

DRILL MASTERS

El Dorado Tool

**Deep Hole
Gundrills
and
Associated
Products**



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Drill Masters and Eldorado Tool: *Bigger and better than ever!*

Until after World War II, there were no domestic manufacturers of gundrilling tools or machines in the United States. In 1948, this gap was filled when Eldorado Tool was founded to manufacture cutting tools and mandrels for deep hole drilling. As they were recognized for the quality of their work and innovation of their designs, Eldorado was asked to design and develop tools for deep holes in a variety of metals used in a wide variety of manufacturing fields.

The company's reputation and range of products grew through the 1950s, and in 1961, Eldorado developed a full line of standard gundrilling machines. In the 1970s they became the first to introduce a complete line of deep hole drilling tools, machines, fixtures and accessories for the metalworking industry.

During this period, Drill Masters, which had originally been founded as a tool manufacturer, evolved into a respected supplier of deep hole drills and accessories for the automotive, aerospace, firearm and molding industries. Both companies developed customer demonstration and training lab facilities, then added gundrilling production services.

By the year 2000 Drill Masters and Eldorado had become two of the leading designers and manufacturers of deep hole drilling tools, machines, fixtures and accessories. Their experience and knowledge of deep hole drilling techniques in almost any material and configuration had made their products and services sought after by a wide range of industries throughout the United States and the entire world.

The combining of these two leaders in 2002 has made Drill Masters-Eldorado Tool one of the largest suppliers and manufacturers of deep hole drilling tools, fixtures and accessories in the world. Our combined experience and resources offers you the widest selection of in-stock drills, and the greatest range of products, services and experience... all made in the U.S.A. Add our rapid delivery and expanded customer service facilities and you'll see why we're the leader in gundrilling for parts, service and innovative assistance.



Deep hole drilling was first developed for the manufacturing of firearms, hence the name gundrilling. Originally a time-consuming and expensive process, technological advances have made it a highly efficient manufacturing process utilized in all metal cutting industries, including automotive, aircraft, aerospace, construction, medical, tool and die, petro chemical, hydraulics, pneumatics and more.

Gundrilling is an ideal solution for most deep hole and high precision drilling projects. This operation produces accurate, repeatable holes with excellent surface finishes. Gundrills hold location to precise tolerances, are sized to exact specifications, produce burr-free holes and can be formed to produce specific shapes in blind holes and bottom forming with a minimum of machine adaptation. These systems can be easily integrated with CNC machining centers, lathes and milling machines for a relatively small investment, making it affordable for large or small shops with production requirements varying from one piece to hundreds of thousands.

The gundrill's function

Gundrilling is a metal removal process involving a drilling machine, a high pressure coolant system and a high quality drill with a single or double flute along the shank. In operation, the drill is positioned and held in the spindle nose, then guided into the workpiece through a prestarted hole or guide bushing to prevent vibration and ensure accuracy. The drill tip's cutting edges produce thin curled chips that are carried back along the shank by the high pressure coolant and deposited in the chip box. The off-center design of the cutting edges creates pressure within the bore, which is carried by pads behind the drill tip. The coolant that flushes out the chips also lubricates these pads, which burnish the surface and develop the fine finish for which gundrilling is known.

The gundrilling machine

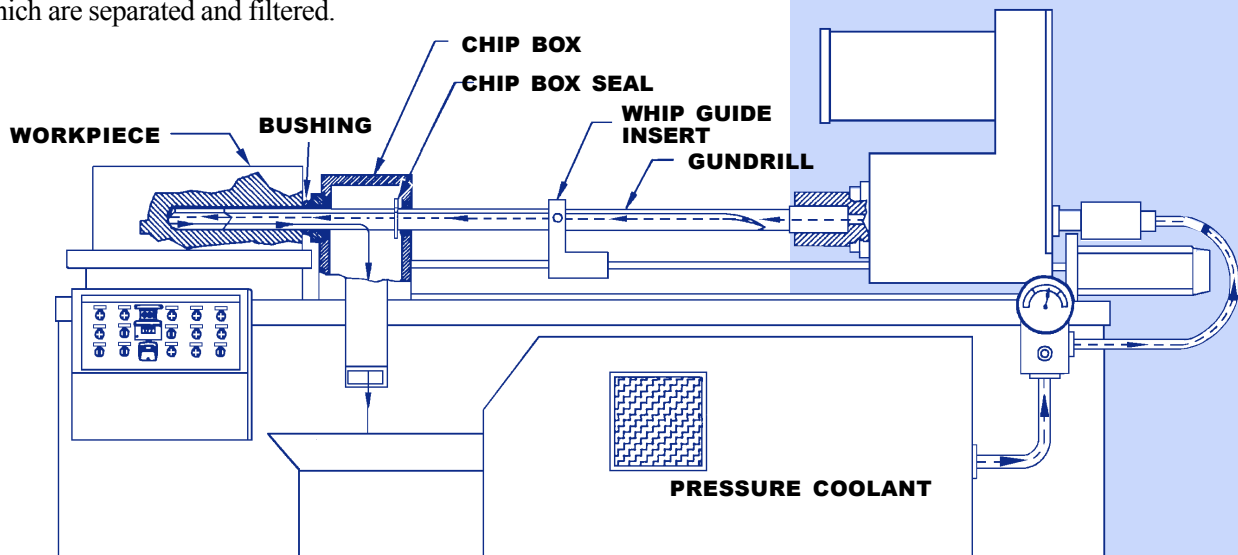
Designed to provide optimum conditions for gundrill operation, the gundrilling machine's high pressure pump delivers lubricant to the rear of the drill. The drill can be driven by the spindle or be held stationary if the workpiece is rotated. During drilling, the workpiece can be advanced or the drill can advance.

The gundrill is supported by anti-whip devices along the shank and at the rear of the chip box. The chip box contains chip defectors and a front end bushing, which guides the drill into the workpiece. The chip box also contains escaping chips and lubricant, which are separated and filtered.

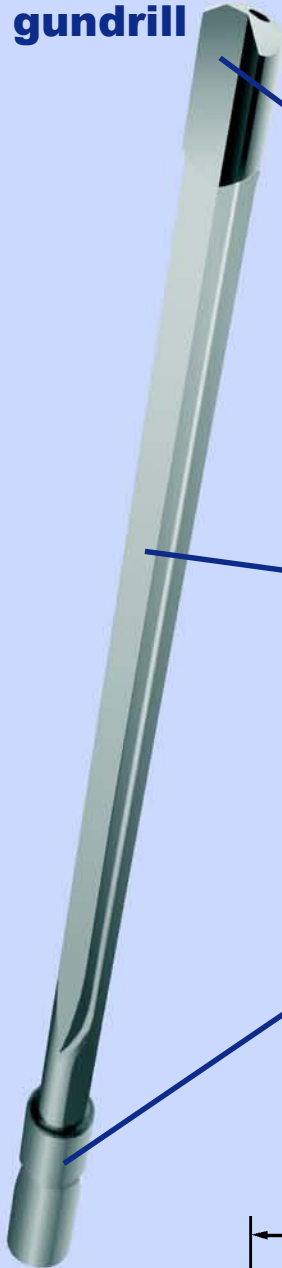
The Gundrilling Process

- Straightness tolerances of .001" (.025mm) per foot.
- Concentricity tolerances of .001" (.025mm) per inch or better.
- Hole diameter tolerances of +/- .0005" (.0127mm)
- Finish tolerances as low as 4 Ra.
- Burr-free intersections
- Consistent reproduction from hole to hole.

