# GUNDRILLS

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 allowing for adequate chip evacuation down the flute channel.

Star SU's Single flute gundrill product line diameter range is .078" [1.98mm] through 1.500" [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 thus 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.

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

The additional advantages of a single flute gundrill:

- Straightness tolerance 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 SU's gundrill engineering center allows designing the tool to custom fit each application.

***Star SU 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 is a single flute 3 piece contructions design and has the deepest flute channel, thus enabling maximum chip evacuation. Diameters are available from .0781 - 1.5".

***Multi step gundrill*** Star® step gundrills are used to produce holes concentric to one another. 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 with regard to length of step and diameter ratio.

## DOUBLE-JET GUNDRILLS

Star SU 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 SU's double jet product line diameter range is .200" [5.08 mm] through 1.500" [38.1mm]. The overall lengths 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 SU 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 .2000" - 1.5."

## SOLID CARBIDE SINGLE FLUTE GUNDRILL

Solid Carbide Gundrills are a two-piece contruction 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 .200" [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's 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 can allow penetrating at 100% to 200% higher feed rates running at conventional RPM's.

### 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 SU Solid Carbide Gundrill*** A 2-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" - .2000". 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. Therefore, with the flute channels on this type of tool being somewhat shallower then the Single Flute, they limit the type of materials to be drilled by the chip size generated. The most common materials drilled are cast iron and cast aluminim. The Double-Crimp has advantages. First, the coolant holes in the Gundrill body are formed by the crimping action; therefore, minimizing the coolant turbulence at the head/body transition. Second, the flutes being equally swaged 180 degrees apart allow 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 geometry angles ground to precise dimensions. With the combinations of geometry, clearances and backtaper, the chip load is reduced by 50% and higher penetration rates are obtained. making the Double-Crimp Gundrill the tool of choice. Double-Crimp Gundrills are available in diameters from .1875" - .5625" with lengths to 72".

***Star SU 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 two flute two hole Gundrill differentiates from the Double-Crimp by the rigidity of its body. 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 ridged tool. Application dictated, this tool is applied in operations that require maximum penetration rates. Like its counterpart, the DCGD, geometries, clearances and backtaper 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 .250" - 1.0" with lengths to 48".

***Star SU Two-Flute Two-Hole Gundrill*** Used for high penetration, same as the Double-Crimp. This tool has a milled flute design and allows maximum rigidity. It is applied where length to diameter ratios dictate a more rigid tool due to the lack of whip guides. This also has a limited flute channel and can only be applied on applications where the chips are smaller in size. Diameters are available from .2500" - 1.000". Lengths are available up to 48".

## 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]. TExtruded 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. Coolant in Gundrilling is used for flushing chips down the flute channel of the tool, cooling the cutting edges, and lubricity. There are three styles of coolants used, including Oil, Semi-Synthetic and Water Soluble.

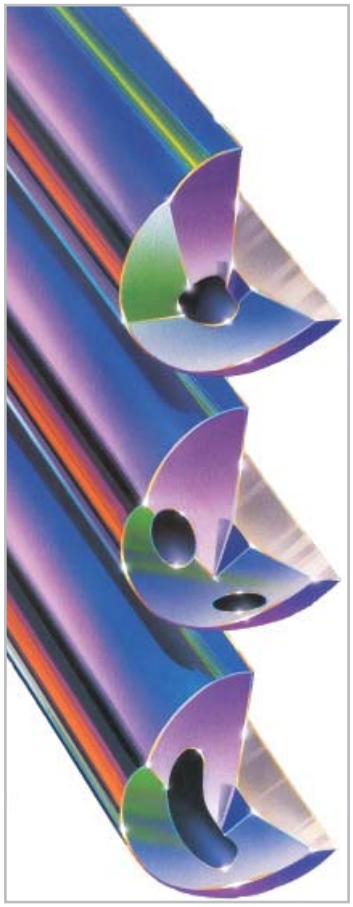
Straight Oil is the best type of coolant for tool life, due to having Sulfur and Chlorine in the mixture. Sulfur is used for an anti-weld, which helps eliminate buildup on the cutting edge. The chlorine is added to assist as a lubricant allowing for better chip evacuation.

