attached

Profile and helix angle corrections to be made during roughing ☐ Drawing attached ☐ Table attached

For Samputensili Chamfering and deburring machines:

Machine type: _____

Machine model: _____

Serial-No. (necessary!):

For chamfering and deburring machines of other manufacturers: workpiece clamping with current too set-up ☐ Drawing attached

Axial position: min. _____

max. _____

Piece or set: ☐ Piece ☐ Set (2 Pieces)

☐ 1 ☐ 2
☐ 3 ☐ 4
☐ 5 ☐ ____

Remarks: _____

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

GEAR CHAMFER & DEBURRING TOOLS

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WWW.STAR-SU.COM

StarSU_GearChamfer&DeburringTools_8-06

# STAR GUNDRILLS

Star Gundrills for
precision hole making

## SINGLE FLUTE GUNDRILL

The Single Flute Gundrill, with its ability to machine very straight deep holes and hold excellent finishes, was originally developed for gun barrel manufacturing. Today, this tool is a general purpose drill designed for deep hole drilling in virtually any material. The gundrill requires high-pressure coolant through the tool, keeping the cutting edges lubricated, and allowing for adequate chip evacuation down the flute channel.

Star Single Flute Gundrill product line diameter range is .078" [1.98mm] through 1.5" [38.10mm] as a solid carbide head. Larger diameter tools are available using a brazed inserted blade design. All gundrills can be made to any specific length. Lengths over 72" [1828mm] will have an additional weld joint in the body of the tool.

The gundrill is designed to drill holes from the solid, obtain bottom hole configurations and assist in burr-free intersections. The gundrill can achieve precision holes in one pass, eliminating the need for secondary passes, and is a tool for consistent hole-to-hole reproduction.

This tool is unique in its limitations, for machining deep holes are limited to the flute length not the depth of the cut. The design of the Single-Lip, straight deep “V” flutes and high coolant pressure allows for fast, consistent penetration without the need for pecking.

Since the point is not on center, the tool requires either a bushing or pilot hole. Once into the cut, the tool is self-piloting.

The additional advantages of the Single Flute gundrill are:

- Straightness tolerances of .001" [0.03mm] per foot
- Concentricity tolerances of .001" [0.03mm] per foot
- Finish hole diameters as good as +/- .0005" [0.013mm]

## DESIGN FEATURES OF THE SINGLE FLUTE GUNDRILL

Star has a wide range of contours/wear pads that gives the tool the burnishing effect needed to obtain the finish and hole size while controlling heat/friction for a given material. These features are strategically engineered per application down the outer diameter for the length of the carbide.

Point angles and clearances play an instrumental part in the equation. The proper selection and reproduction of geometry is crucial to its total overall performance. These angles and clearances can be modified to change the cutting performance results and also assist in modifying the high-pressure coolant for better chip flushing or reducing the heat of the cutting edges.

Every material has its own machinability characteristics. With five decades of design and manufacturing experience, Star’s gundrill engineering center allows designing the tool to custom fit each application.

***Star Single Flute Gundrill*** Used as a general-purpose tool in most drilling applications to obtain hole sized within .001", run-out requirements of .001" per inch, straightness of .001" per foot. This tool has a single flute, 3-piece construction design and has the deepest flute channel, enabling maximum chip evacuation. Diameters are available from .0781 - 1.5".

***Multi Step Gundrill*** Star step gundrills are used to produce concentric holes. They can be provided in many diameters and step lengths with a variety of forms on the steps. They are also used to cut a variety of materials. Consult engineering for the length of step and diameter ratio.

## DOUBLE JET GUNDRILLS

Star with its years of experience in gundrilling developed a Star original patented Double Jet Gundrill. The most critical interface in which the carbide is subjected to the most trauma, is during entry and exit of the part. This is caused by the lack of lubricity to the cutting edges. The double jet was designed to combat this type of condition with its unique placement of the coolant holes supplying adequate amounts of coolant to the cutting edge while entering and exiting the part.

Star's Double Jet product line diameter range is .20" [5.08 mm] through 1.5" [38.1mm]. The overall length can be made to any specific length. Lengths over 72" [1828mm] will have an additional weld joint in the body of the tool.

An additional advantage to this style gundrill is its ability to break through intersecting holes and/or enter irregular surfaces without premature wear. The unique coolant hole location also assists in kick off burrs that can occur during break through. As with all gundrills, straightness, concentricity, size and finishes are obtained.

***Star Double Jet Gundrill*** A unique Star Cutter design used on interrupted cut applications when coolant is lost during breakout or intersecting holes. This tool allows coolant to be directed on the cutting edge, thus lubricating the corner of the tool and reducing the rubbing forces. Diameters are available from .20" - 1.5."

## SOLID CARBIDE SINGLE FLUTE GUNDRILL

Solid Carbide gundrills have a two-piece construction design. The tip and body are a single piece of carbide brazed into the driver/shank and the flute is ground down the length of the head and body. The absence of the braze joint at the head/body transition eliminates the possibility of coolant obstructions while adding significant strength to the tool.

Solid Carbide gundrills are available from diameter ranges of .055" [1.40mm] to .20" [4.75mm] with lengths up to 12" [305mm]. Larger sizes are achievable upon special request.

The greatest benefit of this type of tool is its rigidity. When a tool enters material, as well as while its drilling, it is exposed to torque forces, or wind-up. This has a detrimental effect on the carbide, resulting in premature wear. The Solid Carbide gundrill strength resists the wind-up forces.

Another advantage of two-piece Solid Carbide gundrill versus the traditional three-piece construction gundrill is the ability to run at much higher feed rates. Many applications yield to high surface footage with conventional style grundrills. The strength of the Solid Carbide gundrill allows penetration at 100% to 200% higher feed rates running at conventional rpms.

### STANDARD SOLID CARBIDE GUNDRILL SIZE RANGE

| Diameter Range | Range of Overall Length of Flute |
|---|---|
| .055" [1.40mm] - .060" [1.52mm] | 4" [100mm] - 7" [178mm] |
| .061" [1.53mm] - .070" [1.78mm] | 4" [100mm] - 10" [254mm] |
| .071" [1.79mm] - .200" [5.08mm] | 4" [100mm] - 12" [305mm] |

***Star Solid Carbide Gundrill*** A two-piece construction design with the head and body consisting of one solid piece of carbide. Commonly used for high penetration rates where maximum tool life can be obtained. Diameters are available from .055" - .20". Lengths are available from 5" - 10".

## DOUBLE CRIMP STYLE GUNDRILL

The term Double Crimp is derived from the process of crimping the same tube used for the Single Flute gundrill, only crimping it twice, 180 degrees apart. Since flute channels on this type of tool are shallower than the single flute, chip sizes generated by the tool can limit the types of materials that can be used. The most common materials drilled are cast iron and cast aluminum. The Double Crimp has advantages. First, the coolant holes in the gundrill body are formed by the crimping action, minimizing the coolant turbulence at the head/body transition. Second, the flutes are equally swaged 180 degrees apart, allowing for much greater rigidity.

The Double Crimp gundrill can obtain feed rates twice that of its single flute partner. This is obtained by two cutting edges opposed to one another and by grinding geometry angles to precise dimensions. With the combinations of geometry, clearances and back taper, the chip load is reduced by 50% and higher penetration rates are obtained. Double Crimp gundrills are available in diameters from .1875" - .5625" with lengths of 72".

***Star Double Crimp Gundrill*** Used for high penetration in softer materials. Cast iron and aluminum are typical materials where the use of two cutting edges allows twice the penetration rate of the single flute design. Diameters available from .1875" - .5625". Lengths are available up to 72"

## TWO-FLUTE TWO-HOLE DRILL (2F2H) — “MILLED STYLE"

The rigidity of its body differentiates the Two-Flute Two-Hole gundrill from the Double Crimp gundrill. This tool is engineered with a solid steel body, milled flutes and coolant holes produced internally to allow for optimum coolant flow to the tip. The results yield a limited external chip channel and an incredibly rigid tool. Application dictated, this tool is used in operations that require maximum penetration rates. Like its counterpart, the Double Crimp gundrill, the Two-Flute Two-Hole gundrill’s geometries, clearances and back taper are critical to its success. The most common materials drilled are cast iron and some aluminum applications. Two-Flute Two-Hole gundrills are available in diameters from .25" - 2.0" with lengths to 48".

***Star Two-Flute Two-Hole Gundrill*** Like the Double Crimp gundrill, the Two-Flute Two-Hole gundrill is used for high penetration applications where chips are smaller in size. Diameters are available from .25" - 2.0". Lengths are available up to 48".

## BI-TIP DEEP HOLE TWO FLUTE MILLED STYLE HELICAL GUNDRILL

Similar to the Two-Flute Two-Hole “milled style” product line engineered with a solid steel body, the Bi-Tip has an auger-like helix ground in the body. This design allows for better chip evacuation in lower coolant pressure conditions.

This enhanced design also allows for higher feed rates and coolant volumes than our Star traditional design. This tool is designed for the machining of cast/ductile and CGI materials. The Bi-Tip deep hole drill is available in diameters ranging from .315" - 1.0" with maximum flute lengths up to 28".

***Star Bi-Tip Two-Flute Helical Deep Hole Drill*** Used for high penetration rates in machining of cast, ductile, and compacted graphite materials (CGI) irons. Diameters are available from .315” - 1.0” with maximum flute lengths up to 28.”

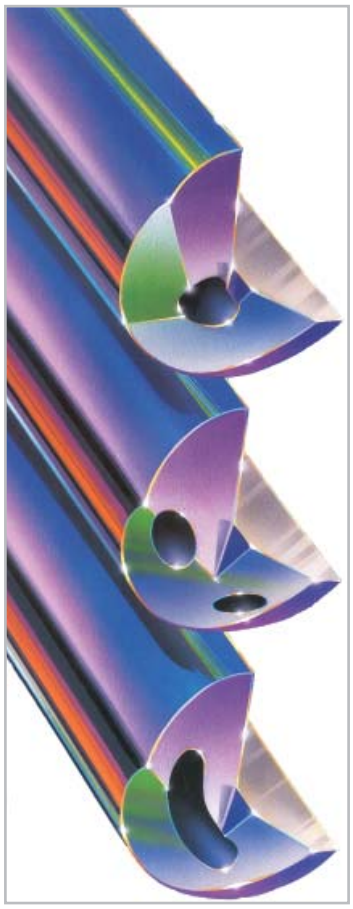
## SINGLE FLUTE GUNDRILL COOLANT HOLE CONFIGURATIONS

Star offers three different styles of coolant hole configurations:

1. Single hole - This style is used when the environment is in best conditions. This means that application has adequate pressures.

2. Dual hole configuration – This coolant hole design is recommended for cutting diameters .376" [9.54mm] and greater. This design allows for higher flows, assisting in better chip evacuation.

3. Kidney shaped hole – This style is recommended for cutting diameters under .375" [9.53mm]. Extruded shapes assist in achieving larger gallons per minute out of the front of the tool, thus allowing for better chip evacuation. This coolant hole configuration also can assist when lubricity is minimal.



## COOLANTS

Coolants that run at high pressure are a must in gundrilling. They are used for flushing chips down the flute channel of the tool, cooling the cutting edges and for lubricity. There are three types of coolants used — oil, semi-synthetic and water soluble.

Straight oil is the best type of coolant for tool life, having sulfur and chlorine in the mixture. Sulfur is used for an anti-weld, which helps eliminate buildup on the cutting edge. The chlorine is added to assist as a lubricant allowing for better chip evacuation.

Semi-synthetic coolant is a metal working fluid that is 5-50% mineral oils, water and synthetic chemicals. This coolant has environmental advantages over oil; however, its use can result in shorter tool life.

Water Soluble is a chemical solution that contains no mineral oils. This coolant requires a concentration level to be maintained in gundrilling. It is recommend to maintain this level between 8%-10%, using 10% as ideal condition.

Going from straight oil to water-soluble can cause a 30 to 50% reduction in tool life.

Note: Coolant temperature should be maintained below 120˚F.

## RECOMMENDED COOLANT PRESSURES

| Size (inches) | Size (mm) | PSI | Bar |
|---|---|---|---|
| .078-.155 | 1.98-3.94 | 1500 | 100 |
| .156-.186 | 3.95-4.72 | 1300 | 90 |
| .187-.217 | 4.73-5.51 | 1150 | 80 |
| .218-.249 | 5.52-6.32 | 1050 | 70 |
| .250-.311 | 6.33-8.00 | 925 | 60 |
| .312-.374 | 8.01-9.50 | 775 | 50 |
| .375-.436 | 9.51-11.07 | 675 | 45 |
| .437-.499 | 11.08-12.69 | 600 | 40 |
| .500-.561 | 12.70-14.25 | 525 | 35 |
| .562-.624 | 14.26-15.85 | 500 | 20 |
| .625-.686 | 15.86-17.45 | 450 | 30 |
| .687-.749 | 17.46-19.04 | 425 | 28 |
| .750-.874 | 19.05-22.20 | 400 | 26 |
| .875-.999 | 22.21-25.39 | 350 | 24 |
| 1.000 and up | 25.40 and up | 300 | 20 |