All in one pass



The anatomy of a gundrill

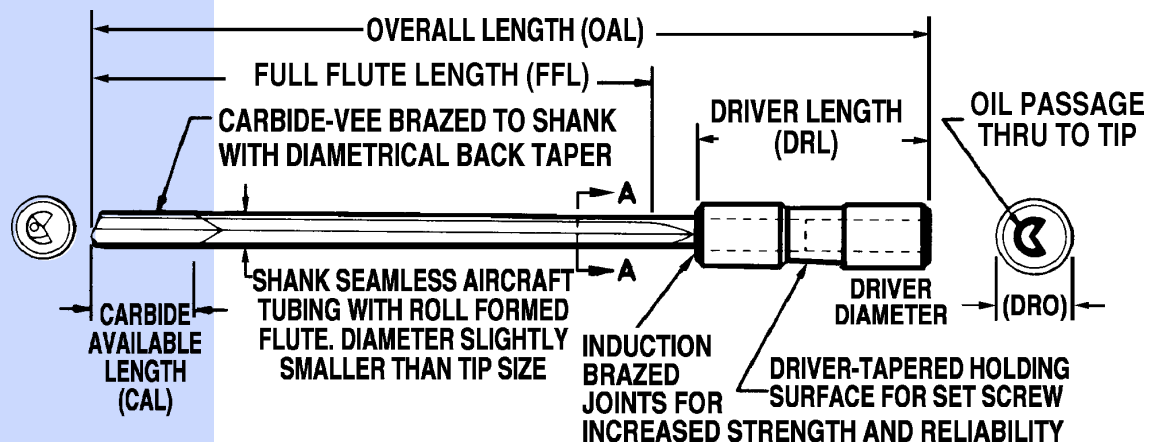


The gun drill is a simple basic tool consisting of a carbide tip, a heat treated alloy shank, and a steel driver, typically silver brazed together into one precision unit.

Tip: The most critical element, the tip cuts the hole as it pilots the drill through the workpiece, producing precision holes in a single pass. The drill's point, or nosegrind, has two basic angles that may be varied for optimum results depending upon the material being drilled. These angles balance cutting forces, distributing them to the tip's bearing pads to keep the drill concentric. The tip is slightly larger than the shank, so the shank can rotate freely without contacting the hole wall. A round, kidney-shaped, or two round holes through the tip line up with the shank's channel to allow the flow of coolant at high pressures.

Shank: The shank is made from aircraft grade alloy steel tubing with a 110°-120° vee-flute formed to the center of the shank's diameter. Coolant is forced from the driver through the center of the shank to the tip, where it is flushed back along the shank's flute. The shank maintains proper gundrill alignment and must be strong enough to absorb cutting torque and thrust. If the shank is too stiff it may transfer minor misalignment in the machine to the tip, but it must not be flexible enough to sag or whip at high RPMs.

Driver: Drivers are cylindrical, with an undercut or flat section for the set screw, which holds in the spindle bore. They are manufactured to industry standards or to special diameters and a concentric hole through the driver's length allows coolant to pass through to the shank and tip.



Gundrill and Reamer Types

Solid carbide tip & shank, single kidney oil hole, single flute

Solid carbide shank and tip, available from .039" (1.00mm) to .1875" (4.75mm) diameter.

Single round oil hole, single flute

Carbide tip, available from .0550" (1.39mm) to 1.2599" (32.00mm) diameters. Inserted carbide style gundrills available from 1.2600" (32.00mm) to 3.000" (76.20mm) diameters.

Two round oil holes, single flute

Carbide tip, available from .3150" (8.00mm) diameter to 1.160" (29.46mm). Use when more cutting fluid is desired to the cutting edge and for additional chip evacuation. Often used on applications where there is inadequate coolant pressure.

Kidney shaped oil hole, single flute

Carbide tip, available from .0750" (1.90mm) diameter to .315" (8.00mm) diameter. This range includes over 100 sizes and lengths for same-day shipment. Often used on applications where there is inadequate coolant pressure.

Two oil holes, two flute

Carbide tip with two cutting edges for twice the feed rates of a single flute. The flute channels are not as deep as on single flute drills, applications are limited to very small chip formation type material such as cast iron, cast aluminum and ductile materials. Available in diameters from .1875" (4.75mm) to 1.25" (31.75mm)

Two oil holes, (milled) two flute

Same cutting characteristics as the two hole twin flute, except the tube (shank) is milled from steel to make a very rigid tool. This tool is required on special applications with cross holes or when very aggressive feed rates are dictated, such as controlling stations on a transfer line.

Single oil hole, single flute, chips ahead reamer

Carbide tip, available from .1875" (4.75mm) diameter to 1.2500" (31.75mm) diameter. This end cutting tool forces chips out ahead of the tool and requires an existing thru hole in the workpiece. Primarily used to open up predrilled or cored holes to close tolerances. Available in butt-braze or vee-style braze.

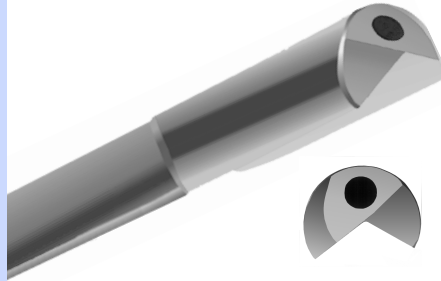
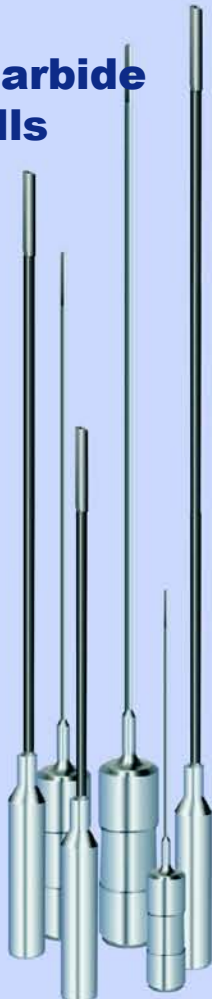
Two oil holes, two flute, chips ahead reamer

Designed to penetrate twice as fast as the single flute reamer. For special applications only where an intersecting core hole might need to be opened.

