



BASIC GUIDE TO MAGNETIC DRILLS & ANNULAR CUTTERS

**How to use a Magnetic Drill with Annular Cutters, what to
look for, best practices and tips to extend tool life
& achieve the best performance**

www.hougen.com

Magnetic Drills

What is a Magnetic Drill?	3
When Do I Use a Mag Drill?	3
Where is a Mag Drill Used?	3
Parts to a Mag Drill	4
Which Mag Drill Do I Select?	5
Size of a Mag Drill	5
Mag Drill Options	5

Annular Cutters

What is an Annular Cutter?	6
Why Use an Annular Cutter?	6
What Annular Cutter Do I Use?	6
Parts to an Annular Cutter	7
Diameter & Depth	7
Cutter Geometry	8
Standard vs. Stack-Cut Geometry	8
Non-Coated vs. Coated	8
Types of Annular Cutters	9
What is a Pilot?	10
What Makes an Annular Cutter Turn?	10
Annular Cutter Accessories	11
Lubrication	11

Tips & Troubleshooting

Mag Drill - Magnet Adhesion	12
Mag Drill - Surface Requirements	12
How Do I Keep My Mag Drill from Slipping?	12
Do I Have to Use Coolant?	13
What Causes Dull or Broken Cutters?	13
Why Does My Slug Stick?	14
Maintaining Your Mag Drill	14
Is a Safety Strap/Chain Necessary?	14
Why is My Magnet Lifting Off the Material?	14
What Should I Do After Drilling the Hole?	14
What is Positive Slug Ejection?	15
What is the Proper Feed Rate for a Mag Drill?	15
Why Not Use Quick Change Cutters?	15
Is a Carbide Cutter Better Than a HSS Cutter?	15
Aren't All Annular Cutters the Same?	15
Why Do I Have Trouble Drilling Stainless Steel?	16
Should I Use a Power Feed Drill?	16
Can I Drill on the Same Material They are Welding?	16
Can I Get a Custom Cutter Made?	16

Hougen History	17
-----------------------------	----

Portable Mag Drill Chart	18
---------------------------------------	----

Annular Cutter Chart	19
-----------------------------------	----

What is a Magnetic Drill?

A magnetic drill is a specialized portable power tool used for drilling holes in steel and similar metals.

- They are used on the job site or in the shop
- Also referred to as a mag drill, portable base drills, portable drill press

When Do I Use a Mag Drill?

It can be time-consuming and cumbersome to try to maneuver large steel or pipe into position at a stationary drill press or work center. A portable magnetic drill allows you to take the drill to the work piece, instead of trying to bring the work piece to the drill.

- A portable magnetic drill may be used in any position—vertical, horizontal, or overhead (upside down)

Where is a Mag Drill Used?

- Steel Fabrication
- Building & Construction
- Bridge Rebuilding
- Mining
- Ship Building
- Truck, RV & Special Vehicle Build
- Pipeline, Offshore & Oil Fields
- Welding Shops
- Power Utilities
- Railroad Industries
- Maintenance Facilities
- Mobile Repair Shops
- Machinery Riggers



Mag drills are used everywhere from one person shops to large plants and construction sites with 1,000's of workers

Parts to a Mag Drill

Made in USA



The above drill is the HMD904 which is the most popular drill for general fabrication.

Visit

www.hougen.com

for Video of the Mag Drills in Action

Which Mag Drill Do I Select?

Use the chart on page 18 to determine which mag drill to use. The mag drill you select depends upon:

- Application
- Diameter of hole
- Depth to be drilled (D.O.C. Depth of Cut)
- Drilling speed requirements
- Number of holes
- Work environment
- Space / physical limitations
- Type of material to be drilled

Size of a Mag Drill

Available in a variety of sizes. From ultra low profile to large multi-speed models.