# GUNDRILL SPEEDS AND FEEDS

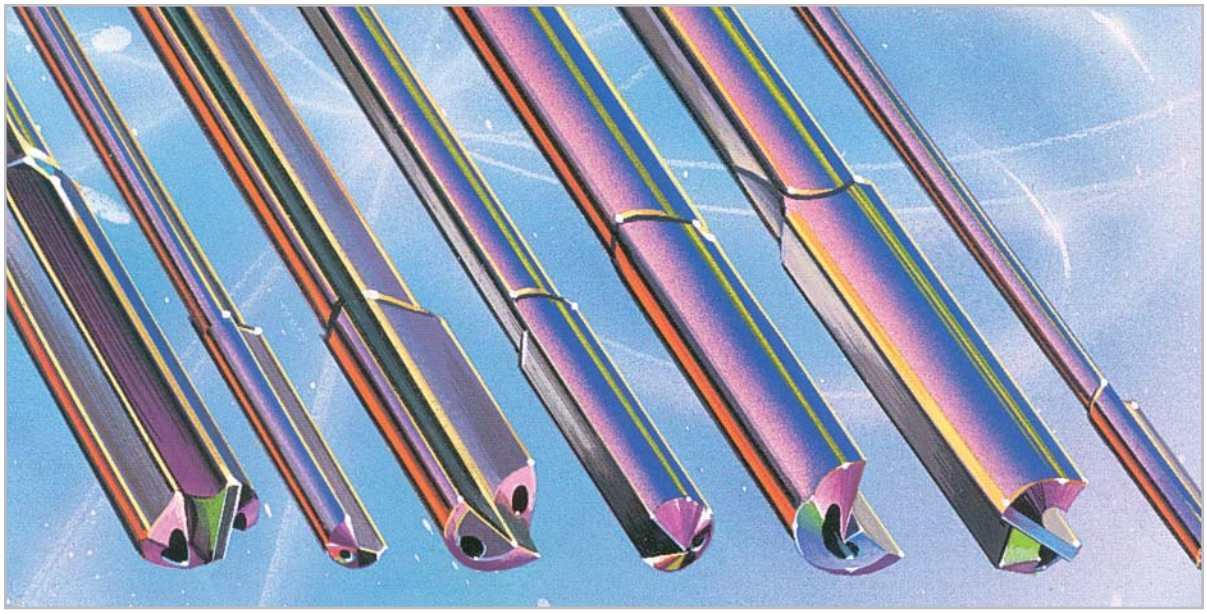
| | | IRON | | | | | | ALUMINUM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DIA | Pressure | Gray Cast | | | Ductile | | | Cast 308, 319, 383 | | | Heat Treated 356, 6061, 7075 | | |
| | | 200 SFM | | | 175 SFM | | | 600 SFM | | | 600 SFM | | |
| IN | PSI | RPM | IPR | IPM | RPM | IPR | IPM | RPM | IPR | IPM | RPM | IPR | IPM |
| 0.07840 | 1500 | 9,737 | 0.0002 | 1.9 | 8,520 | 0.0002 | 1.7 | 14,000 | 0.0002 | 2.8 | 14,000 | 0.0002 | 2.8 |
| 0.09370 | 1500 | 8,147 | 0.0003 | 2.4 | 7,128 | 0.0003 | 2.1 | 14,000 | 0.0003 | 4.2 | 14,000 | 0.0003 | 4.2 |
| 0.12500 | 1500 | 6,107 | 0.0005 | 3.1 | 5,344 | 0.0005 | 2.7 | 14,000 | 0.0006 | 8.4 | 14,000 | 0.0005 | 7.0 |
| 0.15620 | 1300 | 4,887 | 0.0007 | 3.4 | 4,276 | 0.0007 | 3.0 | 14,000 | 0.0009 | 12.7 | 14,000 | 0.0006 | 8.4 |
| 0.18750 | 1150 | 4,071 | 0.0009 | 3.7 | 3,562 | 0.0009 | 3.2 | 12,214 | 0.0012 | 14.7 | 12,214 | 0.0007 | 8.5 |
| 0.21870 | 1050 | 3,490 | 0.0012 | 4.2 | 3,054 | 0.0012 | 3.7 | 10,471 | 0.0015 | 15.7 | 10,471 | 0.0009 | 9.4 |
| 0.25000 | 925 | 3,053 | 0.0015 | 4.6 | 2,672 | 0.0015 | 4.0 | 9,160 | 0.0020 | 18.3 | 9,160 | 0.0010 | 9.2 |
| 0.31250 | 775 | 2,443 | 0.0018 | 4.4 | 2,137 | 0.0018 | 3.8 | 7,328 | 1.0025 | 18.3 | 7,328 | 0.0012 | 8.8 |
| 0.37500 | 675 | 2,036 | 0.0020 | 4.1 | 1,781 | 0.0020 | 3.6 | 6,107 | 0.0028 | 17.1 | 6,107 | 0.0014 | 8.5 |
| 0.43750 | 600 | 1,745 | 0.0023 | 4.0 | 1,527 | 0.0023 | 3.5 | 5,234 | 0.0032 | 16.8 | 5,234 | 1.0016 | 8.4 |
| 0.50000 | 525 | 1,527 | 0.0025 | 3.8 | 1,336 | 0.0025 | 3.3 | 4,580 | 0.0035 | 16.0 | 4,580 | 0.0018 | 8.2 |
| 0.56250 | 500 | 1,357 | 0.0028 | 3.8 | 1,187 | 0.0028 | 3.3 | 4,071 | 0.0037 | 15.1 | 4,071 | 0.0020 | 8.1 |
| 0.62500 | 450 | 1,221 | 0.0030 | 3.7 | 1,069 | 0.0030 | 3.2 | 3,664 | 0.0040 | 14.7 | 3,664 | 0.0022 | 8.1 |
| 0.68750 | 425 | 1,110 | 0.0033 | 3.7 | 972 | 0.0033 | 3.2 | 3,331 | 0.0043 | 14.3 | 3,331 | 0.0024 | 8.0 |
| 0.75000 | 400 | 1,018 | 0.0035 | 3.6 | 891 | 0.0035 | 3.1 | 3,053 | 0.0046 | 14.0 | 3,053 | 0.0026 | 7.9 |
| 0.87500 | 350 | 872 | 0.0040 | 3.5 | 763 | 0.0040 | 3.1 | 2,617 | 0.0050 | 13.1 | 2,617 | 0.0028 | 7.3 |
| 1.00000 | 300 | 763 | 0.0040 | 3.1 | 668 | 0.0040 | 2.7 | 2,290 | 0.0050 | 11.5 | 2,290 | 0.0030 | 6.9 |

RPM = SFM / (DIA x .262)  IPM = RPM x IPR
2 Flute 2 Hole Gundrills / Double Crimp Gundrills, Run at 2 x IPR

| STEEL | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DIA | Pressure | Carbon 1010, 1118, 1145 | | | Alloy 4140, 5120, 8620 | | | 17-4PH, 15-PH 300 Series | | | Stainless 400 Series | | |
| | | 350 SFM | | | 325 SFM | | | 225 SFM | | | 200 SFM | | |
| IN | PSI | RPM | IPR | IPM | RPM | IPR | IPM | RPM | IPR | IPM | RPM | IPR | IPM |
| 0.0740 | 1500 | 14,000 | 0.00015 | 2.1 | 14,000 | 0.00015 | 2.1 | 10,963 | 0.00010 | 1.10 | 9,737 | 0.00012 | 1.2 |
| 0.0937 | 1500 | 14,000 | 0.00020 | 2.8 | 13,239 | 0.00020 | 2.6 | 9,173 | 0.00015 | 1.38 | 8,147 | 0.00015 | 1.2 |
| 0.1250 | 1500 | 10,681 | 0.00280 | 3.0 | 9,924 | 0.00280 | 2.8 | 6,876 | 0.00020 | 1.38 | 6,107 | 0.00020 | 1.2 |
| 0.1562 | 1300 | 8,552 | 0.00038 | 3.2 | 7,941 | 0.00038 | 3.0 | 5,503 | 0.00030 | 1.65 | 4,887 | 0.00025 | 1.2 |
| 0.1875 | 1150 | 7,125 | 0.00046 | 3.3 | 6,616 | 0.00046 | 3.0 | 4,584 | 0.00035 | 1.60 | 4,371 | 0.00030 | 1.2 |
| 0.2187 | 1050 | 6,108 | 0.00055 | 3.4 | 5,672 | 0.00055 | 3.1 | 3,930 | 0.00040 | 1.57 | 3,490 | 0.00035 | 1.2 |
| 0.2500 | 925 | 5,344 | 0.00070 | 3.8 | 4,962 | 0.00070 | 3.5 | 3,438 | 0.00050 | 1.72 | 3,053 | 0.00040 | 1.2 |
| 0.3125 | 775 | 4,275 | 0.00080 | 3.4 | 3,969 | 0.00080 | 3.2 | 2,750 | 0.00055 | 1.51 | 2,443 | 0.00045 | 1.1 |
| 0.3750 | 645 | 3,562 | 0.00090 | 3.2 | 3,308 | 0.00090 | 3.0 | 2,292 | 0.00060 | 1.38 | 2,036 | 0.00050 | 1.0 |
| 0.4375 | 600 | 3,053 | 0.00100 | 3.1 | 2,835 | 0.00100 | 2.8 | 1,965 | 0.00065 | 1.28 | 1,745 | 0.00055 | 1.0 |
| 0.5000 | 525 | 2,672 | 0.00110 | 2.9 | 2,481 | 0.00110 | 2.7 | 1,719 | 0.00070 | 1.20 | 1,527 | 0.00060 | 0.9 |
| 0.5625 | 500 | 2,375 | 0.00120 | 2.8 | 2,205 | 0.00120 | 2.6 | 1,528 | 0.00075 | 1.15 | 1,357 | 0.00065 | 0.9 |
| 0.6250 | 450 | 2,137 | 0.00120 | 2.6 | 1,985 | 0.00120 | 2.4 | 1,375 | 0.00075 | 1.03 | 1,221 | 0.00070 | 1.9 |
| 0.6875 | 425 | 1,943 | 0.00130 | 2.5 | 1,804 | 0.00130 | 2.3 | 1,250 | 0.00075 | 0.94 | 1,110 | 0.00070 | 0.8 |
| 0.7500 | 400 | 1,781 | 0.00140 | 2.5 | 1,654 | 0.00140 | 2.3 | 1,146 | 0.00080 | 0.92 | 1,018 | 0.00080 | 0.8 |
| 0.875 | 350 | 1,527 | 0.00150 | 2.3 | 1,418 | 0.00150 | 2.1 | 982 | 0.00090 | 0.88 | 872 | 0.00080 | 1.7 |
| 1.0000 | 300 | 1,336 | 0.00150 | 2.0 | 1,240 | 0.00150 | 1.9 | 860 | 0.00100 | 0.86 | 763 | 0.00080 | 0.6 |

## STEEL

| | | Tool Steel, Nitralloy, Greek Ascoloy, 316 Stainless, 420, H-13, 455 Custom | | | 416 Stainless, ETD-150 Copper | | |
|---|---|---|---|---|---|---|---|
| DIA | Pressure | 200 SFM | | | 275 SFM | | |
| IN | PSI | RPM | IPR | IPM | RPM | IPR | IPM |
| .0784 | 1,500 | 9,745 | .00010 | .97 | 13,399 | .00010 | 1.34 |
| .0937 | 1,500 | 8,154 | .00015 | 1.22 | 11,211 | .00015 | 1.68 |
| .1250 | 1,500 | 6,112 | .00020 | 1.22 | 8,404 | .00020 | 1.68 |
| .1562 | 1,300 | 4,891 | .00030 | 1.47 | 6,725 | .00030 | 2.02 |
| .1875 | 1,150 | 4,075 | .00035 | 1.43 | 5,603 | .00035 | 1.96 |
| .2187 | 1,050 | 3,493 | .00040 | 1.40 | 4,803 | .00040 | 1.92 |
| .2500 | 925 | 3,056 | .00050 | 1.53 | 4,202 | .00050 | 2.10 |
| .3125 | 775 | 2,445 | .00055 | 1.34 | 3,362 | .00055 | 1.85 |
| .3750 | 675 | 2,055 | .00060 | 1.22 | 2,801 | .00060 | 1.68 |
| .4375 | 600 | 1,746 | .00065 | 1.14 | 2,401 | .00065 | 1.56 |
| .5000 | 525 | 1,528 | .00070 | 1.07 | 2,101 | .00070 | 1.47 |
| .5625 | 500 | 1,358 | .00075 | 1.02 | 1,868 | .00075 | 1.40 |
| .6250 | 450 | 1,222 | .00075 | 0.92 | 1,681 | .00075 | 1.26 |
| .6875 | 425 | 1,111 | .00075 | 0.83 | 1,528 | .00075 | 1.15 |
| .7500 | 400 | 1,019 | .00080 | 0.81 | 1,401 | .00080 | 1.12 |
| .8750 | 350 | 873 | .00090 | 0.79 | 1,201 | .00090 | 1.08 |
| 1.000 | 300 | 764 | .00100 | 0.76 | 1,051 | .00100 | 1.05 |



## EXOTIC MATERIALS (STEEL)

| | | K-Monel, Hastelloy B,G,X Incoloy 800-825 Tungsten, Refractoaloy | | | Waspaloy, A286, Rene, Haynes Inconel, 600, 625, Nimonic | | | Titanium, 718 Inconel, Molly Nitronic 40-080 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| DIA | Pressure | 80 SFM | | | 100 SFM | | | 135 SFM | | |
| IN | PSI | RPM | IPR | IPM | RPM | IPR | RPM | RPM | IPR | IPM |
| 0.0784 | 1,500 | 3,898 | 0.00010 | 0.39 | 4,872 | 0.00010 | 0.49 | 6,578 | 0.00010 | 0.66 |
| 0.0937 | 1,500 | 3,261 | 0.00015 | 0.49 | 1,077 | 0.00015 | 0.61 | 5,504 | 0.00015 | 0.83 |
| 0.1250 | 1,500 | 2,445 | 0.00020 | 0.49 | 3,056 | 0.00020 | 0.61 | 4,126 | 0.00020 | 0.83 |
| 0.156 | 1,300 | 1,956 | 0.00030 | 0.59 | 2,446 | 0.00030 | 0.73 | 3,302 | 0.00030 | 0.99 |
| 0.1875 | 1,150 | 1,630 | 0.00035 | 0.57 | 2,037 | 0.00035 | 0.71 | 2,750 | 0.00035 | 0.96 |
| 0.2187 | 1,050 | 1,397 | 0.00040 | 0.56 | 1,747 | 0.00040 | 0.70 | 2,358 | 0.00040 | 0.94 |
| 0.2500 | 925 | 1,222 | 0.00050 | 0.61 | 7,528 | 0.00050 | 0.76 | 2,063 | 0.00050 | 1.03 |
| 0.3125 | 775 | 987 | 0.00055 | 0.54 | 1,222 | 0.00055 | 0.67 | 1,650 | 0.00055 | 0.91 |
| 0.3750 | 675 | 815 | 0.00060 | 0.49 | 1,019 | 0.00060 | 0.61 | 1,375 | 0.00060 | 0.83 |
| 0.4375 | 600 | 699 | 0.00065 | 0.45 | 873 | 0.00065 | 0.57 | 1,179 | 0.00065 | 0.77 |
| 0.5000 | 525 | 611 | 0.00070 | 0.43 | 764 | 0.00070 | 0.53 | 1,031 | 0.00070 | 0.72 |
| 0.5625 | 500 | 543 | 0.00075 | 0.41 | 679 | 0.00075 | 0.51 | 917 | 0.00075 | 0.69 |
| 0.6250 | 450 | 489 | 0.00075 | 0.37 | 611 | 0.00075 | 0.46 | 825 | 0.00075 | 0.62 |
| 0.6875 | 425 | 445 | 0.00075 | 0.33 | 556 | 0.00075 | 0.42 | 750 | 0.00075 | 0.56 |
| 0.7500 | 400 | 407 | 0.00080 | 0.33 | 509 | 0.00080 | 0.41 | 688 | 0.00080 | 0.55 |
| 0.8750 | 350 | 349 | 0.00090 | 0.31 | 437 | 0.00090 | 0.39 | 589 | 0.00090 | 0.53 |
| 1.0000 | 300 | 306 | 0.00100 | 0.31 | 382 | 0.00100 | 0.38 | 516 | 0.00100 | 0.52 |