Single Flute Gundrill Types

Drill Masters-Eldorado single flute gundrills are available in diameters from .039" (1.00 mm) to 3.000" (76.20 mm). Included in this range are over 800 sizes and lengths available for same-day delivery. We also offer an expedited service for non-stock gundrills to satisfy your urgent requests. As part of our Quality Assurance program, our carbide and steel tubing are subjected to complete metallurgical analysis prior to manufacturing the final product. In addition to the single flute design, we offer two flute, solid carbide tip and shank, Opti-Flo (kidney oil hole), and Opti-Flo II (two oil hole) gundrills. Shown here are some of the popular gundrills and gunbores we manufacture.

Solid Carbide Gundrills

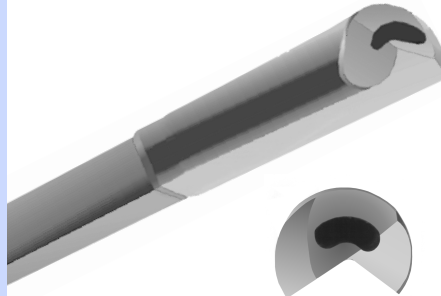


Single round hole, single flute

Solid carbide tip, available from .055" (1.397mm) to 0.1875" (4.7625mm) in over 800 standard sizes and lengths for immediate delivery and as special orders from 0.035" (0.889mm) to 3.000" (76.2mm).

Two round holes, single flute

The Opti-Flo II features a carbide tip, available from 0.3125" (7.9375mm) to 3.00" (76.2mm) in standard stock sizes and lengths for immediate delivery and as special orders from 0.055" (1.397mm) to 3.000" (76.2mm).



Single kidney hole, single flute

The Opti-Flo features a carbide tip, available from .055" (1.397mm) to 0.3125" (7.9375mm) in standard stock sizes and lengths for immediate delivery and as special orders to customer specifications.

Solid carbide drills

When the head and body of a gundrill are a single piece of carbide brazed to a steel driver, there's no joint at the head/body transition giving the drill:

- More strength and rigidity, greater tool life
- Maximum productivity and higher penetration rates

Delivery within 24 hours on standard diameters from 0.055 (1.397mm) to 0.070" (1.778mm) in lengths to 6.00" (152.4mm).

Special orders to almost any length or diameter

European & domestic carbide grades

C-2 (K20, K30)

1.5 average grain size, 6% cobalt, 440,000 TRS

C-3 (K05, K10)

0.8 average grain size, 6% cobalt, 460,000 TRS

C-10 (K30, K40)

0.8 average grain size, 10% cobalt, 500,000 TRS

Available in single, kidney and dual hole configurations

New carbide grades with sub-micro grain below 0.5 and higher cobalt content are being developed for gundrilling

Two hole, two flute

Solid carbide tip with tube (shank) manufactured from 4135 aircraft grade tubing. Diameters available from .375" (4.75mm) to 1.25" (31.75mm) and lengths to 84" (2133mm)

**Two hole, (milled) two flute**

Solid carbide tip with a tube (shank) manufactured from solid steel construction. The flutes are milled, resulting in a very rigid tool. Diameters available from .375" (9.525mm) to 1.25" (31.75mm) and lengths to 36" (914mm)

Two Flute Gundrill

The two flute gundrill design incorporates two cutting edges, which reduces chip load and increases penetration rate up to 100% over single flute drills in various non-ferrous applications. They can be used in conventional gundrilling machines and in CNC lathes and machining centers. Two flute gundrill features include:

- Sub-micro grain carbide tips for greater tool life
- 4135 aircraft grade shanks
- Dual oil holes for optimum chip evacuation

Two Flute Milled Gundrills

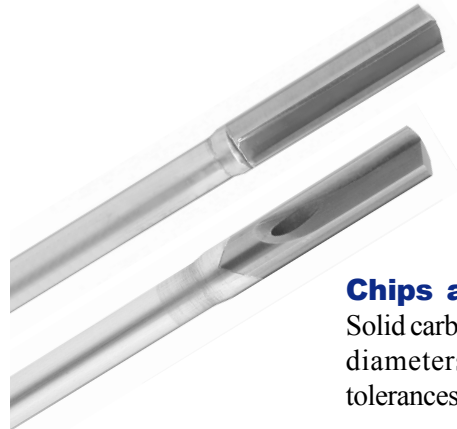
These tools are run under the same principals as the crimped two flute drill, but offer a milled tube (shank), which allows higher penetration rates. They are usually applied to special applications, such as intersecting holes or where extremely high penetration rates are required.

Multi-diameter, step

Solid carbide tip ground to print tolerances enable multiple diameters produced in a single pass.

Multi-Diameter Step Gundrills

Many parts require as many as two, three, or four various size holes in a single bore. Certain applications may allow a single multi-diameter gundrill to produce all or some of these holes, reducing machining time.

**Chips ahead reamers**

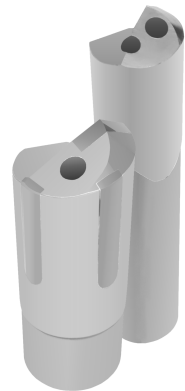
Solid carbide tip reamers are available in most diameters and lengths to produce close tolerances, eliminating the need for honing.

Reamers

Chips ahead and behind reamers are commonly used to obtain very tight ID bore sizes. Drilling an initial hole .015" - .030" under the desired finished diameter yields the perfect amount of material to be removed with this type of tool. The result is a hole size to .0002" in diameter and finishes to 16 RMS or better in a single pass, usually eliminating the need for honing.

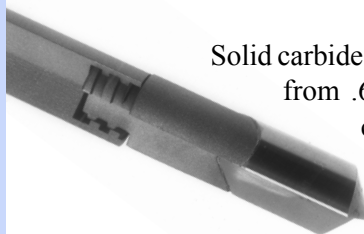
Steel Head Drill Tips with Carbide Inserts

Steel head drill tips with carbide inserts are available as standard items from 1.261" (32.03mm) to 3.000" (76.2mm) diameters.

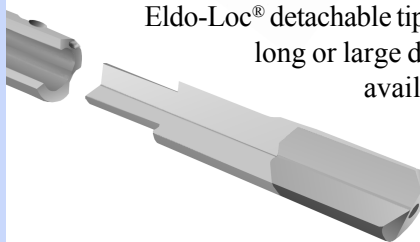


Interlocking Detachable Cutting Heads

Interlocking detachable cutting heads allow you to install a new head in minutes without removing the shaft from the assembly. Benefits include no down time, increased tool life and greater productivity. Order them to fit your existing drivers, shanks, and detachable heads. If your standard shanks are in good condition, you can convert to this system.



Solid carbide heads are available as standard items in diameters from .625" (15.875mm) to 1.375" (34.925mm), with carbide inserts from 1.396" (35.458mm) to 2.25" (57.15mm).