Semi - Synthetic is a metal working fluid that is a combination of 5-50% mineral oils, water, and synthetic chemicals. This coolant is used in many cases for environmental reasons versus straight oil. However, its drawback is normally a tool life reduction.

Water Soluble is a chemical solution that contains no mineral oils. This coolant requires a concentration level to be maintained in Gundrilling. It's 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 degrees 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 |

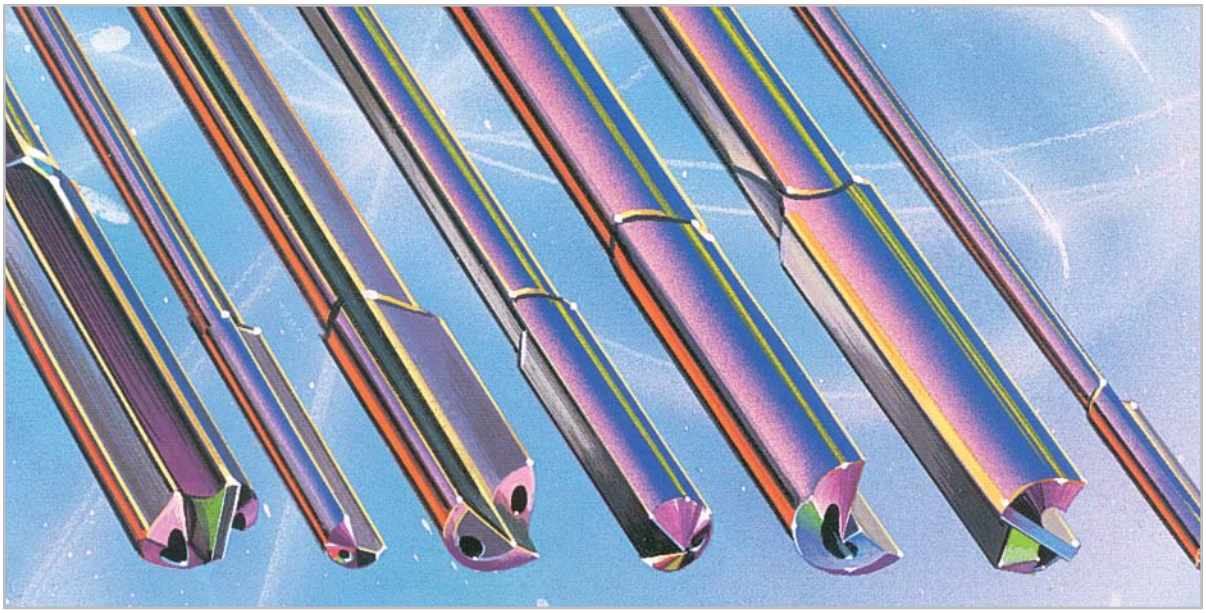
RPM = SFM / (DIA x .262)  IPM = RPM x IPR

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)

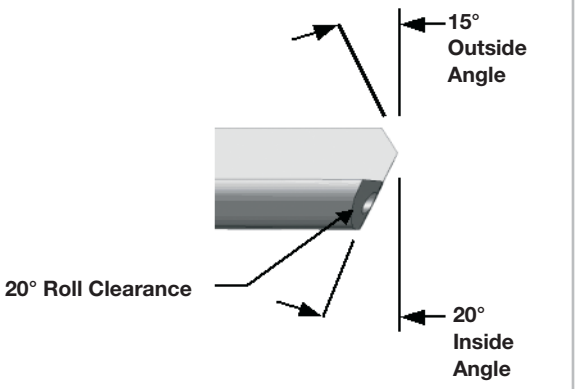
| | | K-Monel, Hastelloy B,G,X Incoloy 800-825 Tungsten, Refractoaloy | | | Waspaloy, A286, Rene, Haynes Inconel, 600, 625, Nimonic | | | Titanium, 718 Inconel, Molly Nitronic 40-080 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| DIA | Pressure | 80 SFM | | | 100 SFM | | | 135 SFM | | |
| IN | 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”**