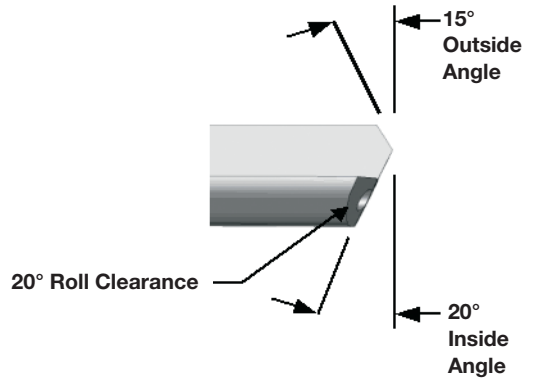
## MAXIMUM UNSUPPORTED DRILL LENGTH

Example: .250 diameter at 200 sfm = 15"

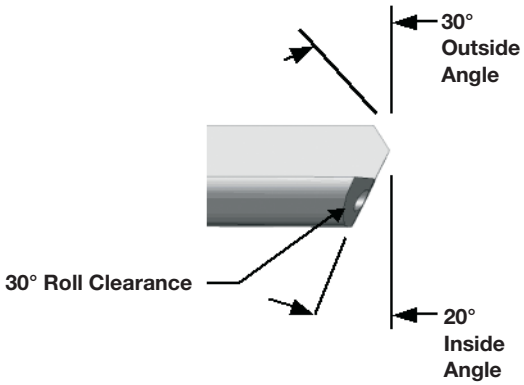
| Gundrill Diameter | Surface Feet Per Minute | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 | 600 |
| 0.078 | 6 | 5 | 5 | 4 | 4 | 4 | 3 | 3 | 3 | 2.5 | 2.5 |
| 0.093 | 8 | 7 | 6 | 5 | 5 | 4 | 4 | 4 | 4 | 3.5 | 3.5 |
| 0.109 | 9 | 7 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 4 |
| 0.125 | 10 | 8 | 7 | 7 | 6 | 6 | 5 | 5 | 5 | 5 | 5 |
| 0.140 | 12 | 10 | 8 | 7 | 7 | 6 | 6 | 6 | 5 | 5 | 5 |
| 0.156 | 13 | 10 | 9 | 8 | 8 | 7 | 7 | 6 | 6 | 6 | 5 |
| 0.171 | 14 | 12 | 10 | 9 | 8 | 8 | 7 | 7 | 6 | 6 | 6 |
| 0.187 | 16 | 14 | 11 | 10 | 9 | 8 | 8 | 7 | 7 | 7 | 6 |
| 0.203 | 17 | 14 | 12 | 11 | 10 | 9 | 9 | 8 | 8 | 7 | 7 |
| 0.218 | 18 | 15 | 13 | 12 | 11 | 10 | 9 | 9 | 8 | 8 | 7 |
| 0.234 | 20 | 16 | 14 | 12 | 11 | 11 | 10 | 9 | 9 | 8 | 8 |
| 0.250 | 21 | 17 | 15 | 13 | 12 | 11 | 11 | 10 | 9 | 9 | 9 |
| 0.256 | 22 | 18 | 16 | 14 | 13 | 12 | 11 | 10 | 9 | 9 | 9 |
| 0.281 | 24 | 19 | 17 | 15 | 14 | 13 | 12 | 11 | 11 | 10 | 10 |
| 0.296 | 25 | 20 | 18 | 16 | 14 | 13 | 12 | 12 | 11 | 11 | 10 |
| 0.312 | 26 | 21 | 19 | 17 | 15 | 14 | 13 | 12 | 12 | 11 | 11 |
| 0.328 | 28 | 22 | 19 | 17 | 16 | 15 | 14 | 13 | 12 | 12 | 11 |
| 0.343 | 29 | 24 | 20 | 18 | 17 | 15 | 14 | 14 | 13 | 12 | 12 |
| 0.359 | 30 | 25 | 21 | 19 | 17 | 16 | 15 | 14 | 13 | 13 | 12 |
| 0.375 | 32 | 26 | 22 | 20 | 18 | 17 | 16 | 15 | 14 | 13 | 13 |
| 0.390 | 33 | 27 | 23 | 21 | 19 | 18 | 16 | 15 | 15 | 14 | 13 |
| 0.406 | 34 | 28 | 24 | 22 | 20 | 18 | 17 | 16 | 15 | 15 | 14 |
| 0.421 | 35 | 29 | 25 | 22 | 20 | 19 | 18 | 17 | 16 | 15 | 14 |
| 0.437 | 37 | 30 | 26 | 23 | 21 | 20 | 18 | 17 | 16 | 16 | 15 |
| 0.453 | 38 | 31 | 27 | 24 | 22 | 20 | 19 | 18 | 17 | 16 | 16 |
| 0.468 | 39 | 32 | 28 | 25 | 23 | 21 | 20 | 19 | 18 | 17 | 17 |
| 0.484 | 41 | 33 | 29 | 26 | 23 | 22 | 20 | 19 | 18 | 17 | 17 |
| 0.500 | 42 | 34 | 30 | 27 | 24 | 22 | 21 | 20 | 19 | 18 | 17 |

Representative “doodads” and “gadgets” used as chip deflectors during the gundrilling operation. Available from Star SU.

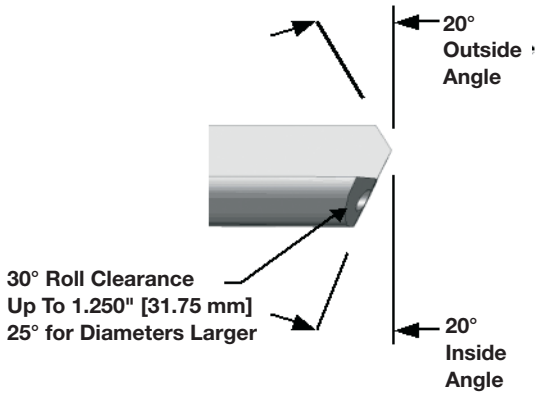
# STANDARD GRINDS



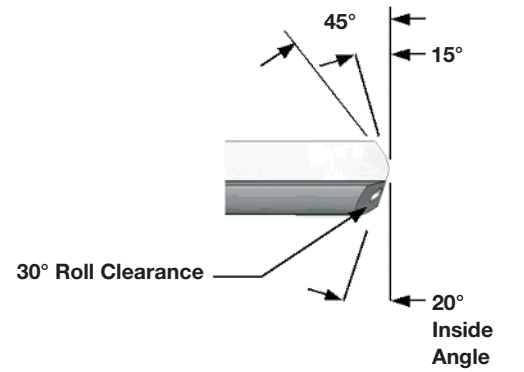

ALUMINUM




STEEL



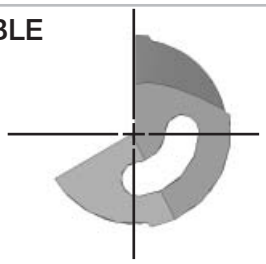

CAST IRON




OPTIONAL STEEL
(Diameter < Or equal To .375" [9.52 mm]

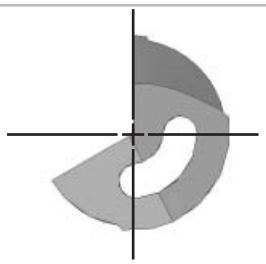
# CONTOUR GRIND GEOMETRIES

## NON-MICABLE



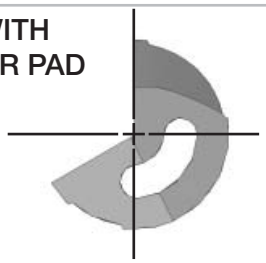
General purpose for all materials. The minimum bearing contact assist the tool from binding in the part.

## MICABLE



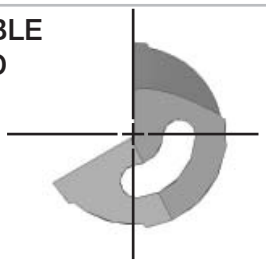
Used in cast irons and aluminum that have cross holes, or require good size control and is good for angular entry.

## MICABLE WITH THIRD WEAR PAD



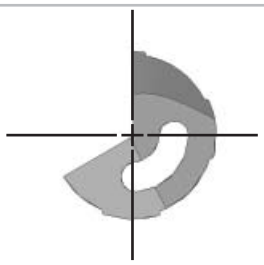
Assist in increasing the finish in non-ferrous materials, good for intersecting holes and interrupted cuts where extra OD support and burnishing is required.

## NON-MICABLE WITH THIRD WEAR PAD



Recommended for all non-ferrous and cast iron gundrills with diameter up to .20" [5.08mm]

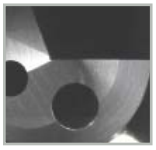
## SPLIT PAD

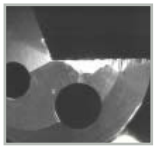


For good size control (including exit), special purpose contour is good for cross drilling, will help in burnishing the bore, and is good for reducing material buildup on the outer diameter.

## WEAR CHARACTERISTICS WITH TOOL LIFE IMPROVEMENT AREAS

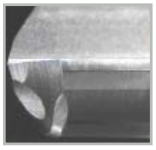
There are three areas viewed on a gundrill for wear. Point wear, outer diameter wear and face wear. After the tool is pulled from the machine and sent to be reground, all areas should be cleaned to sharp condition. The area most commonly missed is the outer diameter. In many cases, a cutter grinder will not clean this up completely. Essentially a partially worn tool would not be installed. A good indicator of this is a noticeable difference in tool life from a new tool to the regrind. When changing geometries, or machine parameters, for tool life improvement, Star SU recommends changing one parameter at a time and running controlled tests.


SHARP


WORN

### POINT WEAR

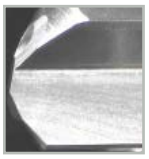
The point wear is a good indicator of a tool being worn. When the wear on the point starts approaching 1/2 - 2/3 the distance of the margin, the tool is considered worn and needs to be reground. If a tool is experiencing premature tool life in this area, there is a good possibility that the tool has the incorrect geometry.


SHARP


WORN

### OUTER DIAMETER WEAR

If a gundrill is pulled prematurely due to the rounding of this corner, it is a good indicator the tool is being run at too high rpm. Depending on the material that is machined, decreasing the rpm can maintain the surface finish and reduce chip load. Keep in mind that changing the surface finish could affect other wear areas of the tool.


SHARP


WORN

### FACE WEAR

Premature face wear can be caused from cratering or buildup on edges. There are a few potential causes. Check the rpm setting or feed rates. When looking into this, the decision made should coincide with the started surface footage and based on the material being machined. Again, remember changing surface finish could affect other wear areas of the tool. Increasing the outside angle could also improve this area. Coolant Pressure should also be reviewed. Increasing the pressure is another possibility.

## ADDITIONAL TROUBLESHOOTING AREAS

Gundrills today are used in a larger variety of different materials, both ferrous and non-ferrous. Due to this variety of materials and variation in process, a standard table for all materials is not feasible. In many cases, optimizing a gundrill can require adjustment.

Using the recommended starting conditions, it is suggested that adjustments be made from the results of the first hole. The following is a general troubleshooting guide. Only one adjustment should be done at a time to ensure proper understanding of the results.

### HOLE MACHINED OVERSIZED

- Decrease rpm
- Decrease PSI
- Increase outer angle
- Increase IPM

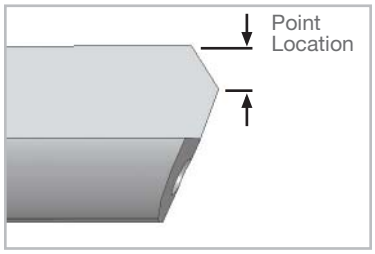
### HOLE MACHINED UNDERSIZED

- Increase rpm
- Increase PSI
- Decrease outer angle
- Decrease IPM

### POOR SURFACE FINISH

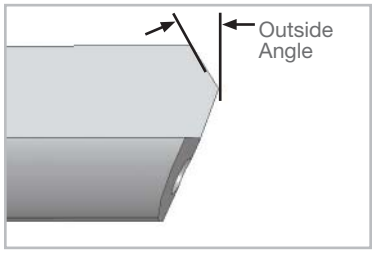
- Increase rpm
- Increase PSI
- Increase outer angle
- Decrease IPM

# SINGLE FLUTE GUNDRILL CHARACTERISTICS



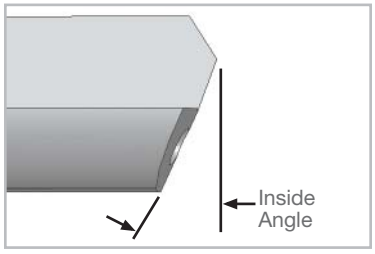

## POINT LOCATION

The point location balances the cutting forces. This dimension is normally held at 25% of the diameter, or D/4. Putting this dimension less then D/4 will cause the tool to push outwards causing the tool to cut larger. Making this angle larger then D/4 will cause the tool to cut tighter. In some cases this could cause the tool to seize in the part.



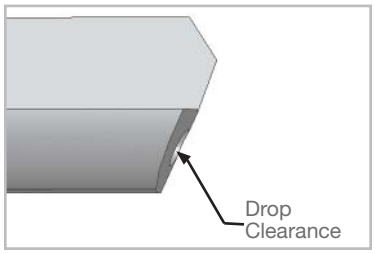

## OUTSIDE ANGLE

The outside angle varies based on the material being machined. This angle is held with a tolerance of +/- 1 degree. This is held to keep consistency from grind to grind for maintaining a constant hole. Increasing (15° to say 30°) the angle will assist in the tool cutting straighter, however it will also cut tighter. If the tool cuts too tightly, it could seize in the part and cause tool breakage. If this angle is decreased, the tool will tend to cut freer and wander.