Eldo-Loc® detachable tip construction provides easier handling of extra long or large diameter gundrills. This is an optional method available for gundrills from .625" (15.875mm) to 2.000" (50.80mm) diameter

Rifle Buttons

Rifling buttons are precision ground for forming the rifling grooves in gun barrels. This is a specialized product for a specialized industry. Sizes range from 17 caliber to 10 gauge, and are available for rifle only, bore only, or combination push or pull. Let us titanium-nitrate coat your rifling buttons for increased tool life, better performance and finer finish. Rifle bore gauges are available upon request.

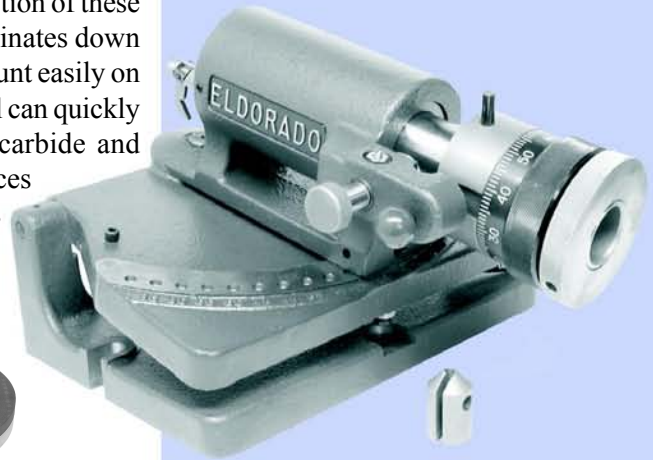


Service and Technical Support

We offer the best service and technical support in the industry

- Retipping
- Resharpening
- Restraightening
- Reconditioning
- Tooling, application and machine analysis
- On-site technical support
- Training at our facility or yours
- R & D capabilities

Traditional models B and C gundrill sharpening fixtures are the most widely used in the world. The B fixture is used to sharpen gundrills from .055" (1.39mm) to 1.062" (26.9mm) in diameter. The C fixture sharpens gundrills from .500" (12.7mm) to 2.000" (50.8mm) in diameter. The heavy duty construction of these units assures repetitive grinding quality, lowers cost per hole, eliminates down time, ends inefficiency and reduces costly rejects. Both fixtures mount easily on conventional tool and cutter or surface grinders. Any shop personnel can quickly and accurately reproduce the required nose geometry without carbide and diamond wheel waste. Once the combination of angles and clearances are specified, the operation is routine. These units are available as stock items and come with detailed operation instructions.



Sharpening Fixtures

Due to its single cutting edge, the gundrill requires support during initial entry into a workpiece. In fact, until the bearing area of the tip has started to enter the workpiece, the tool cannot guide itself. Therefore, either an accurate predrilled hole must be provided in the workpiece or a starting bushing must be supplied. The starting bushing must be in direct rigid contact with the workpiece to avoid the possibility of chip interference. The bushing is mounted in the front wall of the chip box. It should be no more than .0002" (.005 mm) larger than the gundrill diameter. Normally, bushings are made of hardened steel. However, carbide lined or solid carbide bushings are available from Drill Masters-Eldorado.

The coolant seal is a round disc that fits securely over the gundrill shank and rides inside the chip box. This seal prevents back feeding up the flute by containing the coolant and chips. Alternatively, some machines are equipped with a coolant seal which mounts on the back end of the chip box, away from the drill point.

Resharpening diamond wheels in 400, 300 or 220 grit are available in configurations for drills .055" (1.397mm) to 1.000" (25.4mm) and 1.000" (25.4mm) to 2.000" (50.8mm).

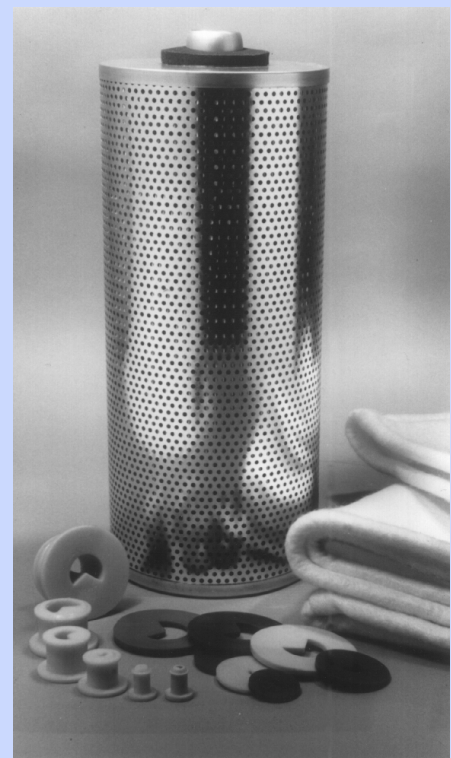
Drill guides and bushings of molded vinyl provide relief from whipping and bowing for higher speeds with less vibration. Sizes run from 0.070" (1.778mm) to 2.18" (55.372mm).

Filter bags for filtration systems prevent large chips from returning to the tank.

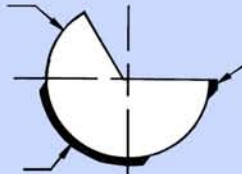
Pump filters with 5 and 15 micron filter elements trap finer particles in filtration systems. 5" (127.5mm) OD x 12.4375" (315.9mm) OAL x .78125" (19.843mm).

Chip deflectors of polypropylene in sizes, 0.78" (1.98mm) to 2.000" (50.8mm) keep oil and chips in the chip box.

Bushings, Seals and Filters

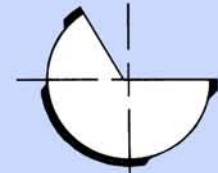


Contours



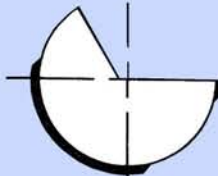
R1: Standard Bearing Pad

General purpose stock drill contour for steel, stainless steel, inconel and aluminum. Offers minimum bearing contact with the workpiece (non-micable).



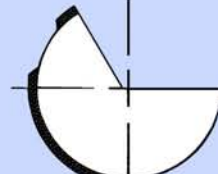
R2: Standard Bearing and Guide Pad

Recommended for all non-ferrous and cast iron up to gundrill diameter of .200" (non-micable).



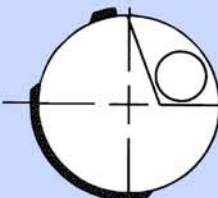
R3: High Bearing Pad

For good size control (including at exit) special purpose contour, where micable diameter is required or extra burnishing action is required, not for all materials (micable).



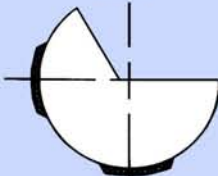
R4: High Bearing and Guide Pad

For use in aluminum and brass for best hole finish and for intersecting holes and interrupted cuts, or extra O.D. support and burnishing. Use with wood and plastic in combination with .0015/.002" back taper. Do not use in high nickel content materials due to high burnishing forces (micable).