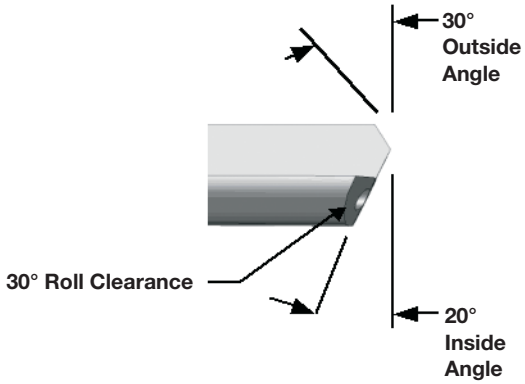
| Gundrill Diameter | Surface Feet Per Minute | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 550 | 600 |
| 0.078 | 6 | 5 | 5 | 4 | 4 | 4 | 3 | 3 | 3 | 2.5 | 2.5 |
| 0.093 | 8 | 7 | 6 | 5 | 5 | 4 | 4 | 4 | 4 | 3.5 | 3.5 |
| 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.

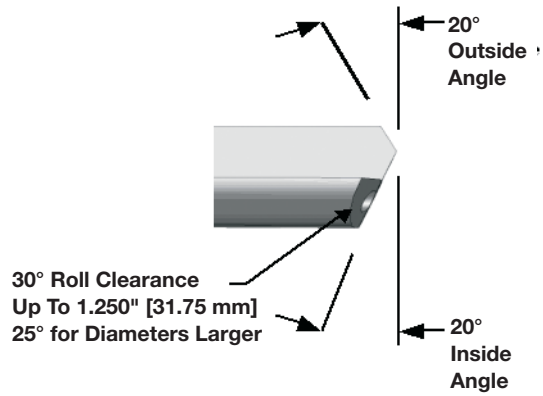
# STANDARD GRINDS



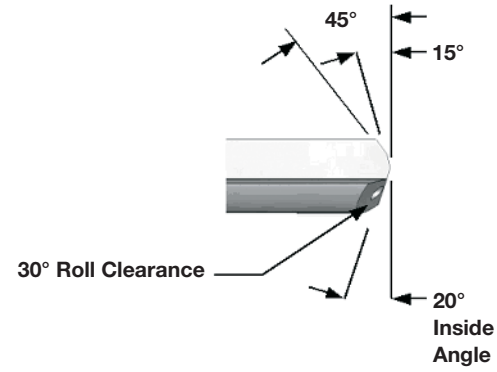

ALUMINUM




STEEL



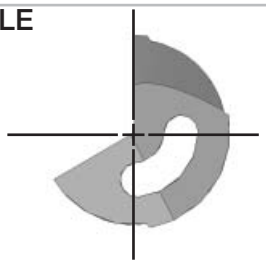

CAST IRON




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

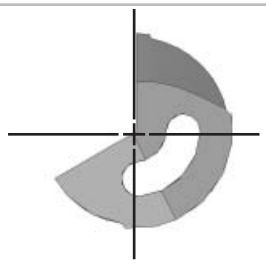
# CONTOUR GRIND GEOMETRIES

## NON-MICABLE



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

## MICABLE

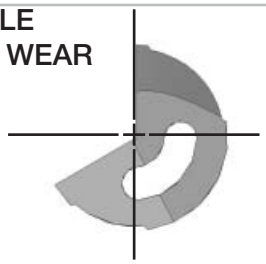


Used in Cast Irons and Aluminum that have cross holes, or requires good size control and is good for angular entry.

## MICABLE WITH THIRD WEAR PAD

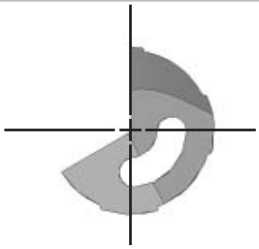
Assist in increasing the finish in Non-Ferrous materials, good for intersecting holes and interrupted cuts where extra OD support and burnishing is required.