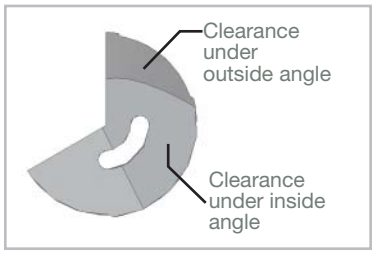

## INSIDE ANGLE

The inside angle is the angle that balances the cutting forces. Increasing this angle will reduce thrust and increase coolant flow. Decreasing this angle will push the drill toward center causing a tighter hole.




## DROP CLEARANCE

The drop clearance is normally a 20° or 30° roll clearance. This clearance is ground in to allow more coolant flow up the flute channel, assisting in chip evacuation. This clearance needs control. Too much clearance could take away too much coolant from the cutting edges, resulting in premature wear on the tool.

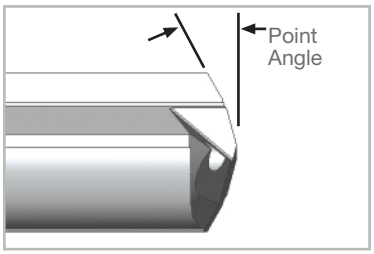



## CLEARANCE ANGLE

The clearance angle is the primary cam relief. Facets are also available for this clearance, and are usually chosen based on the users regrind capabilities.

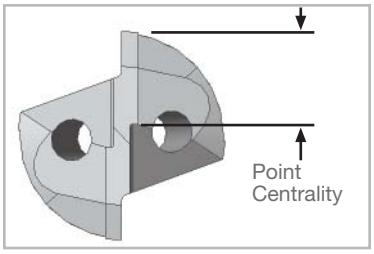
The clearance under the inside angle is a flat relief grind. This clearance is normally the same as the outside relief.

# DOUBLE FLUTE GUNDRILL CHARACTERISTICS



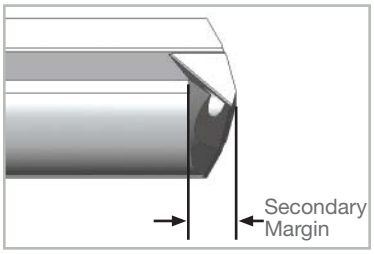

## POINT ANGLE

The “Point Angle” is the cutting angle of the gundrill. The angle is held to ± 1° keeping consistency from tool-to-tool and hole-to-hole produced. If the angle is increased, the tool will tend to cut tighter and straighter. Decreasing this angle will cause the drill to cut larger and have a tendency to wander. The cutting lip heights from blade to blade are held within .0005" [0.013mm]. If the lip heights are more, then the tools will have a tendency to fly cut. This will most likely cause an oversized hole to be cut and will cause premature tool wear.




## POINT CENTRALITY

This feature is not forgiving. The point centrality must be held within ±. .001" [0.025]. The result of being off center is a broken tool at the start of the cut, or if the tool gets into the cut it will start cutting over-size as it gets deeper into the part.

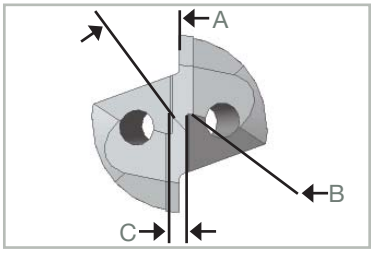



## SECONDARY MARGIN

The secondary margin is a supporting margin to help control size and straightness on a two-flute gundrill. This is the distance the secondary margin trails the cutting margin. The distance held is normally 15% calculation from the diameter of the tool. This dimension is not to exceed .125" [3.18mm].

## CHISEL ANGLE (A)

The chisel angle is controlled by the primary clearance. This angle is the first point of contact as the material is being machined. This angle produces the geometry to make the drill cut.




## NOTCH/GASH (B)

The notch or gash is a clearance to get the chips up into the flute channel. This notch needs to break into the coolant hole ¼ to ½ of the coolant hole diameter, allowing adequate coolant to assist in forcing the chip into the flute.

## WEB THICKNESS (C)

The web thickness is developed after notch has been ground in. This dimension varies based on the diameter of the tool. It is normally held within 10% – 13% of the cutting diameter.

## TRADITIONAL BUSHING SET UP

There are two materials typically used in making bushings for traditional gundrilling: high-speed steel or tungsten carbide. The preferred choice is tungsten carbide. The high-speed steel will wear out more quickly and has a tendency toward bell mouth from the drill rotating. When a bushing becomes bell mouth it becomes oversized.

When setting the tolerance of the bushing's inter-diameter, it should be calculated out taking the large end of the outer diameter tolerance of the gundrill and tolerancing it up +. 0001 / +. 0003.

Ex. .2500" diameter gundrill

Bushing ID: .2501" - .2503"

The best practice for locating the bushing to the part is to have it flush against the part. If the process requires a part shuttling in, this will only work using a power bushing. If the setup does not allow for the bushing to go flush against the part, it is then best to leave a gap. The gap in most cases can be judged using a diameter to a diameter-and-a-half away from the part. However, this does not apply to larger diameter drills .750" diameter and above, and judgement should be used. The purpose of the gap is to allow room for chips to fall out between the part and bushing. There must be enough clearance so the chips do not get caught up in the area, as allowing chips to pack up could result in the gundrill breaking.

A corner break should be ground on the inner diameter of the bushing if it is gapped from the part. This allows for a good lead to the gundrill to re-enter the bushing when it is retracting. This corner break is normally .005" - .010" x 45°.

This helps the tool to enter the part with full support from the bushing and will help prevent deflection during the start of the cut. This type of setup is the same as listed previously — flush against the part, gapped accordingly and with a lead on the end for the tool to assist as it re-enters the bushing.

## BUSHINGLESS PROCESS

The bushingless process is used when stationary bushings cannot be installed. This is normally found in machining center applications.

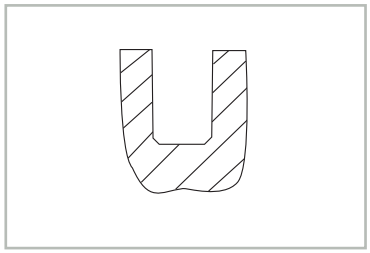
Best practice for non-ferrous materials is to pilot drill a flat bottom. In ferrous materials it is best to match the gundrill point as close as possible. The included angle of the pilot drill is not to be less than the included angle of the gundrill. If the pilot drill angle is more, the gundrill will come in contact at the corner of the gundrill rather than the point where the outside/inside angles meet.

The pilot drill is normally a high performance carbide drill. If the hole requires a chamfer at the end, this can be accomplished by using a step chamfer drill as the pilot drill.

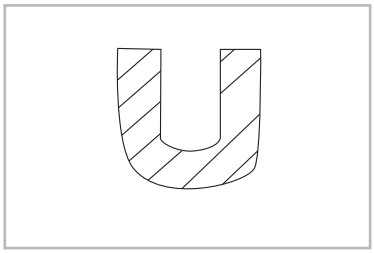
The pilot drill dimensions to the gundrill as shown: 1.5 – 2.0 times diameter deep with .0005" - .0010" clearances from the outer diameter of the gundrill. If cycle time is needed, an advantage to this process could be to drill your pilot as deep as the carbide drill will allow. Carbide drills run at higher feed rates then gundrills.

Index the drill into the pilot hole and run at very low to no rpms. If programmable, the tools should enter the part in reverse rpms to help protect the cutting edge during entry. The coolant pressure also should be turned off. Once the gundrill is into the part, turn the rpms and coolant pressure on and proceed to cut.

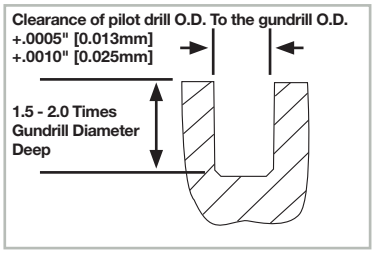
### NON-FERROUS MATERIALS



### FERROUS MATERIALS



### CLEARANCE OF PILOT DRILL O.D.



## STAR SU LLC EXPEDITED SINGLE FLUTE GUNDRILL PROGRAMS:

**Call our toll free number:**
**1-877-635-3488**

Star SU LLC offers three programs to cover your gundrill needs. When you need gundrills in a hurry, call Star SU LLC for quick results.

### SOLUTION: 24 HOUR-DELIVERY SINGLE FLUTE STOCK

When you have an emergency and need stock single flute gundrills in a hurry, you can rely on Star SU to deliver. Star SU carries a large range of stocked gundrills with various diameters, ranging from .078" - .75" in various lengths, delivered within 24 hours.

### SOLUTION: 24 HOUR-DELIVERY SINGLE FLUTE MOLD TOOL PROGRAM

Star SU offers a 24-hour delivery service for standard diameter and length mold making gundrills. These mold drills are available in diameters ranging from .1885" – 1.5". Standard 1.25" diameter by 2.75" long drivers apply. If the size you need is not a stocked item, please contact us. We offer an additional expedited program to meet our customers needs.

### SOLUTION: 72-HOUR (THREE WORKING DAYS) CUSTOMER DESIGN PROGRAM

Star SU offers custom designed single flute gundrills in diameters ranging from 0.092" – 1.508", **shipped within 72 hours (three working days)**. This program allows special designs for specific diameters, overall lengths, point geometries and contours. Please specify type of material machined at time of order placement to ensure proper design.

GUNDRILLS

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USA
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Star SU LLC, Hoffman Estates/Illinois




WWW.STAR-SU.COM

StarSU_Gundrills_8-08

# ROTARY CUTTING TOOLS

Carbide drills,
reamers, form tools

# STAR SU ROTARY CUTTING TOOLS

Since 1970, Star SU has designed and manufactured custom carbide drills, reamers and special cutters for use with CNC production systems as well as standard and flexible machining systems.

Star SU products are engineered and manufactured using state-of-the-art equipment. Your production requirements are extremely important to us, and we pride ourselves on meeting your goals utilizing our custom designed and built products.

Star SU offers a wide range of precision solid carbide drills and reamers. Pressure and Non-Pressure coolant styles are available.

- Solid carbide drills and reamers
- Pressure coolant drills and reamers

**“We don’t just stop at being competitive. We focus on our quality.”**

# STAR SU PRESSURE COOLANT VALVE GUIDE REAMERS

Star SU pressure coolant reamers utilize pressurized coolant to force chips ahead of the tool to produce ultra-smooth, ultra-precise holes. They produce holes to tolerance of 0.0005" and less in steel, cast iron, malleable iron, nodular iron, aluminum, bronze and exotic materials.

Ideally adapted to the sizing and enlarging of previously drilled or cored holes, Star SU reamers provide higher penetration rates and closer size tolerance. Since they have a longer tool life than carbide reamers without pressurized coolant and have no tendency to follow pre-drilled or cored hole surfaces, they can produce precise, straight holes.

Star SU reamers are made in sizes from 3/16" to 4" in diameter. Cutting speeds are the same as those recommended for multiple flute gundrills.

Star SU reamers are made in both multiple flute and multi-diameter types. They can have solid carbide heads brazed to a tubular steel body in sizes up to 2.0" diameter and with brazed inserts in 2.0" to 4.0" diameter ranges.

- Multi-step design
- Straight flute design
- Spiral flute design
- Various shank (holder) designs
- RH and LH spiral designs
- Single and multi-flute designs

## CARBIDE FORM TOOLS

Star SU reamers are available in the following configurations:

- Straight or spiral design
- Right-hand and left-hand helical designs for spiral tools.
- Single or multiple diameters
- Single or multiple-flute design
- Diameter range from .1875" to 3.000" (4.76 to 76mm)
- Overall lengths up to 48" (1200mm).

For deep applications when the overall length of the tool is between 8" and 48" (200 to 1200mm), reamers are made with a solid carbide head brazed onto a steel body. For short holes, especially when using machining centers, Star SU special carbide tools are recommended.

## SOLID AND BRAZED CARBIDE FORM TOOLS

Star SU developed a solid carbide line of drills and reamers to meet the demand from our customers for close tolerance, multiple diameter tooling used in unbushed applications.

We apply the same high standards for engineering and manufacturing that our customers have come to depend on. Our goal is to combine multiple process steps into one single application tool. When it is critical that diameters and step lengths remain concentric and precise, our design and manufacturing team perform. When the job calls for a special tool that you can't get from a modified standard, you can expect a tool designed for your specific application from Star SU.

# SUPER ROUND TOOL

U.S. PATENT NO. 7,207,752

## WHERE REAMING JUST GOT THE HOLE A LOT STRAIGHTER.

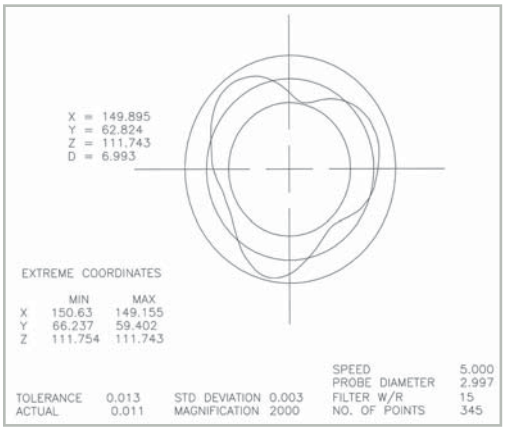
The SRT's unique, patented design combines two tools into one - multiple straight flutes for consistent location and multiple helical flutes to ensure roundness and finish.

The SRT consistently produces roundness and straightness within microns on a wide variety of applications including: powdered metal, cast iron, graphite iron, steel and aluminum. Reamers range in size from 5 mm up to 60 mm in diameter.