Multi-speed
with Large
Capacity
72 lbs

Mag Drill Options

Mag Drills can also have many options/accessories to help increase the products versatility

- Coolant bottle system
- Swivel base magnet
- Multi-speed gear box
- Power feed
- Drill chucks
- Pipe adapters
- Countersinking
- Tapping
- Arbor adapters
- Vac-Pad™



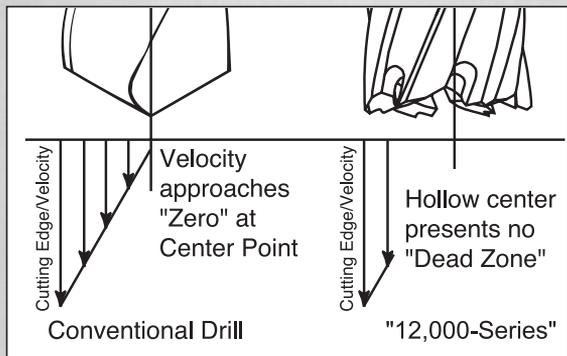
What is an Annular Cutter?

An annular cutter is a specialized bit for drilling through metal. Like a hole saw for wood, an annular cutter only cuts the outside edge of a hole. It produces accurate burr-free holes to close tolerances without pre-drilling or step drilling. It can drill a much larger hole and requires less force and time than a standard twist drill bit. As it turns, the cutter produces chips from the outside cutting edges and after cutting the hole a 'slug' (round chunk of metal from the center of the cutter) falls out.



Why Use an Annular Cutter?

Annular Cutters offer superior holemaking capabilities. They cut faster, last longer, produce a better hole finish, a true round hole with very tight tolerances, can be re-sharpened and drills holes with less power and torque.



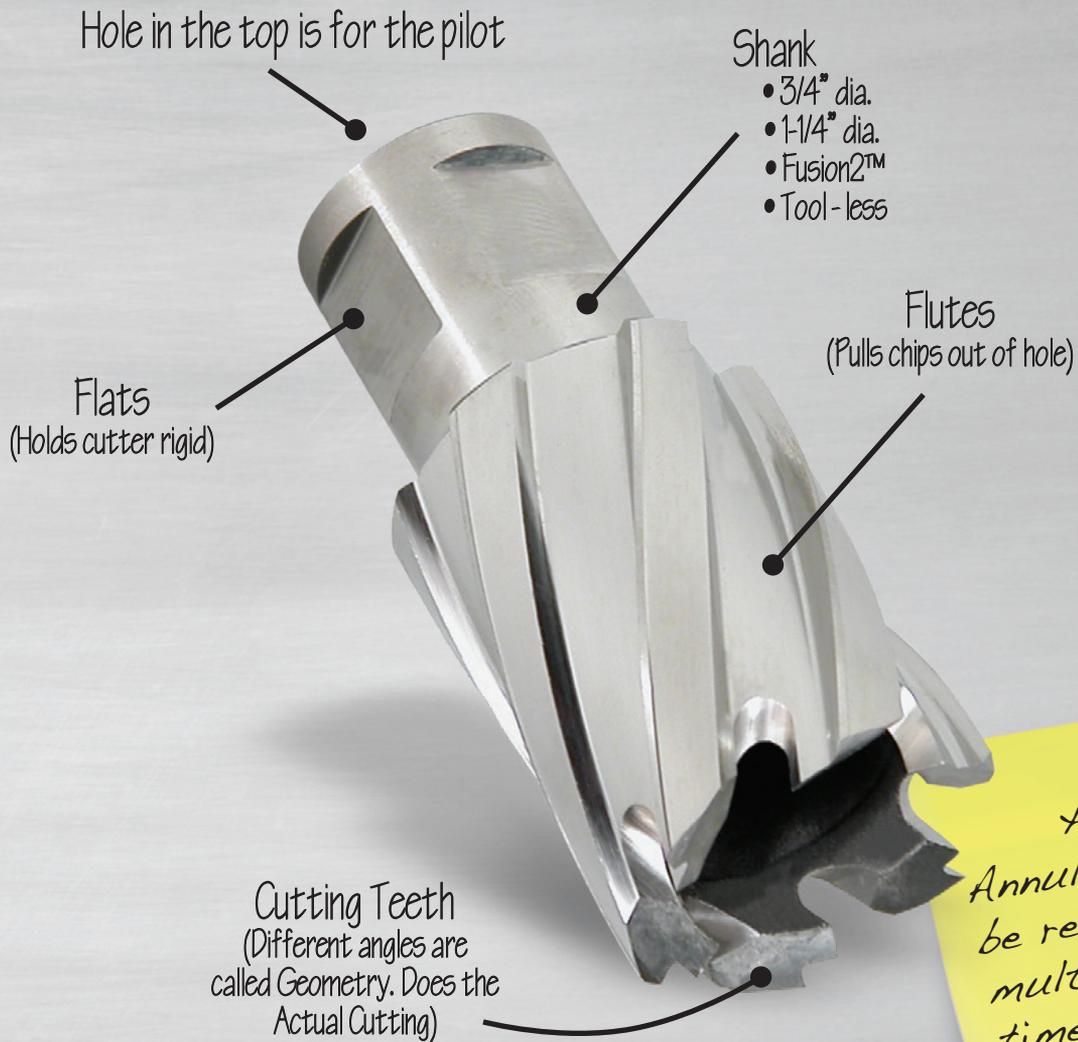
What Annular Cutter Do I Use?