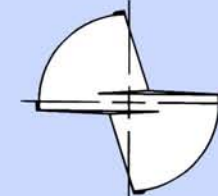
R6: High Bearing and Guide Pad Reamer

For chips ahead reaming applications when opening up existing holes, e.g., valve guides (micable).



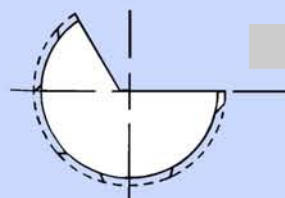
R9: High Interrupted Bearing Pad

For good size control, including at exit. Special purpose contour where micable diameter is required, or extra burnishing action is required, not for all materials (micable).



R10: Two Flute Bearing Pad

Used for high penetration rates in applications such as lubrication holes. Contour for aluminum shown (micable).

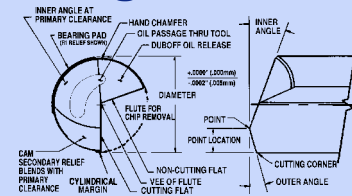


SP: Special Contour

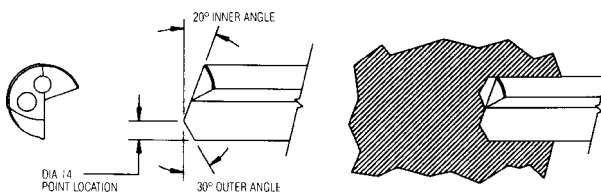
Bearing pad angles as defined by special requirements. CNC contour grinding allows us to manufacture to customer specifications.

The center design of our gundrills allows for a wide range of nosegrinds from a full spherical radius to a flat bottom design. The nosegrind angles are important in attaining the best quality results. Angles can be modified to improve the flushing action of the high pressure oil and to improve chip control. Specific grinds have been developed for severe applications such as exit breakouts and interrupted or angular entries. Some of the most popular nosegrind configurations are shown here.

Nosegrinds

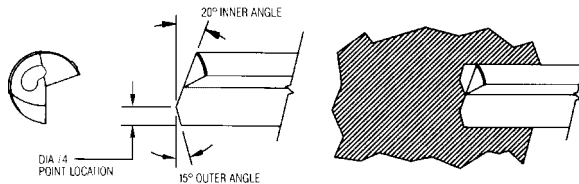


N-8 Nosegrind



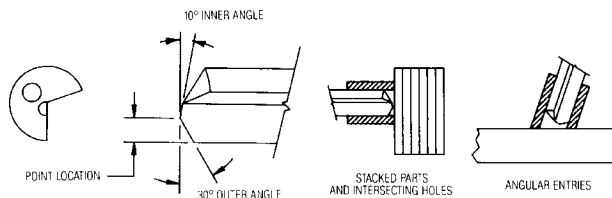
General purpose stock drill grind for steel, inconel and stainless steel, most often used with stock 'R1' O.D. contour.

N-4 Nosegrind



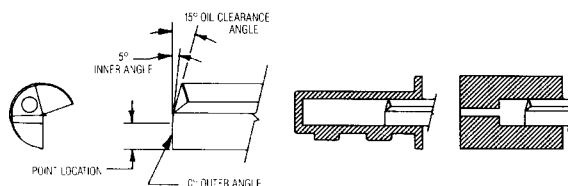
In aluminum and brass, use this grind with 'R4' O.D. contour for best hole finish.

N-73 Nosegrind



For drilling, stacked parts and angular entries. Due to the point's placement near the center of the drill, this is the strongest gundrill.

N-126 Nosegrind

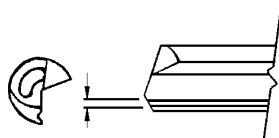


For applications requiring nearly flat bottoms. It can also be ground for a completely flat bottom, or on difficult materials, use to qualify bottoms only.

Chip Breakers

Facet Nosegrind

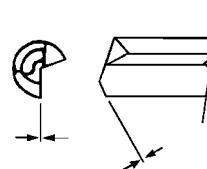
Chip Breakers are generally used to break string type chips often attributed to gummy material or when machines limit the surface footage necessary to generate the heat needed to break a chip. There are two types of Chip Breakers:



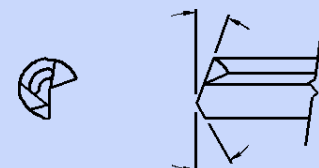
RADIAL

The Radial Chip Breaker runs down the length of the carbide flat and lasts the life of the tool.

The Standard Chip Breaker is reproduced each time the tool is ground.



STANDARD

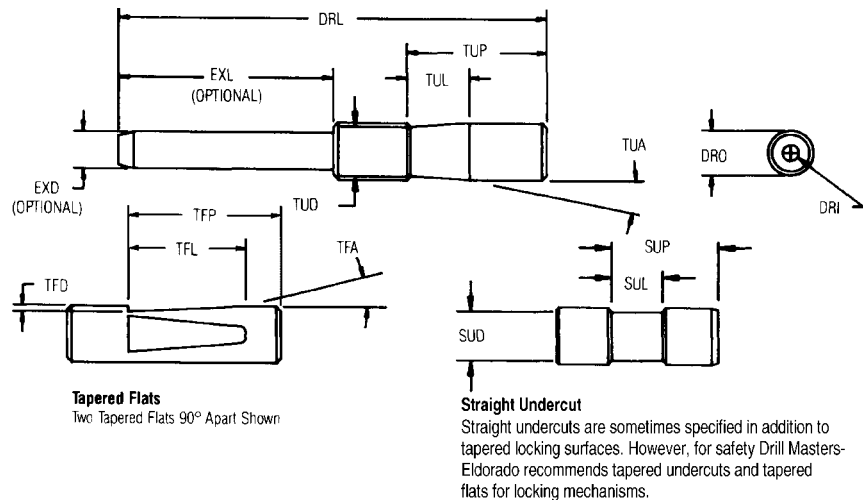


Facet grinds are preferred on specific applications, or when regrind fixtures limit the cam type sharpenings. They can be ground to various slash type angles with good performance and allow a greater amount of clearance for coolant to cool the chip at the cutting edge. This grind is standard on most European applications.

Drivers

Driver design is important because of the high speeds and pressures used in the gundrilling process. Maximizing the gundrill driver length improves rigidity and concentricity. The following ordering guidelines are recommended to specify gundrill drivers.

Driver Details



Driver Ordering Guidelines

Optional Specifications:

- ___ SUL-Straight undercut length
- ___ SUD-Straight undercut diameter
- ___ SUP-Straight undercut placement
- ___ EXL-Extension length
- ___ EXD-Extension diameter

These guidelines are suggested description methods. We encourage the use of stock designs, but will readily quote for special requirements.