- Roundness and straightness within 5 microns
- Lowest cost per hole
- Increase thru put and reduce cycle times
- Sizes from 5mm and up
- Special design and build

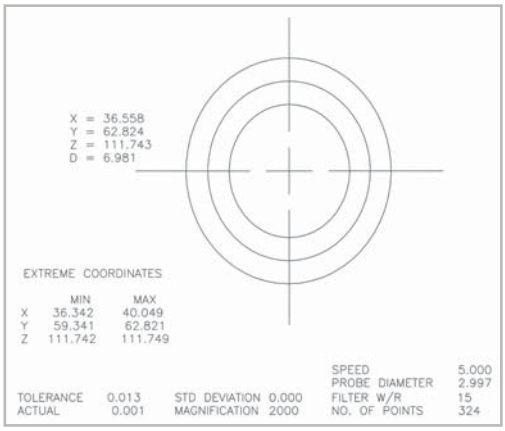
# SUPER ROUND TOOL

## COMPETITION




Roundness and straightness within
11 microns after 3,500 holes

## SUPER ROUND TOOL




Roundness and straightness within
2 microns after 3,500 holes

Material: powdered metal
Stock removal: .040
Speed: 2,100 rpm
Feed: 24 ipm
SRT: 9,000 holes
Competition: 3,500 holes

Other materials, including cast iron, aluminum, compacted graphite iron and steel, can be machined with similar results.

ROTARY CUTTING TOOLS


Star SU LLC
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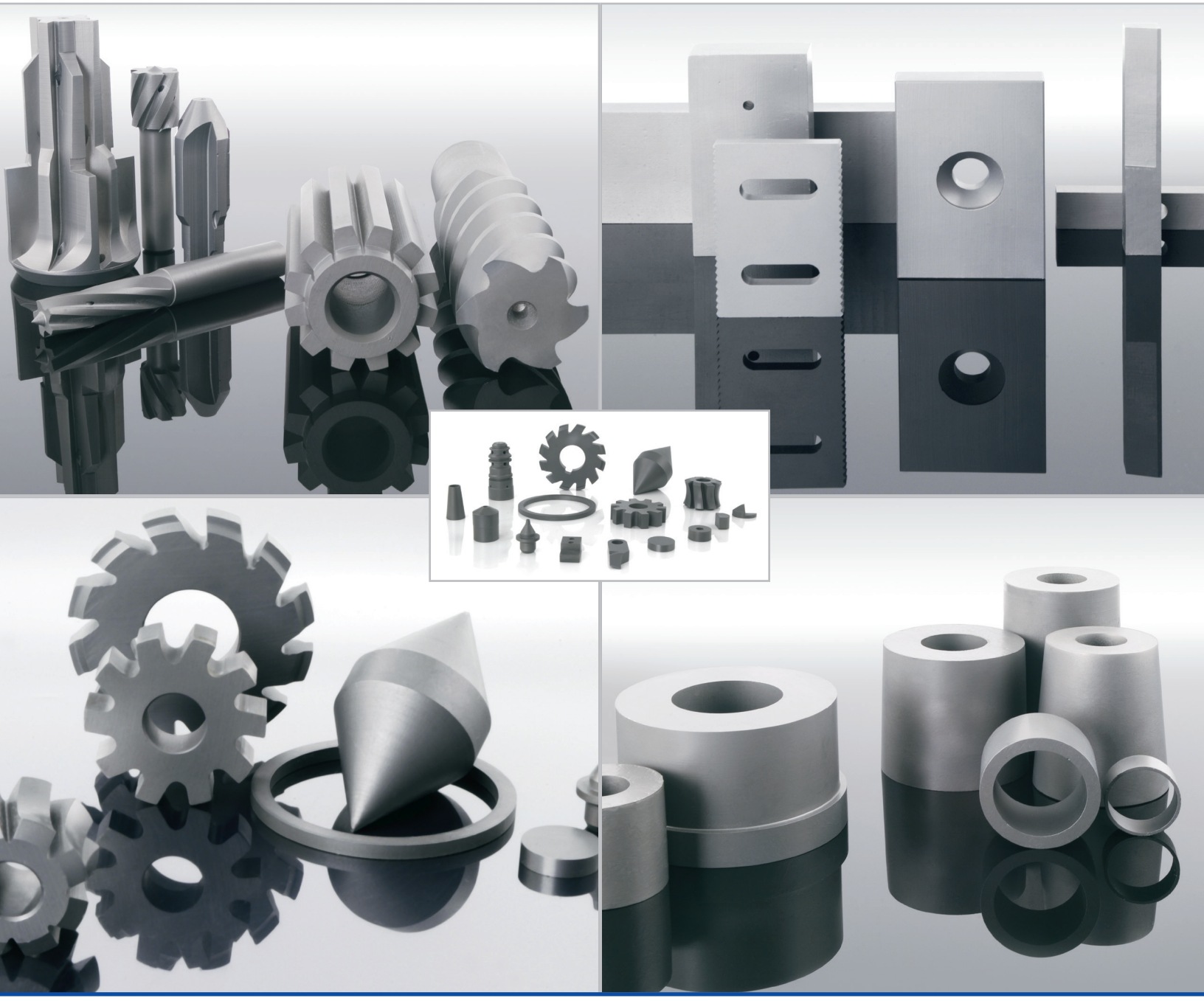
# CARBIDE PREFORMS



Tungsten carbide preforms for flat blanks,
round rod, cold head dies and bushings, special forms for wear parts

H. B. Carbide Company, established in 1983 and located in Lewiston, MI, is owned and operated by Star Cutter Company. H.B. Carbide manufactures tungsten carbide preforms using extrusion, isopressing, and preforming and sintering operations.

## FLUTED PREFORMS

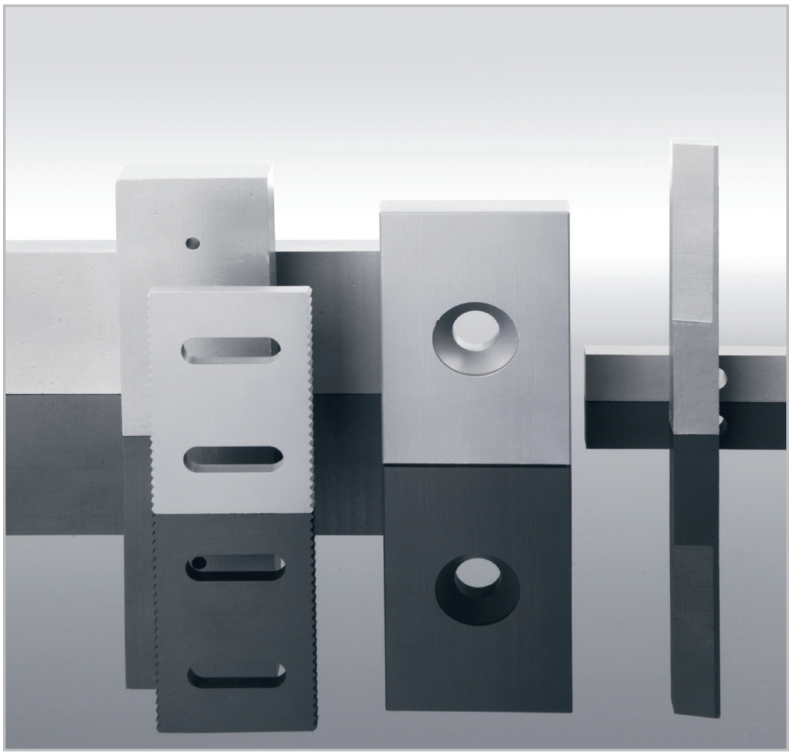
Straight and spiral flutes, straight holes, crossholes, steps, centers, flats, keyways, chamfers.

## SPECIAL TOOLING

Wear parts, centers, milling cutters, custom tool blanks to customer print.

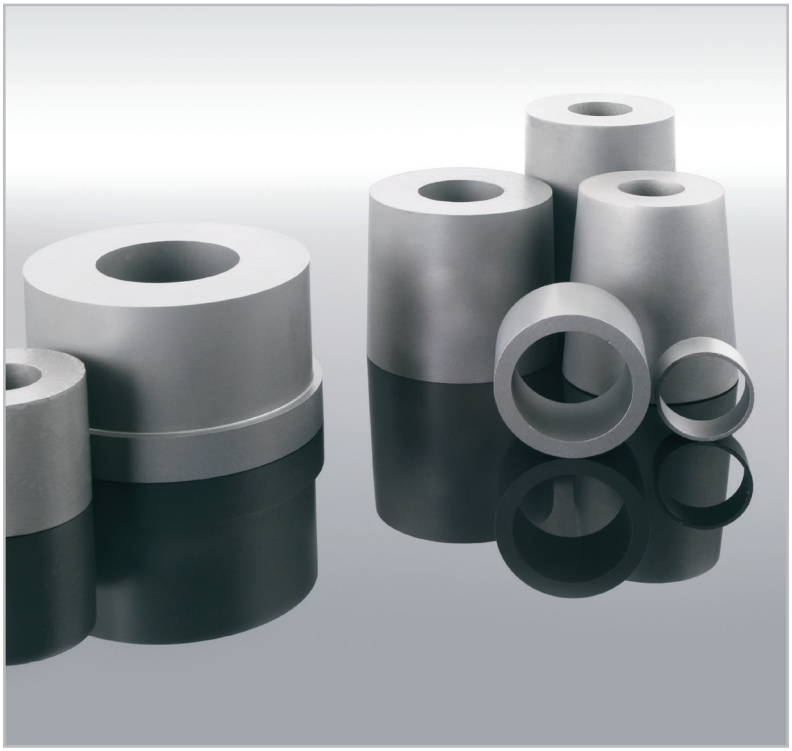
H.B.Carbide Company is recognized as a leading source of high precision and high quality tungsten carbide preforms for cutting tools, dies, and wear parts used in a variety of specialized applications throughout the world.

H.B Carbide uses only the highest quality raw materials and employs state-of-the-art computer controlled vacuum furnaces and vacuum Sinter-Hipping furnaces for complete control of sintering conditions.



## FLAT BLANKS

Wire EDM blanks, saw blade blanks, form tool blanks, washers. HB Carbide EDM blanks are guaranteed against cracking.



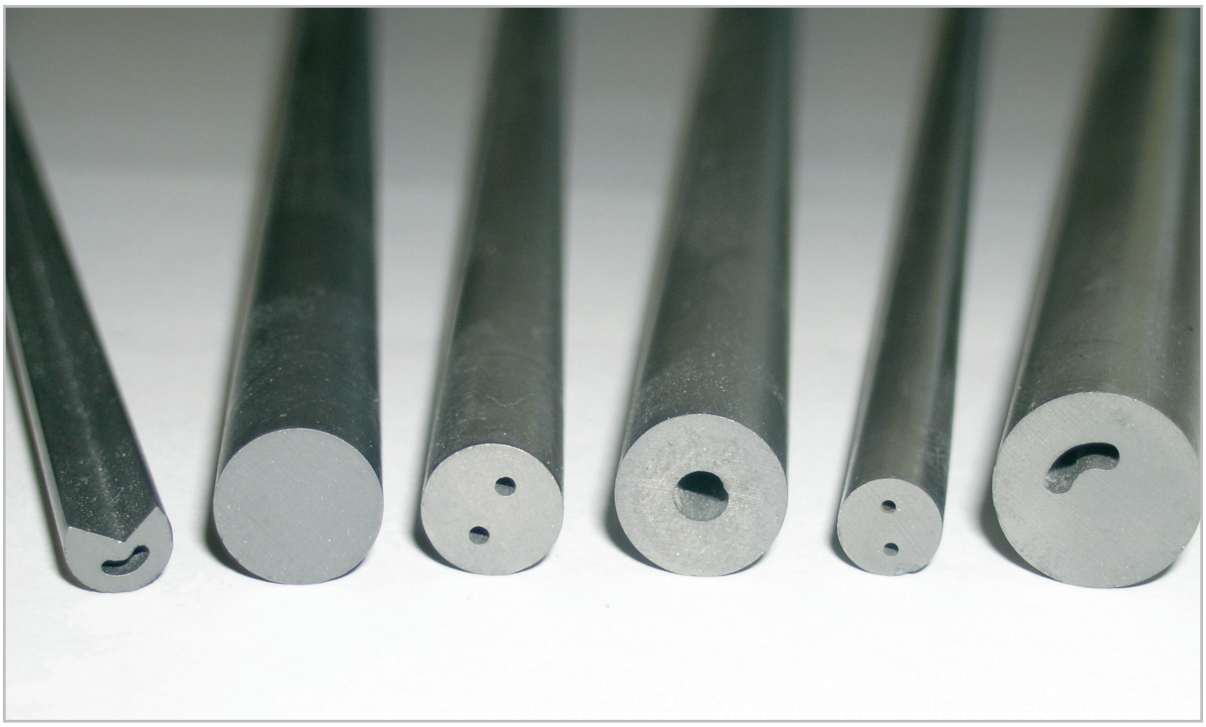
## DIES AND BUSHINGS

Wear parts, seal rings, wire drawing dies, cold heading dies, and bushings.

Ground and unground rods, cut to length or full sticks. Round rods up to 36 inches long.

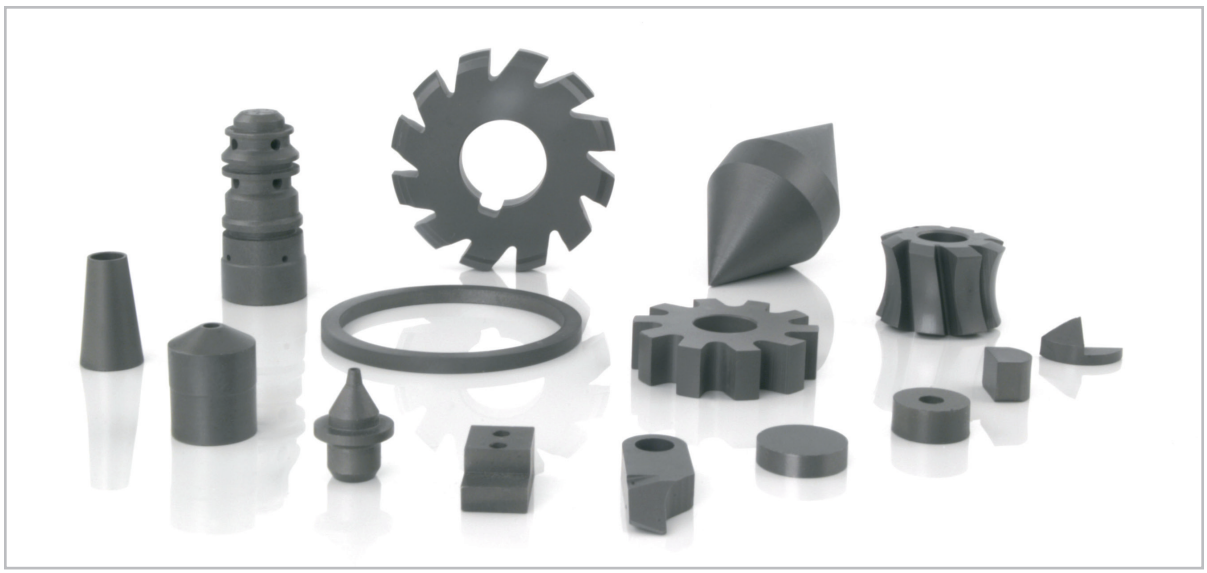
H.B.Carbide is dedicated to quality, committed to technology, and focused on personal customer service. Quotation response is generally within 4 working hours of request. Orders are typically shipped within 5-8 working days. H.B.Carbide is able to expedite delivery. Please call for assistance. Technical assistance is readily available for grade selection and preform design.