## NON-MICABLE WITH THIRD WEAR PAD



Recommended for all Non-Ferrous and Cast Iron Gundrills with diameter up to .2000" [5.08mm]

## SPLIT PAD



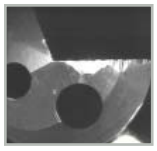
For good size control (including exit), special purpose contour is good for cross drilling, will help burnishing the bore, and good for reducing material build up on the Outer Diameter.

## WEAR CHARACTERISTICS WITH TOOL LIFE IMPROVEMENT AREAS

There are three areas viewed on a gundrill for wear. Point Wear, Flank Wear and Outer Diameter 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.

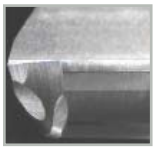
Essentially a partially worn tool would not be installed. A good indicator of this is a noticeable difference in tool life from a new tool to the regrind. When changing geometries, or machine parameters, for tool life improvement, it is recommended that one thing at a time is changed and run a controlled test.


SHARP


WORN

### POINT WEAR

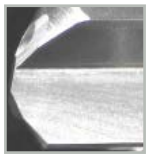
The point wear is a good indicator of a tool being worn. When the wear on the point starts approaching 1/2 - 2/3 the distance of the margin, the tool is considered worn and needs to be reground. If a tool is experiencing premature tool life in this area, there is a good possibility that the tool has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

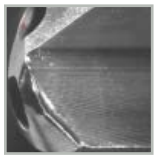

SHARP


WORN

### OUTER DIAMETER WEAR

If a gundrill is pulled prematurely due to rounding of this corner, it is a good indicator the tool is being run at too high RPM. The RPMs need to be decreased with consideration toward maintaining the surface finish and chip load based on the material being machined. 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. The setting for RPMs or Feed rates could be off. Increasing the RPMs or decreasing the feed rate can assist in this area. 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 ticking in.

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

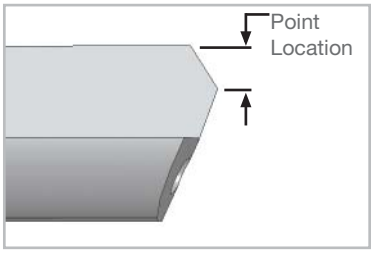
### HOLE MACHINED UNDERSIZED

- Increase RPM
- Increase PSI
- Decrease outer angle
- Decrease IPM

### POOR SURFACE FINISH

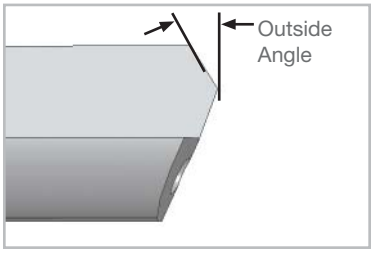
- Increase RPM
- Increase PSI
- Increase outer angle
- Decrease IPM

# SINGLE FLUTE GUNDRILL CHARACTERISTICS



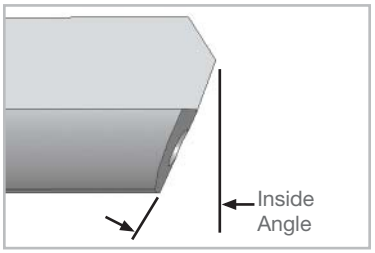

## POINT LOCATION

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.



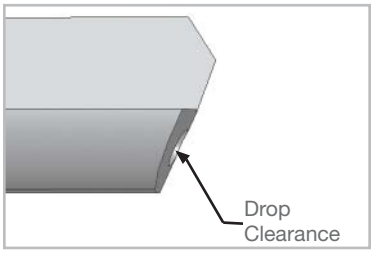

## OUTSIDE ANGLE

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 (15º to say 30º) the angle will assist in the tool cutting straighter, however it will also cut tighter. If the tool cuts too tight, it could seize in the part causing tool breakage. If this angle is decreased, the tool will tend to cut freer and wander.