Use the chart on page 19 to determine which annular cutter to use. The cutter you select depends on the diameter of the hole, the depth of cut and the type of material. A wide range of annular cutters are designed to cut through the following materials:

- Carbon Steel
- Hard Alloys ex: Titanium
- Stainless Steel
- Hastelloy
- Aluminum



Parts to an Annular Cutter



Hougen® Annular Cutters can be re-sharpened multiple times. Each time reduces the cost of your hole.

Diameter & Depth

When determining the cutter size, they are measured by the depth and diameter. If you look at an actual cutter, the depth is longer than what it is rated, (a 1" cutter is really 1-1/4") because this ensures the tool can drill all the way through the hole and allows extra length for resharpening.

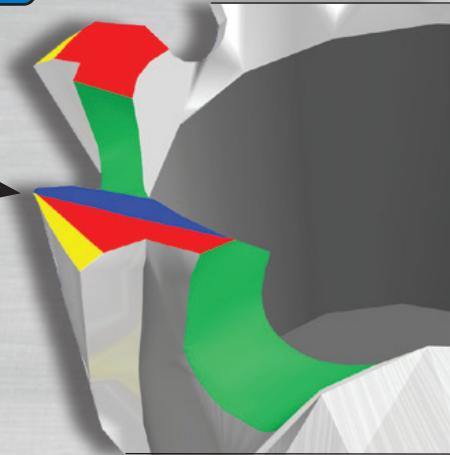


Cutter Geometry

Angles on the cutting teeth make a big difference in how the tool performs. More precision angles increase the tool life and accuracy. Hougén tools have one of four different tooth geometries.

- 2 angle
- 2 & 3 angle - Hougén-Edge®
- Stack-Cut
- Industrial

Different Angles
on the Teeth



Standard vs. Stack-Cut Geometry

Most annular cutters come with Standard geometry. These cutters are designed to cut through one piece of steel. They offer the fastest, cleanest hole producing a slug that looks like a 'Top Hat'. When the job requires drilling two or more pieces of material, cutters with stack-cut geometry **must** be used. The cutting teeth cut from the inside out producing a round cylinder slug.



Standard Geometry Slug



Stack-Cut Geometry Slug



Non-Coated vs. Coated

For 80% of applications a standard HSS cutter works best.

Using a coated or carbide cutter in these applications offers no additional benefit. Hard materials is where the benefit of using a coated or carbide cutter will pay off with increased tool life.



Standard "12,000-Series"
Cutter



TiN Coated
"12,000-Series" Cutter

Types of Annular Cutters

“12,000-Series” M2 HSS (High Speed Steel)

Most popular and used for a wide variety of applications.