## SPECIAL EXTRUDED SHAPES AND GUNDRILL BLANKS



Round, square, rectangular rod, with or without holes, varied shapes with a constant cross section, can be cut to specified lengths, with or without centers. Gundrill blanks can be full-length sticks, cut to length heads, and can have preformed presharpening angles included. Round or other shaped coolant holes including single hole, double hole or kidney holes can be manufactured.

## SPECIAL TOOLING



Wear parts, punches, knives, rings, clamps, nozzles, centers, washers, detailed blanks to customer print.

## CEMENTED CARBIDE PROPERTIES

### PHYSICAL PROPERTIES

| HB Carbide Grade | Applications | US Industry Designation | ISO Code | Average grain size (micron) | Density g/cc | WC (%) | CO (%) | Hardness Rockwell A | Sinter Hip TRS (psi) |
|---|---|---|---|---|---|---|---|---|---|
| HB-2 | Excellent wear properties, abrasion resistant grade, medium grain size, general purpose grade for all cutting tools, drills, endmills, and reamers, for finishing and semi-finishing, and wear parts with little impact, EDM blanks, seal rings, knives | C-2 | K20 - K30 | 0.8 | 14.9 | 94 | 6 | 92.2 | 530,000 |
| HB-3 | Extremely hard material, highly abrasion resistant, micro grain grade, for finish machining cutting tools, drills, endmills, and reamers, and wear parts, with very little or no shock, EDM Blanks, wire guides, sand blast nozzles | C-3 | K05 - K10 | 0.8 | 14.9 | 94 | 6 | 93.0 | 520,000 |
| HB-110 | Excellent wear properties, micro grain grade, general purpose cutting tool grade for semi-finishing and finishing, drills, endmills, reamers, stamping dies, punches, knives and all types of cutting tools, will withstand slight shock, EDM blanks | C-2<br>C-10 | K30 - K40 | 0.8 | 14.5 | 90 | 10 | 91.7 | 550,000 |
| HB-115 | High wear, low to medium impact, micro grain grade, for cutting tools, dies, knives, punches, roughing tools, will withstand slight shock, EDM blanks, crush rolls, form rolls, coining dies | C-12 | K40 | 0.8 | 14.0 | 85 | 15 | 90.0 | 610,000 |
| HB-512 | Extra fine grain carbide grade, all types finish cutting tools, drills, endmills, and reamers | C-1<br>C-2 | K40 - K50 | 0.6 | 14.3 | 88 | 12 | 92.5 | 640,000 |
| HB-312 | Low impact resistance, coarse grain size grade, knives, punches, will withstand slight shock | C-12 | | 4.0 | 14.3 | 88 | 12 | 88.7 | 445,000 |
| HB-315 | Low impact, coarse grain grade, rough core nibs for header dies, swaging dies, and forming applications | C-13 | | 4.0 | 14.0 | 85 | 15 | 87.4 | 470,000 |
| HB-320 | Medium impact, coarse grain grade, rough core nibs for header dies, swaging dies, draw dies, crushing hammers, forming applications | C-14 | | 4.0 | 13.5 | 80 | 20 | 85.4 | 455,000 |
| HB-325 | Highest impact, coarse grain grade, rough core nibs for header dies, swaging dies, draw dies, forming applications | C-14 | | 4.0 | 13.1 | 75 | 25 | 83.3 | 430,000 |
| HB-411 | Multi grain size grade, impact punches, wear parts, plastic injection molding pins | C-12 | | 0.8 to 4.0 | 14.4 | 88.5 | 11.5 | 90.0 | 530,000 |

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Star SU LLC, Hoffman Estates/Illinois

# APPLIED TOOL COATING TECHNOLOGY

Oerlikon Balzers Balinit® coating technology for enhancing
Star SU tool life and productivity

# BALINIT®-COATED TOOLS CUT COSTS AND BOOST PRODUCTIVITY

## THE SOLUTION IS BALINIT®

Worldwide, the BALINIT® trademark stands for innovative coating developed by Oerlikon Balzers. They are only a few thousanths of a millimeter thick, but harder than steel. When tools and precision components are coated with BALINIT®, their performance increases by several orders of magnitude. Thus, you can considerably enhance productivity in metal processing operations.

The objectives are to

- cut costs
- enhance productivity
- increase manufacturing reliability
- protect the environment

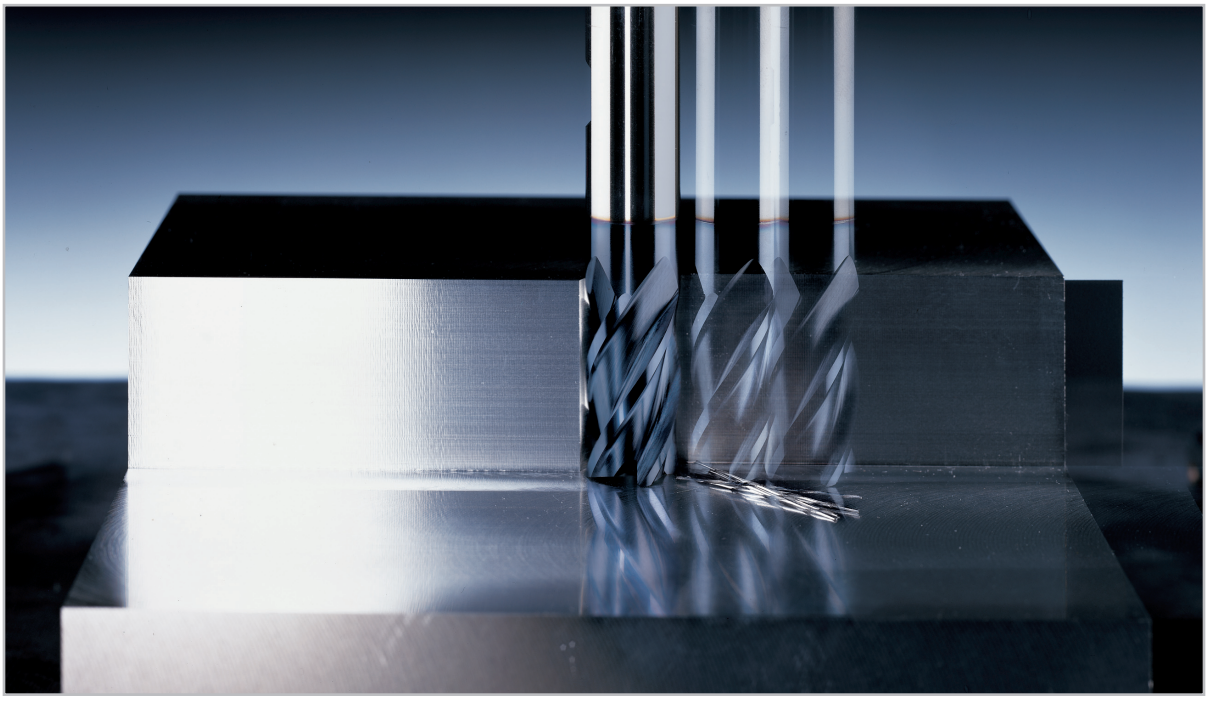
## BALINIT® GETS YOUR PRODUCTION IN GEAR

Your BALINIT®-coated precision tools will remain fully functional much longer than uncoated ones, often with a concurrent increase in machine performance and consistent operation.

## WITH BALINIT®-COATED TOOLS, YOU CAN

- boost productivity
- reduce manufacturing costs
- improve manufacturing reliability
- enhance the quality of your products
- offer shorter delivery times
- help preserve the environment and natural resources

BALINIT® gives you high-performance tooling which complies with the constantly growing requirements in modern manufacturing technology.



## BALINIT® CUTS YOUR COSTS

### BALINIT®-COATED TOOLS REDUCE

- set-up, tooling and retouching costs due to longer service life
- machining times due to better cutting performance scrap volumes and finish machining due to better workpiece quality
- the expenditure for coolants and lubricants due to dry machining or minimal-coolant lubrication

### NO CONTRADICTION: REDUCE COSTS WHILE PROTECTING THE ENVIRONMENT

The dry-cutting mode eliminates the high cost of procuring, processing and disposing of coolants and lubricants. Remarkable savings are possible when jobs are worked with minimal-coolant lubrication, dry chips can be directly recycled. Machine and workpiece cleaning is either considerably simplified or eliminated. Another cost-saving factor associated with coated cutting tools is the use of ecologically benign coolant media and lubrication systems.

In high-speed milling with BALINIT®-coated tools, graphite workpieces can be manufactured five times faster and to higher quality standards.

## BALINIT® BOOSTS YOUR PRODUCTIVITY

### STOCK REMOVAL WITH BALINIT®-COATED TOOLS IS MORE ECONOMICAL

- higher cutting speeds and feeds as well as longer tool service life result in much shorter machining times and considerably higher metal removal rates
- fewer tool changes reduce machine downtimes and scrap
- molds and components made of hardened steel can be manufactured more rapidly

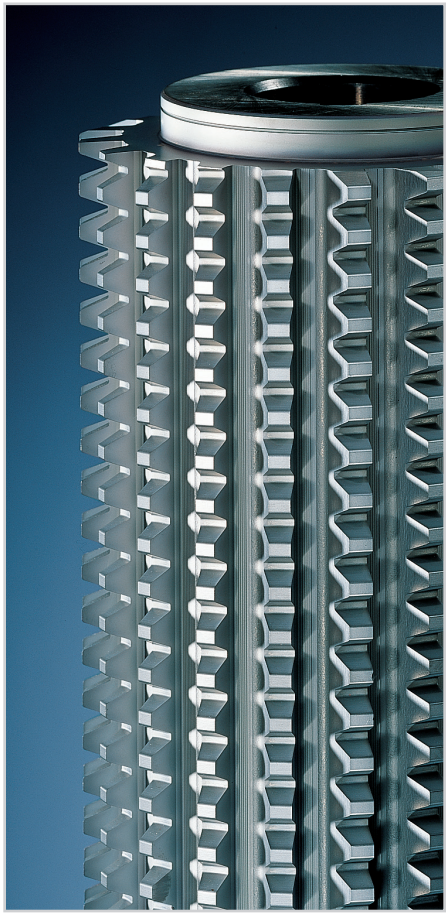
### HIGH-SPEED CUTTING WITH BALINIT®

BALINIT®-coated tools make it possible to fully exploit the benefits of high-speed cutting with

- shorter throughput times
- precision machining of near-net-shape blanks or semi-finished workpieces with minimal allowance
- less finish machining due to more precise contours and closer tolerances when complex shapes are involved

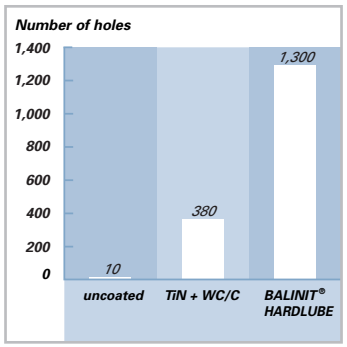
### DISTINCTIVE ADVANTAGES FOR HARD MACHINING

More and more frequently, molds are being manufactured with BALINIT®-coated mills using hard machining methods; this clearly reduces production times and costs in comparison with die sinking. But the graphite electrodes for die sinking can also be manufactured more quickly, more cost-effectively and to better quality standards when using BALINIT®-coated tools.



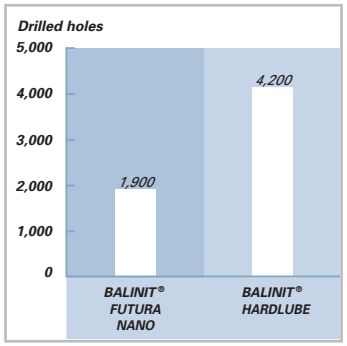
# BALINIT® GIVES YOU A GRIP ON MANUFACTURING RELIABILITY

## TAPPING (DRY)




Tool:
HSS tap M8
Workpiece:
DIN 1.7225 / AISI 4140
Cutting speed:
$V_C$ = 50 ft/min

## DRILLING (WET)



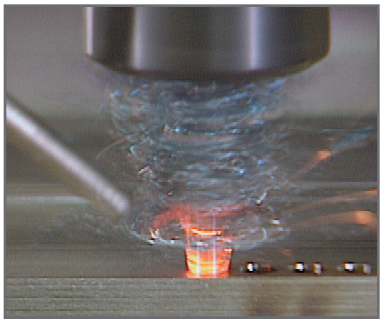

Tool:
Carbide drill, diam. 5/16 in
Workpiece:
DIN 1.7227 / AISI 4150
Cutting parameters:
$V_C$ = 300 ft / min
f = 0.008 in / rev
Drilling depth:
0.7 in
Coolant:
Emulsion

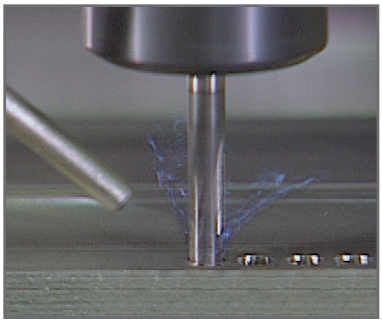
With the BALINIT® HARD-LUBE-coated drill (right), the chips flow through the flute as if lubricated; the TiAlN-coated drill (left) has reached the end of its service life after the same number of holes drilled.

In complex metal removal operations, the emphasis is on ever-greater manufacturing reliability. The reproducible cutting data and tool life of BALINIT®-coated tools make it possible to calculate tool changes and maintain uniform cycle times.

### DRY MACHINING WITH BALINIT®

The combination of a wear and temperature-resistant hard coating with a PVD low-friction coating enables dry drilling and tapping in steel and aluminium wrought alloys. The outer lubricant layer assures that the flutes appear polished after only a few revolutions to achieve smooth chip flow. The inner hard coating effectively protects the cutting edges against wear even at extremely high service temperatures. This results in greater manufacturing reliability even in wet machining, especially when deep holes are being drilled.