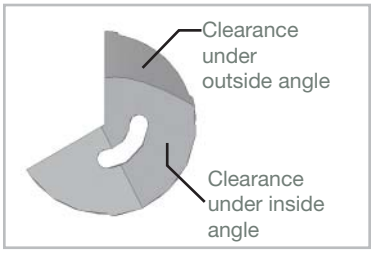

## INSIDE ANGLE

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 20º or 30º 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.

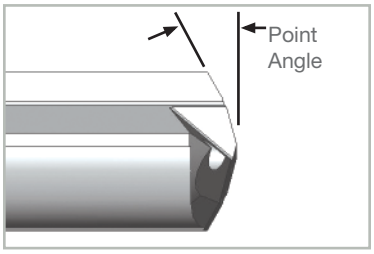



## CLEARANCE ANGLE

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

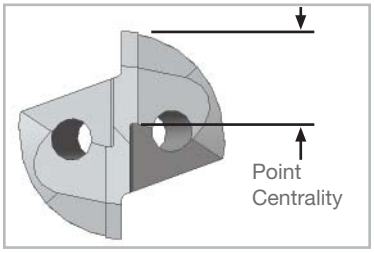
The clearance under the inside angle is a flat relief grind. This clearance is normally the same as the outside relief.

# DOUBLE FLUTE GUNDRILL CHARACTERISTICS



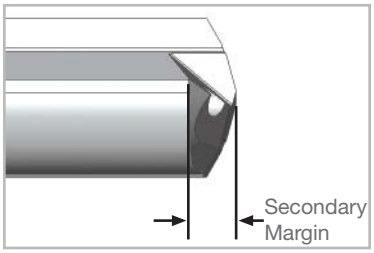

## POINT ANGLE

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 have premature wear.



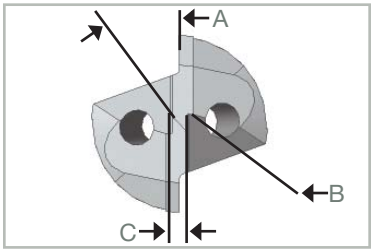

## POINT CENTRALITY

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 trials 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. This allows 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 bushing for traditional gundrilling: high-speed steel or tungsten carbide. The preferred choice is tungsten carbide. The high-speed steal will wear out more quickly and has a tendency toward bell mouth from the drill rotating. When a bushing becomes bell mouth, essentially, it is in oversized bushing conditions.

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

Ex. .2500" diameter gundrill

Bushing ID: .2501" - .2503"

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 practice 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°.

It is best practice to match the surface on the bushing if the part surface where the gundrill enters is irregular or has an angle. This helps the tool to enter the part with full support from the bushing. This will help prevent deflection during the start of cut. This type of setup is the same as listed previously, being flush against the part, gapped accordingly, and put a lead on the end for the tool to assist as it is re-entering the bushing.

## BUSHINGLESS PROCESS

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

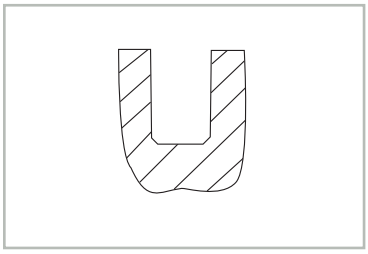
Best practice for non-ferrous materials is to pilot drill a flat bottom. In ferrous materials it is best to match the Gundrill point as close as possible. The included angle of the pilot drill is not to be less then the included of the gundrill. If the pilot drill angle is more, the Gundrill will come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

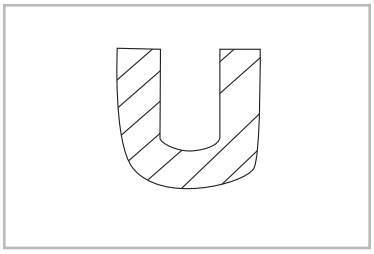
The pilot drill dimensions to the Gundrill as shown: 1.5 – 2.0 time diameter deep with .0005" - .0010 clearances from the outer diameter of the gundrill. If cycle time is needed, an advantage to this process could be to drill your pilot as deep as the carbide drill will allow. Carbide drills run at higher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

Index the drill into the pilot hole and run at very low to no RPM's. 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 RPM's and coolant pressure on and proceed to cut.