___ **DRO (Driver Outside Diameter):** Standard tolerance is $+.000$ $-.0005$ " ($-.013$ mm)

___ **DRL (Driver Overall Length)**

___ **DRI (Driver Inside Diameter):** Standard unless otherwise specified.

Driver Locking Mechanism

Tapered Flat Details

- ___ TFA-Tapered flat angle (normally 2°)
- ___ TFL- Tapered flat length
- ___ TFD- Tapered flat depth
- ___ TFP-Tapered flat placement
- ___ TFQ-Tapered flat quantity

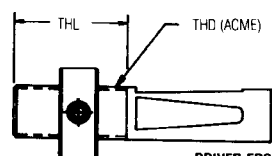
Tapered Undercut Details

- ___ TUA-Tapered undercut angle (normally 2°)
- ___ TUL-Tapered undercut length
- ___ TUD-Tapered undercut diameter
- ___ TUP-Tapered undercut placement

Adjustable Drivers

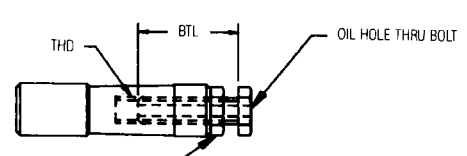
Driver adjustment (optional)

- ___ THL-Thread length (external)
- ___ THD-Thread specification
- ___ BTL-Bolt length (optional)



DRIVER-FRONT ADJ

Minimum thread length (THL) should be at least equal to useable tip length + 1 to 2 thread diameters.



JAM NUT

DRIVER-REAR ADJ.

Bolt length should be $\frac{1}{2}$ to 1 thread diameters longer than useable tip length + jam nut thickness.

Length of tapered flat(s) or undercut should allow proper set screw clamping over useable adjustment range.

GUNDRILL SPEEDS, FEEDS & COOLANT PRESSURES STARTING PARAMETERS (Single Flute)

GUNDRILL DIAMETER	COOLANT PRESSURE	K-MONEL HASTELLOY TUNGSTEN INCOLOY 800-825 REFRACTALLOY SFM=80				WASPALLOY, A286, RENE, HAYNES INCONEL 600,625 NIMONIC SFM=100				TITANIUM 718 INCONEL MOLLY NITRONIC 40-80 SFM=135				NITRALLOY, GREEKASCOLOY 400 MONEL 4340 SFM=200				ETD-150, COPPER SFM=275				DUCTILE* SFM=150				BRASS BRONZE SFM=550			
		PSI	RPM	IPM	MAX. UNSUP-PORTED LENGTH	RPM	IPM	MAX. UNSUP-PORTED LENGTH	RPM	IPM	MAX. UNSUP-PORTED LENGTH	RPM	IPM	MAX. UNSUP-PORTED LENGTH	RPM	IPM	MAX. UNSUP-PORTED LENGTH	RPM	IPM	MAX. UNSUP-PORTED LENGTH	RPM	IPM	MAX. UNSUP-PORTED LENGTH	RPM	IPM	MAX. UNSUP-PORTED LENGTH	RPM	IPM	MAX. UNSUP-PORTED LENGTH
0.0550	1800	5556	0.3	4.0	6945	0.3	4.0	9376	0.5	4.0	10000	0.5	4.0	10000	0.5	4.0	10000	0.5	4.0	10000	0.5	4.0	10000	0.5	4.0	10000	0.5	4.0	10000
0.0781	1500	3913	0.4	7.2	4891	0.5	6.6	6603	0.7	5.8	9782	1.0	4.6	10000	1.0	4.6	8560	0.9	5.0	10000	1.0	5.0	10000	1.0	5.0	10000	1.0	5.0	10000
0.0937	1500	3261	0.5	9.0	4077	0.6	8.0	5504	0.8	6.5	8154	1.2	3.6	10000	1.5	4.6	7134	1.1	6.1	10000	1.5	5.1	10000	1.5	5.1	10000	1.5	5.1	10000
0.1250	1500	2445	0.4	12.0	3056	0.7	11.0	4126	0.9	9.0	6112	1.4	7.7	8404	1.9	6.5	5348	1.2	8.0	10000	2.3	6.0	10000	2.3	6.0	10000	2.3	6.0	10000
0.1562	1300	1956	0.6	15.3	2446	0.7	13.7	3302	1.0	11.4	4891	1.5	9.7	6725	2.0	8.2	4280	1.3	10.0	10000	3.0	7.1	10000	3.0	7.1	10000	3.0	7.1	10000
0.1875	1150	1630	0.6	18.5	2037	0.7	16.6	2750	1.0	14.0	4075	1.4	11.7	5603	2.0	9.9	3565	1.3	12.2	10000	3.5	7.4	10000	3.5	7.4	10000	3.5	7.4	10000
0.2187	1050	1397	0.6	21.2	1747	0.7	19.0	2358	0.9	15.5	3493	1.4	13.4	4803	1.9	11.4	3057	1.2	14.0	9607	3.8	8.2	9607	3.8	8.2	9607	3.8	8.2	9607
0.2500	925	1222	0.6	24.9	1528	0.8	22.3	2063	1.0	18.5	3056	1.5	15.7	4202	2.1	13.3	2674	1.3	16.4	8404	4.2	9.6	8404	4.2	9.6	8404	4.2	9.6	8404
0.2812	850	1087	0.6	28.0	1358	0.8	24.0	1834	1.1	21.0	2717	1.6	17.7	3736	2.2	15.0	2377	1.4	19.0	7472	4.3	10.8	7472	4.3	10.8	7472	4.3	10.8	7472
0.3125	775	978	0.6	31.2	1222	0.7	28.0	1650	1.0	24.0	2445	1.5	19.7	3362	2.0	16.8	2139	1.3	20.5	6723	4.0	12.0	6723	4.0	12.0	6723	4.0	12.0	6723
0.3437	725	889	0.6	34.4	1111	0.7	30.0	1500	0.9	26.0	2223	1.4	21.7	3056	1.9	18.2	1945	1.2	23.0	6113	3.9	13.3	6113	3.9	13.3	6113	3.9	13.3	6113
0.3750	675	815	0.5	37.0	1019	0.7	33.7	1375	0.9	29.5	2037	1.3	23.0	2801	1.8	20.0	1783	1.2	25.0	5603	3.6	14.5	5603	3.6	14.5	5603	3.6	14.5	5603
0.4062	625	752	0.5	40.8	940	0.6	36.5	1270	0.9	32.0	1881	1.3	25.7	2586	1.8	21.9	1646	1.1	27.3	5172	3.5	15.0	5172	3.5	15.0	5172	3.5	15.0	5172
0.4375	600	699	0.5	44.0	873	0.6	39.5	1179	0.8	35.0	1746	1.2	27.8	2401	1.6	23.6	1528	1.0	29.5	4802	3.3	17.0	4802	3.3	17.0	4802	3.3	17.0	4802
0.4687	550	652	0.5	47.0	815	0.6	42.0	1100	0.8	35.0	1630	1.1	29.8	2241	1.6	25.3	1426	1.0	31.5	4483	3.1	18.2	4483	3.1	18.2	4483	3.1	18.2	4483
0.5000	525	611	0.5	54.0	764	0.5	45.0	1031	0.7	38.0	1528	1.1	31.8	2101	1.5	27.0	1337	0.9	33.6	4202	2.9	19.0	4202	2.9	19.0	4202	2.9	19.0	4202
0.5312	500	575	0.5	55.0	719	0.5	47.9	971	0.7	40.0	1438	1.0	33.8	1978	1.4	28.7	1258	0.9	36.3	3955	2.9	20.5	3955	2.9	20.5	3955	2.9	20.5	3955
0.5625	500	543	0.5	56.0	679	0.5	50.8	917	0.7	42.3	1358	1.0	35.8	1868	1.4	30.4	1188	0.9	39.0	3735	2.7	22.0	3735	2.7	22.0	3735	2.7	22.0	3735
0.5937	475	515	0.4	59.0	643	0.5	53.9	869	0.7	45.0	1287	1.0	38.0	1769	1.3	32.3	1126	0.8	40.7	3539	2.7	23.3	3539	2.7	23.3	3539	2.7	23.3	3539
0.6250	475	489	0.4	63.6	611	0.5	57.0	825	0.6	48.0	1222	0.9	40.2	1681	1.3	34.2	1070	0.8	42.5	3362	2.5	24.6	3362	2.5	24.6	3362	2.5	24.6	3362
0.6562	425	466	0.4	66.8	582	0.5	59.0	786	0.6	50.5	1164	0.9	42.0	1601	1.2	36.0	1019	0.8	45.0	3202	2.5	26.0	3202	2.5	26.0	3202	2.5	26.0	3202
0.6875	425	445	0.4	70.0	556	0.4	62.7	750	0.6	53.0	1111	0.9	44.0	1528	1.2	38.0	972	0.8	50.0	3056	2.4	27.0	3056	2.4	27.0	3056	2.4	27.0	3056
0.7187	400	425	0.4	73.0	532	0.4	65.0	718	0.6	55.0	1063	0.9	46.0	1462	1.2	39.5	930	0.7	51.0	2923	2.3	28.0	2923	2.3	28.0	2923	2.3	28.0	2923
0.7500	400	407	0.4	76.3	509	0.4	68.0	688	0.6	57.0	1019	0.8	48.0	1401	1.1	41.0	891	0.7	52.0	2801	2.2	29.0	2801	2.2	29.0	2801	2.2	29.0	2801
0.8750	350	349	0.4	89.0	437	0.4	79.0	589	0.5	73.0	873	0.8	56.0	1201	1.1	47.0	764	0.7	59.0	2401	2.2	34.0	2401	2.2	34.0	2401	2.2	34.0	2401
1.0000	310	306	0.4	100	382	0.4	91.0	516	0.5	80.0	764	0.8	64.0	1051	1.1	54.0	669	0.7	68.0	2101	2.1	39.0	2101	2.1	39.0	2101	2.1	39.0	2101
1.2500	270	244	0.4	126	306	0.4	113	413	0.5	95.0	611	0.6	80.0	840	0.8	68.0	535	0.5	86.0	1681	1.7	49.0	1681	1.7	49.0	1681	1.7	49.0	1681
1.5000	230	204	0.4	154	255	0.4	138	344	0.5	120	509	0.5	91.0	700	0.7	82.0	446	0.5	105	1401	1.4	60.0	1401	1.4	60.0	1401	1.4	60.0	1401