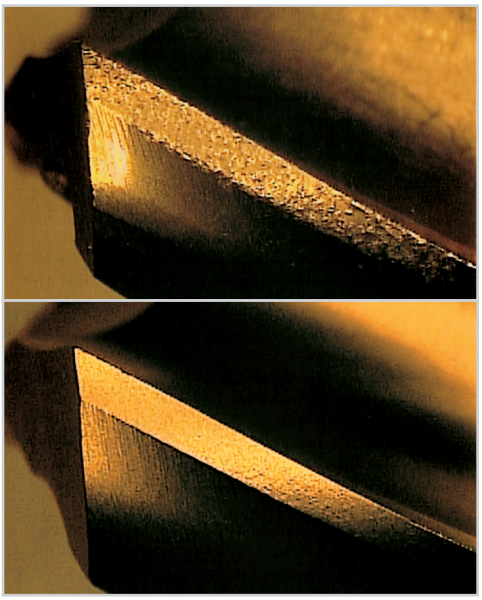


## RECOATING OFFERS EVEN GREATER SAVINGS

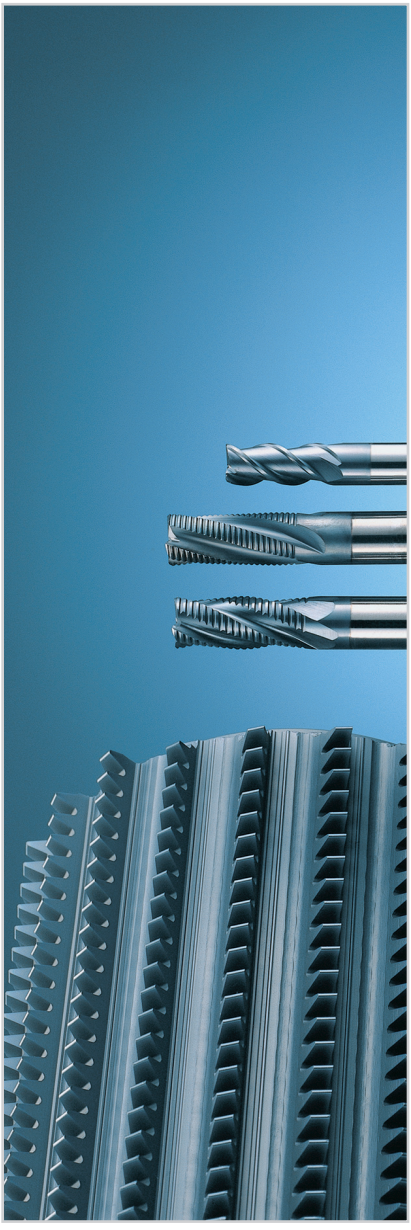
The full benefit of BALINIT® coatings is realized when resharpened tools are recoated. They deliver the same performance as coated new tools – a must if specified service life and cycle time are to be maintained in production lines.

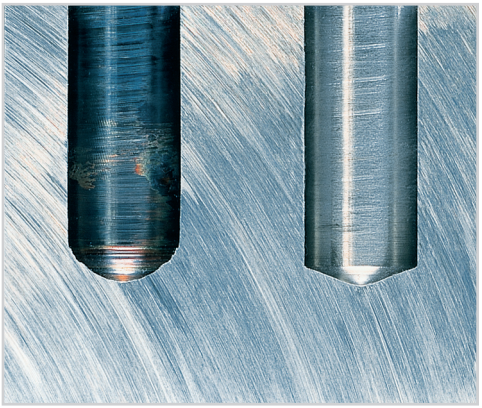
Resharpened tools recoated with BALINIT® have a longer aggregate service life. Moreover, they reduce:

- tool costs
- resharpening costs
- tool changes
- scrap



If all hobs for the production of transmission gears are recoated, this process alone can save more than $60 million for a worldwide production of 50 million cars a year.





After the same number of holes drilled, a distinct difference can be seen in the quality of the holes: TiAlN-coated drill (left), BALINIT® HARDLUBE-coated drill (right).

# BALINIT® ALCRONA SETS NEW PERFORMANCE BENCHMARK

## BALINIT® ALCRONA MAKES YOUR TOOLS FIT FOR THE ULTIMATE IN PERFORMANCE

The new magic tool coating formula is aluminium chromium nitride (AlCrN). BALINIT® coatings of this new G6 generation developed by Balzers markedly expand the performance envelope versus conventional titanium- based coatings (such as TiAlN, AlTiN or TiCN).

## UNIQUE COATING PROPERTIES

The BALINIT® ALCRONA AlCrN coating exhibits thus far an unmatched degree of oxidation resistance and hot hardness. These properties have triggered a quantum leap in tool wear resistance.

## THE BOTTOM LINE: GREATER PRODUCTIVITY

Tools coated with BALINIT® ALCRONA let you choose perceptibly higher cutting speeds and allow you to more effectively exploit the potential of modern machine tools. You can produce more parts per time unit to decisively boost the productivity of your manufacturing resources and hone your competitive edge.

Extraordinary performance gains have been demonstrated in dry and wet machining processes involving

- Unalloyed steels
- High-strength steels
- High-hardness steels (up to 54 HRC)

## HARNESS THIS TOTALLY NEW TOOL COATING FORMULA

BALINIT® ALCRONA is eminently suitable for

- Carbide end mills and indexable carbide inserts for roughing and finishing
- HSS end mills for roughing and finishing
- Carbide and HSS hobs
- CBN indexable inserts for turning

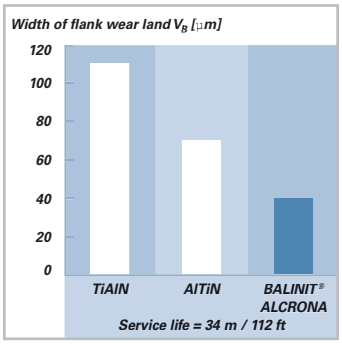
## SUPERIOR PERFORMANCE FOR THE ENTIRE LIFE OF THE TOOL

As is the case with all BALINIT® coatings, BALINIT® ALCRONA is suitable for recoating tools with no trade-off in performance.

| PROPERTIES OF BALINIT® ALCRONA | |
|---|---|
| Coating material | AlCrN |
| Microhardness (HV 0.05) | 3,200 |
| Oxidation onset temperature | 1,100°C<br>2,000°F |
| Residual compressive stress (GPa) | -3 |
| Coating color | Blue-grey |

# BALINIT® ALCRONA ESTABLISHES A NEW BENCHMARK IN MILLING

## ROUGHING




**Tool:**

Carbide end mill, D = 10mm / 0.39in

**Workpiece:**

Steel 52 HRC

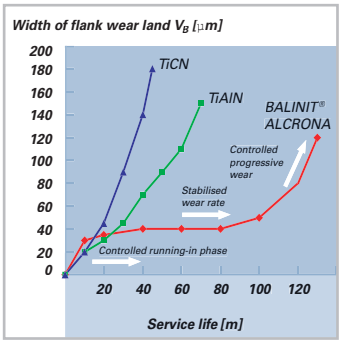
**Machining mode:**

Dry

**Source:**

Oerlikon Balzers Cutting Laboratory

## FINISHING




**Tool:**

Carbide end mill, D = 8mm / 0.31in

**Workpiece:**

Steel DIN 1.1191 / AISI 1045

**Cutting speed:**

$v_c$ = 400 m/min / 1,312 ft/min

Cooled

**Source:**

Oerlikon Balzers Cutting Laboratory

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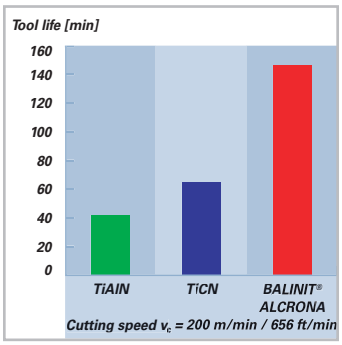


**Tool:**

Carbide end mill, D = 8 mm / 0.31 in

**Workpiece:**

Steel DIN 1.1191 / AISI 1045

**Cutting parameters:**

$f_t$ = 0.1 mm / 0.004 in

$a_e$ = 0.5 mm / 0.020 in

$a_p$ = 10 mm / 0.394 in

Climb milling

Emulsion 5%

$VB_{max}$ = 0.12 mm / 0.005 in

**Source:**

Oerlikon Balzers Cutting Laboratory

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## PROPERTIES AND APPLICATIONS OF BALZERS BALINIT® WEAR–RESISTANT COATINGS

| | BALINIT® A | BALINIT® B | BALINIT® D | BALINIT® ALCRONA | BALINIT® HELICA |
|---|---|---|---|---|---|
| **Coating Material** | Titanium Nitride (TiN) | Titanium Carbonitride (TiCN) | Chromium Nitride (CrN) | Aluminum Chromium Nitride (AlCrN) | Aluminum Chromium Nitride (AlCrN)-based |
| **Microhardness (HV 0.05)** | 2300 | 3000 | 1750 | 3200 | 3000 |
| **Coefficient of Friction Against Steel (Dry)** | 0.4 | 0.4 | 0.5 | 0.35 | 0.25 |
| **Coating Thickness** | 2 - 4 µm | 2 - 4 µm | 2 - 6/10 µm | 2 - 5 µm | -4 |
| **Oxidation Onset Temperature** | 600° C<br>1100° F | 400° C<br>750° F | 700° C<br>1300° F | 1100° C<br>2000° F | 1100° C<br>2000° F |
| **Coating Color** | Gold-Yellow | Blue-Grey | Siver-Grey | Blue-Grey | Copper |
| **Key Characteristics** | Basic TiN hard coating | Enhanced hardness and wear resistence over TiN | Excellent adhesion, high toughness, good corrosion resistence | Highest oxidation resistenceand hot hardness for high temperaturewear resistence | Multilayered, smoothened coating for balanced high temperture wear resistance and heat conductivity |
| **Primary Applications (HSS & carbide cutting tools; stamping & forming tools, dies & molds; sliding wear components)** | General purpose coating for cutting, forming, plastic molding | Cutting carbon steel, alloy steel and cast iron; cold forming & stamping tools | Machining copper; metal forming; plastic molding | General wet/dry machining esp. hobbing, milling, soft to hard steels (up to 54 HRc), cast iron stainless steel, also for CBN inserts; hot forming tools | Specialized for drills; proven on carbon steels, cast iron, stainless steels; including deep hole application |

*For non-HSS metalforming tools or components to be PVD coated, tempering temperature must be > 500 °C (950 °F)*

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## PROPERTIES AND APPLICATIONS OF BALZERS BALINIT® WEAR–RESISTANT COATINGS

| | BALINIT® FUTURA NANO | BALINIT® X.TREME | BALINIT® X.CEED | BALINIT® HARD-LUBE | BALINIT® TRITON | BALINIT® DIAMOND |
|---|---|---|---|---|---|---|
| **Coating Material** | Titanium Aluminum Nitride (TiAlN) | | | Titanium Aluminum Nitride/ Tungsten Carbide/ Carbon (TiAlN/WC/C) | Diamondlike Carbon | Crystalline Diamond |
| **Microhardness (HV 0.05)** | 3300 | 3500 | 3300 | 3000 | 2500 | >8000 |
| **Coefficient of Friction Against Steel (Dry)** | 0.3 - 0.35 | 0.4 | 0.4 | 0.15 - 0.2 | 0.1 -0.2 | 0.15 - 0.2 |
| **Coating Thickness** | 1 - 5 µm | 1 - 3 µm | 1 - 3 µm | 2 - 6 µm | 1 - 3 µm | 6 - 20 µm |
| **Oxidation Onset Temperature** | 900° C 1650° F | 800° C 1470° F | 900° C 1650° F | 800° C 1470° F | 350° C 660° F | 600° C 1100° F |
| **Coating Color** | Violet-Grey | Violet-Grey | Blue-Grey | Dark-Grey | Black | Grey |
| **Key Characteristics** | Nanolayered coating, high toughness & oxidation resistance | High oxidation resistance, hardest nitride coating | Smooth morphology, highest oxidation resistance (within the TiAlN family) | Combined hard and lubricant coating layers | Enhanced sliding wear load capacity with high lubricity | Hardest coating, best abrasive wear resistance |
| **Primary Applications (HSS & carbide cutting tools; stamping & forming tools, dies & molds; sliding wear components)** | Broad-based coating for cutting all steels, cast iron, stainless steel, dry machining possible; forming; die-casting; | Specialized for carbide end mills for hardened steel work pieces, dry machining possible | For carbide tool machining of hard steels (>50 HRC), aerospace materials include titanium alloys, stainless steel, Inconel | For improved chip flow in wet or minimal lubrication machining e.g. milling, drilling, tapping cast iron, hardened steels, titanium alloys | Avoids built up edge in cutting aluminum (<11%Si) alloys; molding; sliding wear components | For carbide tools only, machining graphite, fiber-reinforced plastic, pre-sintered carbide, aluminum (>11%Si) alloys, non-ferrous metals, wood |

*For non-HSS metalforming tools or components to be PVD coated, tempering temperature must be > 500 °C (950 °F)*

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## BALZERS COATING SELECTION GUIDE FOR CUTTING TOOLS

| Material | TURNING | MILLING | | DRILLING | | HOBBING | |
|---|---|---|---|---|---|---|---|
| | HM | HSS | HM | HSS | HM | HSS | HM |
| Plain Carbon Steel <30 HRc | B/FN/AC | B/FN/AC | FN/AC<br>FN/AC | FN/HL | HL/AC<br>FN/HL | FN/AC<br>FN/AC | FN/AC<br>FN/AC |
| Alloy Steel 30 - 45 HR | B/FN/AC | FN/AC<br>B/FN/AC | FN/AC<br>FN/AC | FN/HL | HL/AC<br>FN/HL | FN/AC<br>FN/AC | FN/X/AC<br>FN/X/AC |
| Hardened Alloy Steel > 45 HRc | AC** | FN/AC | XC/AC<br>XC/AC | | FN/HL/AC<br>FN/HL | | |
| Stainless Steel | HL/XC/AC | FN/HL | XC/HL/AC | FN/HL | FN/HL | | |
| Cast Iron | HL/AC<br>FN/AC | FN/HL<br>FN/AC | FN/AC<br>FN/AC | FN/HL<br>FN/HL | FN/HL/AC<br>FN/HL/AC | | |
| Wrought Aluminum Alloy | B/TR | TR | HL/TR | TR | TR<br>HL/TR | | |
| Cast Aluminum < 12%Si Alloy | HL/TR | TR | HL/TR | TR | HL/TR | | |
| Titanium Alloys | FN/HL/XC | HL/AC | HL/XC/AC | FN/HL | HL/XC/AC | | |
| Nickel Based Superalloy | FN/XC/AC | FN/HL | X/XC/AC | FN/HL | FN/HL | | |
| Copper Alloy | D/HL | D/HL | D/HL | HL | D/HL | | |
| Brass/ Bronze | FN/HL | FN/HL | FN/HL | FN/HL | FN/HL | FN/HL | FN/HL |
| Graphite | DIA | | AC/DIA | | DIA | | |
| Carbon Composite | DIA | | DIA | | DIA | | |