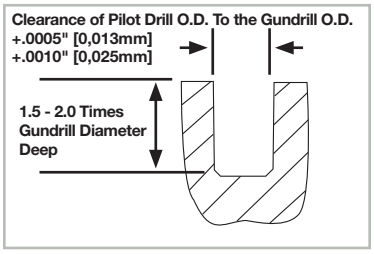
### NON-FERROUS MATERIALS



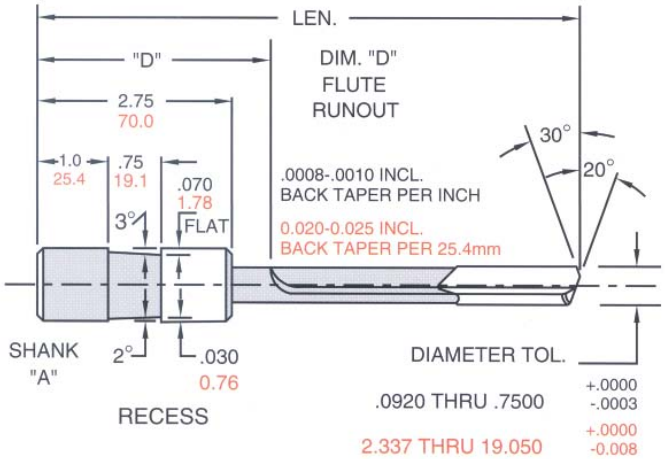
### FERROUS MATERIALS

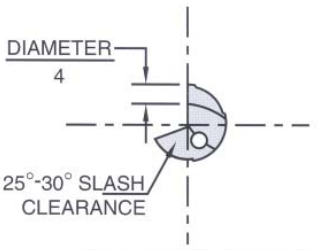


### CLEARANCE OF PILOT DRILL O.D.

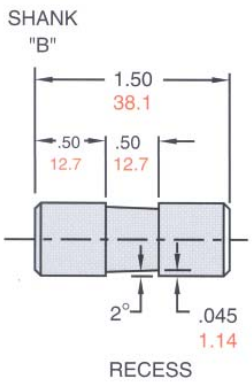


# C.D. GUNDRILLS




ROUND COOLANT HOLE
STANDARD FOR DRILLS
LARGER THAN .375
9.53
SOLID CARBIDE HEAD

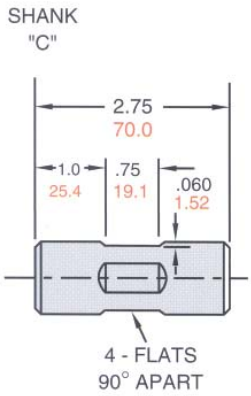



NOTE:
DIM. "D" FLUTE RUNOUT TOL.
+.25 ON DIA.'S
.0920 THRU .7500
+6.35 ON DIA.'S
2.337 THRU 6.350
+.50 ON DIA.'S
.2510 THRU 1.5000
+12.70 ON DIA.'S
6.351 THRU 38.100

ELONGATED
STANDARD
UP THRU
.375 9.53 DIA.