$$\text{RPM} = \frac{3.82 \times \text{SFM}}{\text{Diameter}}$$

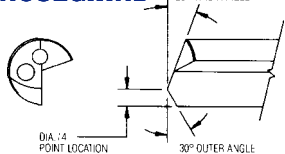
$$\text{SFM} = \frac{\text{RPM} \times \text{Diameter}}{3.82}$$

$$\text{FPR} = \text{IPR} / \text{RPM}$$

$$\text{IPM} = \text{FPR} \times \text{RPM}$$

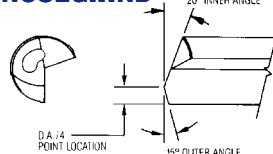
*Indicates a two flute drill may be used at two times the recommended feed rate

N-8 NOSEGRIND



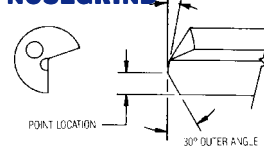
General purpose stock drill grind for steel, inconel and stainless steel, most often used with stock 'R1' O.D. diameter.

N-4 NOSEGRIND



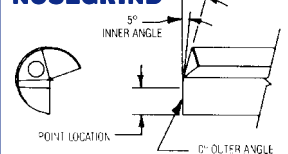
In aluminum and brass, use this grind with 'R4' O.D. contour for best hole finish.

N-73 NOSEGRIND



For drilling, stacked parts and angular entries. Due to the point's placement near the center of the drill, this is the strongest gundrill.

N-126 NOSEGRIND



For applications requiring nearly flat bottoms. It can also grind for a completely flat bottom. On difficult materials, use to qualify bottoms only.

Dia	FPR	Dia	FPR
0.055-	0.00005	0.500-	0.00070
0.078-	0.00010	0.750-	0.00080
0.156-	0.00030	1.000-	0.00100
0.200-	0.00040	1.250-	0.00100
0.250-	0.00050	1.500-	0.00100

GUNDRILL SPEEDS, FEEDS & COOLANT PRESSURES STARTING PARAMETERS (Single Flute)