- Mild & Structural Steel
- Aluminum
- Stainless Steel (lower BHN)



“12,000-Series” M2 HSS TiN Coated

Coatings offer better performance in harder steels.

- Structural Steel
- Stainless Steel



Copperhead™ Carbide Tip

Carbide provides longer tool life in harder or abrasive materials. Use a higher RPM than HSS tools for best tool life.

- Corroded or Weathered Material
- Structural & Stainless Steel
- AR



Other Types of Annular Cutters

Hougen makes many different annular cutters even ones for sheet metal. Below are two styles of annular cutters for use in hand-held drills and drill presses. They offer many of the same advantages as the mag drill annular cutters such as speed, quality of hole and longer tool life.

Holcutter™



RotaCut™



What is a Pilot?

A Pilot is a large nail looking object that must be used when using an annular cutter. It serves three very important functions:

1. Locates the center of the hole
2. Allows coolant to flow down around the slug and to the cutting teeth
3. Ejects the slug at the end of the cut



Slot allows coolant to flow to the cutting teeth

Pilots go through the center of the cutter. They retract up into the mag drill arbor as the hole is made. Pilots last a very long time and can be used with multiple sizes of cutters.

What Makes an Annular Cutter Turn?



Magnetic Drills

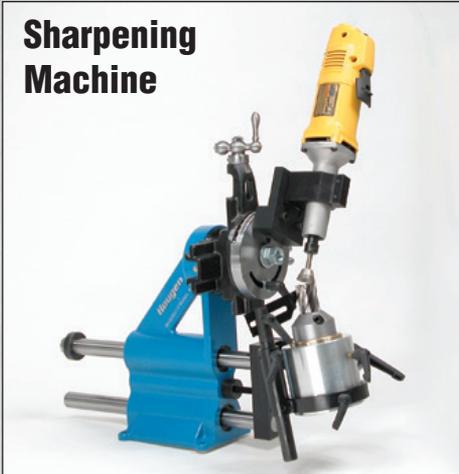
Annular Cutters are most often used with mag drills but can also be used with machine tools such as mills and large drill presses with tool holders.

Industrial Machines

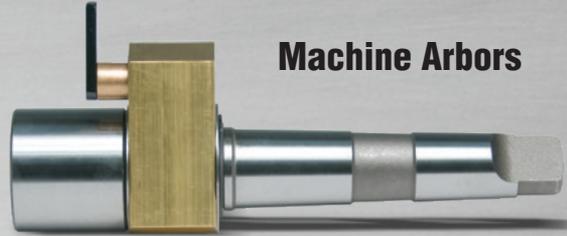


Annular Cutter Accessories

Sharpening Machine



Machine Arbors



Hole Enlarging Pilots



Chuck Arbors



Lubrication

Whenever using an annular cutter always use some type of lubrication. This will help keep the cutting tool cooler, increase tool life, allow better chip flow and provide a better hole finish. Hougen offers a variety of lubricants for use with annular cutters and for use in a variety of cutting applications.



TIPS & TROUBLESHOOTING FOR USING MAG DRILLS & ANNULAR CUTTERS

**READ YOUR OPERATOR'S MANUAL
ALWAYS OBSERVE STANDARD AND
SPECIFIC SAFETY INSTRUCTIONS**

**When in
Doubt**

**VISIT WWW.HOUGEN.COM OR CALL
HOUGEN TECHNICAL SERVICE 800-426-7818**

Mag Drill - Magnet Adhesion

Mag drills must magnetize to a solid surface. Magnetic strength is related to steel thickness. Minimum thickness is 3/8". If the material is thinner, the magnet will not hold well. Clamp another piece of steel on top or below the thinner steel for stronger adhesion. Material that is clean and free from coatings will offer the best surface for the magnet. For non-ferrous materials use a Vac-pad™ (HMD904 & HMD905 Non-swivel drills only) or clamp a piece of steel on top of it.