A = BALINIT® A
AC = BALINIT® ALCRONA
B = BALINIT® B
C = BALINIT® C
D = BALINIT® D
DIA = BALINIT® DIAMOND
TR = BALINIT® TRITON
FN = BALINIT® FUTURA NANO
HL = BALINIT® HARDLUBE
X = BALINIT® X.TREME
XC = BALINIT® X.CEED

Red Colored Type: Dry / Mist Lubrication
Blue Colored Type: Wet Machining

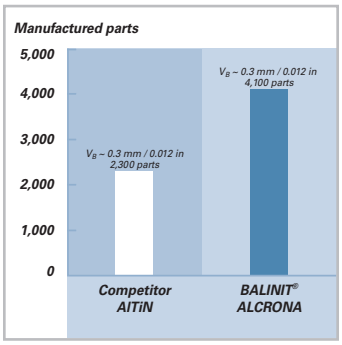
* Turning includes cuttoff, grooving, threading
** With CBN insert

Multiple choice e.g., B/FN/AC means B=>FN=>AC recommended as cutting speed increases.
HM = carbide or cermet hardmetal
HSS = high speed steel

For metalforming applications check tempering temperature: if below 500° C (950° F), call for details. Specialty coatings available on request, for updates please check our web site.

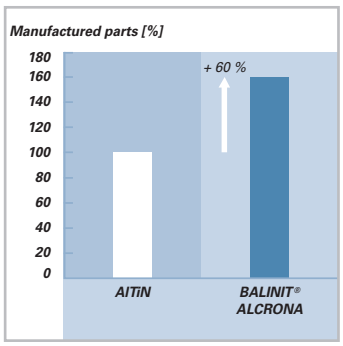
# BALINIT® ALCRONA PRODUCTIVITY IN HOBBING AND TURNING

## HOBBING



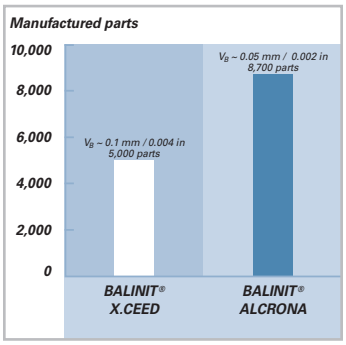

**Tool:**
PM-HSS hob
**Workpiece:**
Steel DIN 1.7131 / AISI 5115
**Cutting parameters:**
$v_C$ = 200 m/ min/656 ft/ min
Dry
**Source:**
Automotive manufacturer

## TURNING




**Tool:**
CBN indexable inserts
**Workpiece:**
Steel 49 to 62 HRC
**Machining:**
Outer diameter turning
Partly interrupted cuts
Partly thin webs
**Source:**
Automotive supplier

## HOBBING




**Tool:**
Carbide hob
**Workpiece:**
Steel DIN 1.7225 / AISI 4142
**Cutting parameters:**
$v_C$ = 260 m/min / 853 ft/min (roughing)
$v_C$ = 500 m/min / 1,640 ft/min (finishing)
Dry
**Source:**
Automotive supplier

APPLIED TOOL COATING TECHNOLOGY

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WWW.STAR-SU.COM

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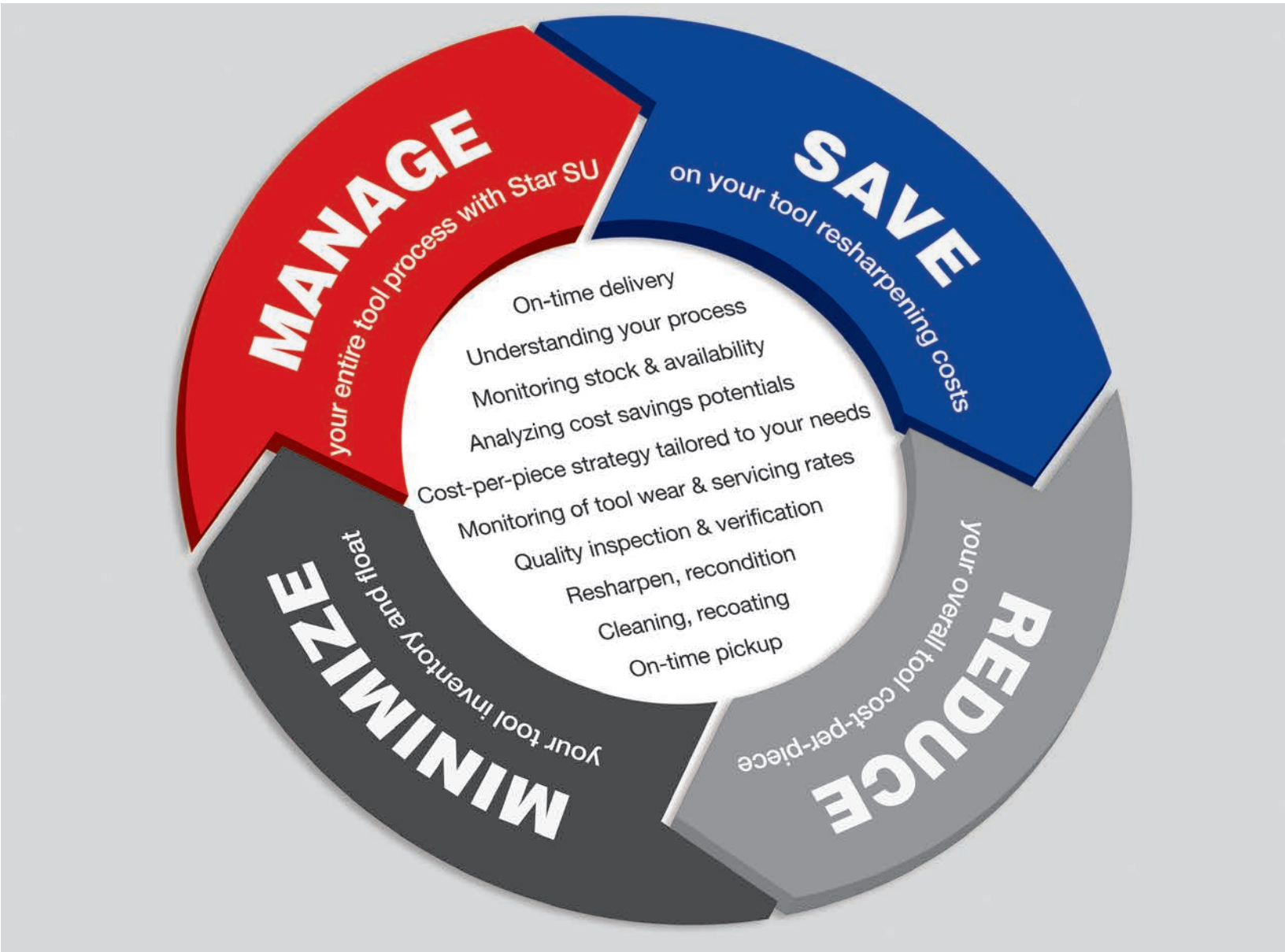
# TOTAL TOOL LIFE CYCLE MANAGEMENT




Services for resharpening tools, managing tool services, PPU and CPU programs

## Total tool life cycle management to match your production needs...

## ...by optimizing each step of the tool life cycle process…to minimize your tool cost-per-piece

Are you really in control of your per-piece tool costs?

Are you really considering all costs connected to your tool supply and maintenance efforts inhouse?

Are all of the steps in your inhouse process chain optimized?

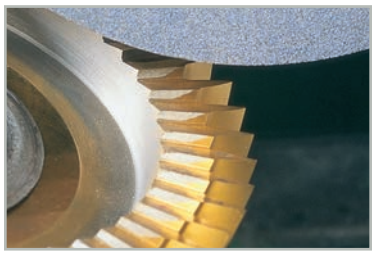
Are you paying too much to maintain your tools?

Star SU offers total tool life cycle management services and equipment for every step of your manufacturing process, including individualized support services to keep your tools running efficiently.

With our new innovative cost/piece (CPU or PPU) approach you can control your perishable tool costs from a reliable and experienced source. We guarantee a certain cost/piece, taking away your worries about the actual tool cost, its potential life or future servicing processes.

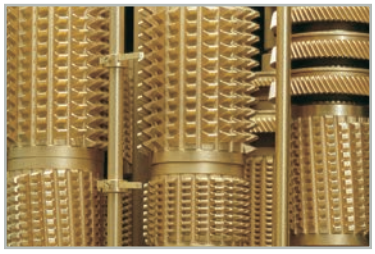
Tools are delivered on time to your appropriate production facility, used tools are automatically picked up, inspected, re-sharpened, edge-prepped and recoated, and delivered according to your needs.

Finally, you choose our level of involvement: from supplying pure reconditioning services for existing single tools to complete service management with the purchase of the initial product.



### DESIGN – FROM THE IDEA TO THE TOOL

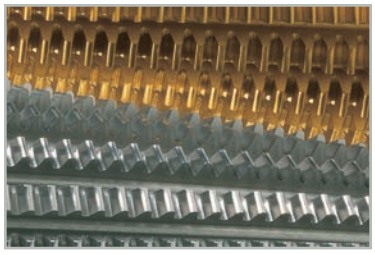
You do not have to worry about the complexity of certain tool types. Specify what you need in a particular gear, spline or tooth form and our team of application and design engineers will do the rest: from quoting the product, designing the tool drawing, creating the roll-out to the final manufacturing of the tool. Our expert staff will work closely with you to make sure you are able to meet your requirements.



### COATING

All Balzers thin film coatings are available to customers through the U.S., Canada, Mexico and South America. Coating types are tailored for different operating conditions.

- Titanium Nitride TiN
- Titanium Carbo-Nitride TiCN
- Futura Nano TiAlN
- Alcrona Pro AlCrN



### RECOATING

Bringing coated tools back to optimum life after resharpening by using the latest Balzers Coating Units, all types of PVD thin film coatings can be reapplied to greatly improve tool performance. For the most demanding applications, enhanced coatings from the latest Balzers Coating Units are available.

### EDGE PREP

All tools are edge-prepped prior to coating to enhance tool life and coating adhesion.

## RESHARPENING – ACHIEVING ORIGINAL TOOL PERFORMANCE

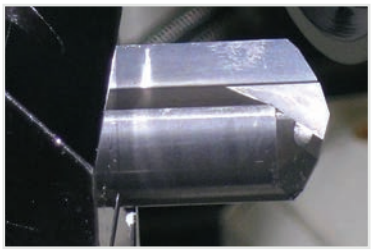
Star SU utilizes high precision, modern CNC grinding machines to restore hobs, shaper cutters, shaving cutters, master gears, milling cutters, rack cutters, saw cutters, as well as chamfering/deburring tools to their original quality, condition and performance.

The widest range of types, configurations, and sizes can be accommodated: from the smallest fine pitch hob to the largest shaving cutters.

Overall, the services are fast, convenient and cost effective – with quality that is unmatched by any other regrind service.

## APPLICATION SERVICES

Star SU provides the services to determine strategies to reduce cutting tool cost-per-piece through lower costs to sharpen and recoat. Recommendations for cutting speeds and feeds from experienced engineers will help you optimize your process through a design of tool review to possibilities to decrease tool change frequency and change over time.



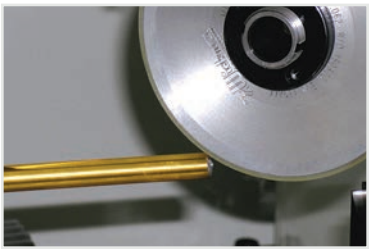
## FAST, FASTER, FASTEST

Our service centers in Michigan, Illinois, and Mexico provide you with fast turnaround of high precision sharpenings.

Pickup and delivery services are available in some areas, as well as complete CMS systems to minimize freight and logistics costs by advanced logistics planning.

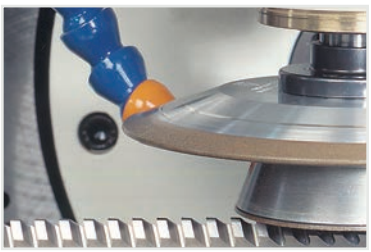
## ADVANTAGES OF TOOLS SERVICE

- No capital cost
- No labor or indirect cost
- Reduced inventory
- Better tool life



## SERVICES

- Resharpening of gundrills, reamers and solid carbide tools, including high performance points.
- Recoating of round tools, including Gundrills and reamers
- Reworking - Retip & Resharp Program
- Broach sharpening
- Retipping of gundrills and brazed reamers
- State-of -the-art inspection
- Resharpening of hobs, shaper cutters, shaving cutters, rack cutters, master gears, milling cutters, chamfering and deburring tools and rolling racks.



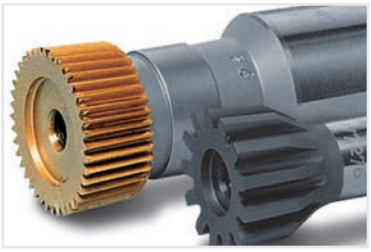
## APPLYING ADVANCED COATINGS

Constant improvement of existing coatings and research of the latest coating technology is a result of the collaboration between Star SU and Oerlikon Balzers Coating.

The Coating process is further optimized by using automated cleaning equipment to remove all oils and residues. Substrates are delivered for coating in a thoroughly clean condition to help guarantee the ultimate quality of the coated product.

Our Balzers coatings will improve abrasion, wear resistance and can increase life up to 10 times in certain applications.

- HSS and carbide tools
- Molds and dies
- Special tools
- Machined parts and other applications



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