GUNDRILL DIAMETER	COOLANT PRESSURE	8620				416 STAINLESS 4140, 5120			TOOL STEEL			15-5, 17-4, 13-8, H-13 455 CUSTOM 303, 304, 310, 316 341, 347, 420, 501			2024AL*, 6061AL* 7075AL* 1010, 1118, 1145			CAST ALUMINUM*			GRAY CAST IRON*		
		SFM=550				SFM=325			SFM=175			SFM=200			SFM=550			SFM=600			SFM=200		
		PSI	RPM	IPM	MAX. UNSUP- PORTED LENGTH	RPM	IPM	MAX. UNSUP- PORTED LENGTH	RPM	IPM	MAX. UNSUP- PORTED LENGTH	RPM	IPM	MAX. UNSUP- PORTED LENGTH	RPM	IPM	MAX. UNSUP- PORTED LENGTH	RPM	IPM	MAX. UNSUP- PORTED LENGTH	RPM	IPM	MAX. UNSUP- PORTED LENGTH
0.0550	1800	10000	0.5	4.0	10000	0.5	4.0	10000	0.5	4.0	10000	0.5	4.0	10000	0.5	4.0	10000	0.5	4.0	10000	0.5	4.0	10000
0.0781	1500	10000	1.0	4.6	10000	1.0	4.6	8560	0.9	4.6	9782	1.0	4.6	10000	1.0	4.6	10000	1.0	4.6	9782	1.0	4.6	10000
0.0937	1500	10000	1.5	5.0	10000	1.5	5.0	7134	1.1	6.0	8154	1.2	5.0	10000	1.5	5.0	10000	1.5	5.0	8154	1.2	5.0	10000
0.1250	1500	10000	2.0	6.0	9932	2.0	6.0	5348	1.1	8.0	6112	1.2	7.7	10000	2.0	6.0	10000	2.0	6.0	6112	1.2	7.7	10000
0.1562	1300	10000	3.0	6.7	7948	2.4	7.7	4280	1.3	10.3	4891	1.5	9.7	10000	3.0	6.6	10000	3.0	6.6	4891	1.5	9.7	10000
0.1875	1150	10000	3.5	7.5	6621	2.3	9.2	3565	1.2	12.4	4075	1.4	11.7	10000	3.5	7.5	10000	3.5	7.5	4075	1.4	11.7	10000
0.2187	1050	9607	3.8	8.2	5677	2.3	10.6	3057	1.2	14.2	3493	1.4	13.4	9607	3.8	8.2	10000	4.0	7.8	3493	1.4	13.4	10000
0.2500	925	8404	4.2	9.6	4966	2.5	12.4	2674	1.3	16.5	3056	1.5	15.7	8404	4.2	9.6	9168	4.6	9.1	3056	1.5	15.7	10000
0.2812	850	7472	4.1	10.8	4415	2.3	14.0	2377	1.2	18.7	2717	1.4	17.7	7472	3.9	10.8	8151	4.2	10.3	2717	1.4	17.7	10000
0.3125	775	6723	4.0	12.0	3973	2.4	15.6	2139	1.3	20.9	2445	1.5	19.7	6723	4.0	12.0	7334	4.4	11.5	2445	1.5	19.7	10000
0.3437	725	6113	3.9	13.3	3612	2.3	17.2	1945	1.2	23.0	2223	1.4	21.7	6113	3.9	13.3	6669	4.2	12.6	2223	1.4	21.7	10000
0.3750	675	5603	3.6	14.5	3311	2.2	18.8	1783	1.2	26.0	2037	1.3	23.2	5603	3.6	14.5	6112	4.0	13.8	2037	1.3	23.2	10000
0.4062	625	5172	3.5	15.0	3056	2.1	19.6	1646	1.1	27.3	1881	1.3	25.7	5172	3.5	15.0	5643	3.8	14.2	1881	1.3	25.7	10000
0.4375	600	4802	3.3	17.0	2838	1.9	21.9	1528	1.0	29.4	1746	1.2	27.8	4802	3.3	17.0	5239	3.6	16.1	1746	1.2	27.8	10000
0.4687	550	4483	3.1	18.2	2649	1.9	23.5	1426	1.0	31.5	1630	1.1	29.8	4483	3.1	18.2	4890	3.4	17.3	1630	1.1	29.8	10000
0.5000	525	4202	2.9	19.3	2483	1.7	25.1	1337	0.9	33.7	1528	1.1	31.8	4202	2.9	19.3	4584	3.2	18.5	1528	1.1	31.8	10000
0.5312	500	3955	2.9	20.6	2337	1.7	26.7	1258	0.9	35.8	1438	1.0	33.8	3955	2.9	20.6	4315	3.1	19.6	1438	1.0	33.8	10000
0.5625	500	3735	2.7	21.9	2207	1.6	28.3	1188	0.9	37.9	1358	1.0	35.8	3735	2.7	21.9	4075	3.0	20.8	1358	1.0	35.8	10000
0.5937	475	3539	2.7	23.2	2091	1.6	30.0	1126	0.8	40.2	1287	1.0	38.0	3539	2.7	23.2	3861	2.9	22.1	1287	1.0	38.0	10000
0.6250	475	3362	2.5	24.6	1986	1.5	31.8	1070	0.8	42.6	1222	0.9	40.2	3362	2.5	24.6	3667	2.8	23.4	1222	0.9	40.2	10000
0.6562	425	3202	2.5	25.8	1892	1.5	37.8	1019	0.8	44.5	1164	0.9	42.2	3202	2.5	25.8	3493	2.7	24.5	1164	0.9	42.2	10000
0.6875	425	3056	2.4	27.0	1806	1.4	39.0	972	0.8	46.5	1111	0.9	44.2	3056	2.4	27.0	3334	2.6	25.7	1111	0.9	44.2	10000
0.7187	400	2923	2.3	28.2	1727	1.4	41.5	930	0.7	48.7	1063	0.9	46.2	2923	2.3	28.2	3189	2.6	26.8	1063	0.9	46.2	10000
0.7500	400	2801	2.2	29.5	1655	1.3	42.7	891	0.7	51.0	1019	0.8	48.2	2801	2.2	29.5	3056	2.4	28.0	1019	0.8	48.2	10000
0.8750	350	2401	2.2	34.4	1419	1.3	44.5	764	0.7	59.5	873	0.8	56.2	2401	2.2	34.4	2619	2.4	32.7	873	0.8	56.2	10000
1.0000	310	2101	2.1	39.0	1242	1.2	50.9	669	0.7	68.0	764	0.8	64.0	2101	2.1	39.3	2292	2.3	37.0	764	0.8	64.0	10000
1.2500	270	1681	1.7	49.0	993	1.0	63.0	535	0.5	84.0	611	0.6	80.0	1681	1.7	50.0	1834	1.8	46.0	611	0.6	80.0	10000
1.5000	230	1401	1.4	59.0	828	0.8	77.0	446	0.4	102	509	0.5	91.0	1401	1.4	59.0	1528	1.5	56.0	509	0.5	97.0	10000

$$\text{RPM} = \frac{3.82 \times \text{SFM}}{\text{Diameter}}$$

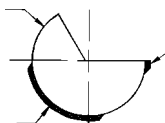
$$\text{SFM} = \frac{\text{RPM} \times \text{Diameter}}{3.82}$$

$$\text{FPR} = \text{IPR/RPM}$$

$$\text{IPM} = \text{FPR} \times \text{RPM}$$

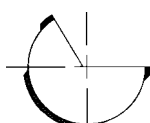
*Indicates a two flute drill may be used at two times the recommended feed rate

R-1 CONTOUR



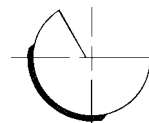
General purpose stock drill contour for steel, stainless steel, inconel and aluminum. Offers minimum bearing contact with the workpiece (non-micable).

R-2 CONTOUR



Recommended for all non-ferrous and cast iron up to gundrill diameter of .200" (non-micable).

R-3 CONTOUR



For good size control (including at exit) special purpose contour, where micable diameter is required or extra burnishing action is required; not for all materials (micable).

R-4 CONTOUR



For use in aluminum and brass for best hole finish and for intersecting holes and interrupted cuts, or extra O.D. support and burnishing. (micable).

Dia	FPR	Dia	FPR
0.055-	0.00005	0.500-	0.00070
0.078-	0.00010	0.750-	0.00080
0.156-	0.00030	1.000-	0.00100
0.200-	0.00040	1.250-	0.00100
0.250-	0.00050	1.500-	0.00100

Hole Faults

15

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