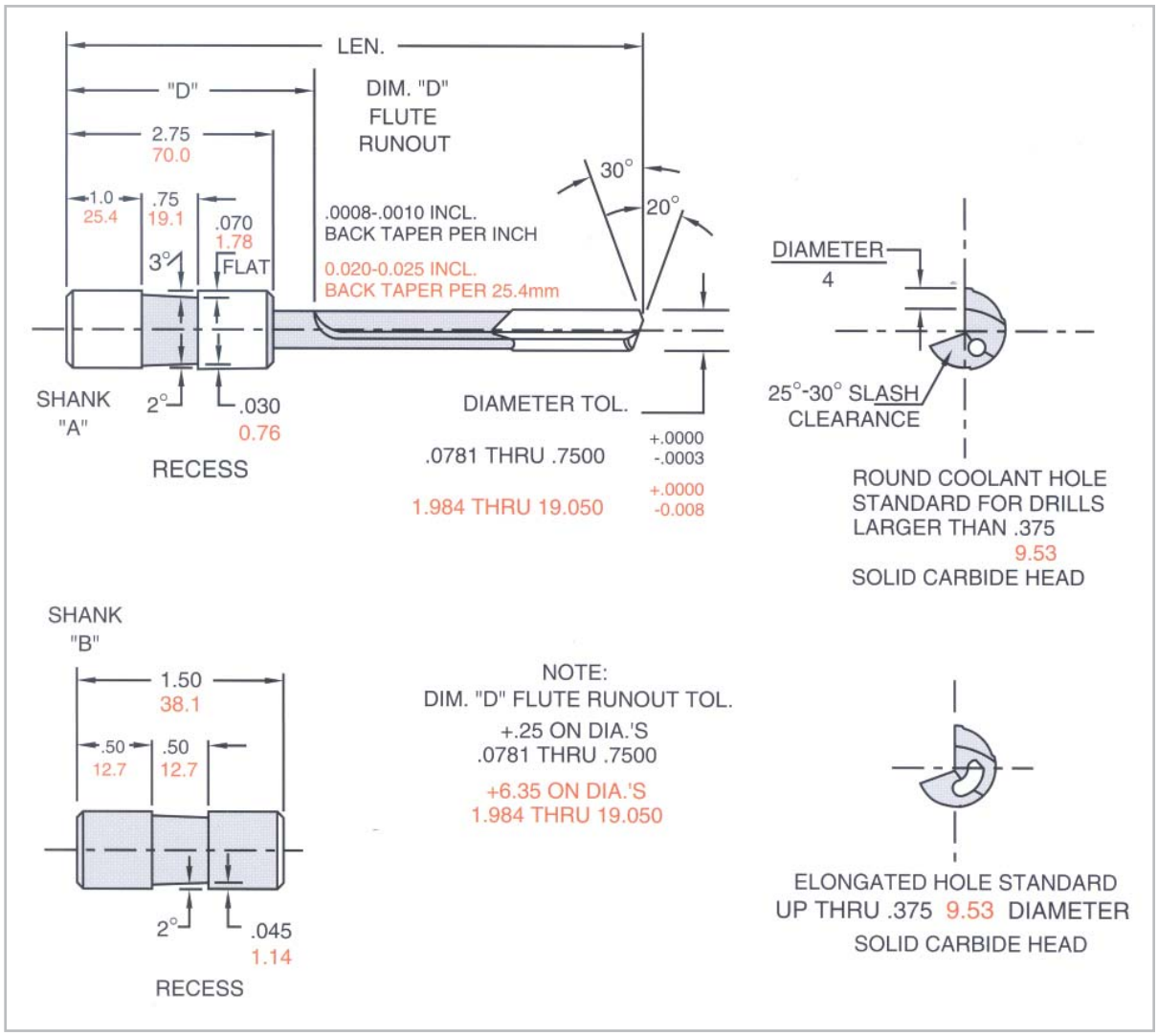
TWIN & ROUND
COOLANT HOLE
OPTIONAL

SOLID CARBIDE HEAD




| DIAMETER RANGE (IN) | DIAMETER RANGE (MM) | SHANK TYPE | SHANK DIAMETER (IN) | SHANK DIAMETER (MM) |
|---|---|---|---|---|
| .0920-.1229 | 2.337-3.123 | B | .5000 | 12.700 |
| .1230-.5079 | 3.124-12.900 | A | .7500 | 19.050 |
| .5080-.7609 | 12.901-19.327 | A | 1.000 | 25.400 |
| .7610-1.0579 | 19.328-26.871 | A | 1.250 | 31.750 |
| 1.0580-1.0999 | 26.872-27.938 | C | 1.500 | 38.100 |
| 1.1000-1.2769 | 27.939-32.433 | C | 1.750 | 44.450 |
| 1.2770-1.5000 | 32.434-38.100 | C | 2.000 | 50.800 |

## STOCK GUNDRILLS



GUNDRILLS

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