Mag Drill - Surface Requirements

A clean smooth surface will allow the magnet to 'stick' better. Situations where the magnet will have **reduced** holding power...

- a) Material less than 3/8" thick
- b) Coatings or paint layers on material
- c) Chips, dirt, or grease between the magnet and the material
- d) Curved surface (Surface should be flat. For pipe applications, a pipe adapter should be used.)
- e) Magnet only partially on work surface

How Do I Keep My Mag Drill from Slipping?

Make sure the drill's magnetic base is clear of chips and debris and is securely attached to a clean surface. Uneven surfaces or large debris buildup prevents the magnet from obtaining optimal holding power, which can cause the drill to shift or lift during operation. A safety chain or strap also helps to prevent injury if the drill shifts. If it does shift or lift during the cut, it is very possible the cutter will break. Hougén mag drills have a built-in safety circuit that stops the motor when the drill lifts from the material. Always use a safety chain especially in horizontal & overhead positions.

Do I Have to Use Coolant?

No.... **BUT...** Coolant increases annular cutter tool life **dramatically**. Hougen offers a number of different kinds of lubricant depending on the application. RotaMagic™ Concentrated Cutting Fluid is a biodegradable coolant that is mixed with water and used with a mag drills coolant system. Slick-Stik™ is a waxy lubricant. The user applies a glob to the inside and cutting teeth. Slick-Stik melts as the hole is made. Good for horizontal and overhead holes. RotaFoam™ is a foamy spray lubricant that is sprayed onto the cutter before each hole. RotaGel™ is blue gel that melts and works well in all applications.

For best results use the mag drills coolant system. Spraying or squirting coolant at the cutter while it is turning does very little in helping tool life. Most of the coolant is pushed aside by the chips and flutes before it reaches the cutting teeth.

***** Note: For Hougen drills without coolant bottles... fill the coolant reservoir through the slots in the arbor. This will hold enough coolant for one hole.**

What Causes Dull or Broken Cutters?

The primary cause of broken or prematurely dull cutters is a feed rate that is too slow. Slow feed rates will reduce the life of your cutter. Using a firm, steady feed pressure throughout the cut will maximize performance and extend tool life. You want to hear the drill motor working & the cutter producing long stringy chips that are being pulled from the hole. Look for a bird's nest around the cutter.

Blue Chips = Big Problem

(Something obstructing the coolant system or you're pushing too hard)



Good Looking Chips !!

The #1 cause of cutters quickly dulling is too little feed pressure. "Babying" the tool will only decrease tool life.

Make sure you have the correct cutter for the material. Stack-Cut for multiple layers.

Second reason why cutters break is movement of the drill or work piece. The cutter wall can easily be snapped if the drill and material is not held rigid.

Why Does My Slug Stick?

Using lubricant or cutting fluid helps the slug to eject at the end of the cut. But when slug ejection becomes unreliable or the steel resists cutting, it probably means the cutting edges are becoming dull. Re-sharpen or replace your cutter. Also make sure there are no chips inside your cutter which can hold up a slug.

Maintaining Your Mag Drill

For the best performance, always maintain your drill as instructed in the operator's manual. A list of op manuals can be found at **Hougen.com** if the manual supplied with your drill can not be located. Many mag drills feature a slide/gib/way system that requires periodic adjustments to maintain rigidity and optimal performance. Worn or damaged parts should be replaced to reduce the possibility of injury. The mag drill should be spot checked for damage prior to use. This will prevent costly repairs from running a damaged drill.

Is a Safety Chain / Strap Necessary?

YES! Your mag drill should always be used with a safety strap or chain especially in horizontal or upside down positions. Not only for safety of the operator but protecting your investment.

True Story - Many many Hougen drills have been lost over the years from falling from bridges when the power cord was unplugged. They fell into the water because they weren't using the safety chain.

Why is My Magnet Lifting Off the Material?

Check your surface as outlined in surface requirements (See Page 12). Also be sure the bottom of the magnet is free from chips and debris. A dull cutter can also push the magnet off the work surface. When drilling upside down, push on the handle closest to the arbor.

What Should I Do After Drilling the Hole?

- Turn off motor
- Ensure the slug has been ejected
- Clean away any chips from the cutting tool & around and under the magnet

What is Positive Slug Ejection?

It is an arbor system that when the feed handles are retracted requires the slug to be pushed out after drilling a hole. The handles will not fully retract until the slug comes out of the cutter. Most Hougen drills include this feature. It is a much more reliable method than a spring ejection arbor.

What is the Proper Feed Rate for a Mag Drill?

A solid steady feed rate should be used to maximize cutter tool life. Listen to the motor. You want the sound of the motor to bog down a little. It should sound like its working. Do not over drive or under drive it as you can break or damage the drill. Also do not “peck” at the hole... meaning... feed the cutter down then let up, then feed the cutter down and let up. This can quickly destroy your tool.

Why Not Use Quick Change Cutters?

Quick change cutters are nice and convenient if you need to change sizes every hole or two. But using a mag drill with the **two set screws to hold the cutter** in place offers a couple of advantages:

- Holds the cutter more rigid and less opportunity for it to move and break
- Will give up to **2x** the tool life

Is a Carbide Cutter Better than a HSS Cutter?

Not necessarily. Carbide cutters are great tools and work good on most types of materials. But where they really shine is when they are used on hard or abrasive materials. They can be used on mild and structural steel but to get the best performance, carbide tooling needs to be turned at a much higher RPM than HSS cutters.

Aren't All Annular Cutters Pretty Much the Same?

That would be like saying all meat tastes the same. Hougen was the inventor of the mag drill annular cutter technology. Hougen[®] Cutters include the most features for the widest range of materials and benefits for long tool life. It takes a lot of extra time to machine and quality check the tools to ensure the customer gets what they expect. When purchasing a Hougen annular cutter, you are buying the highest quality Hougen tool in the market.

Why Do I Have Trouble Drilling Stainless Steel?

Stainless steel is a beautiful material but it can easily work harden. Meaning... if you pause your feed pressure even a little, the material can harden up to the point that it becomes almost impossible to continue. Use solid steady feed pressure, plenty of coolant and **DO NOT** let up to adjust your position.

Should I Use a Power Feed Drill?

Power feed drills offer a nice option for increased productivity. Many shops set up multiple drills for one operator to run.

Can I Drill on the Same Material They are Welding?

No. Drilling on the same material as they are welding can cause the magnet and circuit board to short out.

Can I Get a Custom Cutter Made?

Absolutely! Hougen can solve your holemaking problems with creative solutions to help you get the job done, complete it faster and at a lower cost. We have helped thousands of customers with unique holemaking solutions. Send us an email with your holemaking challenge or complete the custom cutter form at www.hougen.com.



For Technical Support & Warranty Service
Contact Hougen Mfg
www.hougen.com

810-635-7111
tech@hougen.com



Hougen Manufacturing, Inc.



Hougen Manufacturing is a family owned business with our world headquarters and manufacturing facility located in Swartz Creek Michigan. The company was started by the late Dr. E. Douglas Hougen who held over 400 worldwide patents including many for the “12,000-Series” Annular Cutter. For over 60 years Hougen has been the world leader in portable magnetic drills and annular cutters. Hougen proudly manufactures all of our magnetic drills, Hougen Cutters and most of our other products in Michigan.

Customers who demand reliability and performance from their tools choose Hougen. From engineering, to manufacturing, to customer service, Hougen produces the best product in the market. Period. With our three principles in mind “Service, Integrity, Reliability”, Hougen ensures you will be happy with our product and will work to continually solve your holmaking problems.

- Over 400 patents worldwide
- Invented spotweld cutter 1959
- Patented “12,000-Series” Cutter 1973
- First lightweight magnetic drill 1974
- First mag drill to use annular cutters
- First mag drill to drill over 1-1/2" dia.
- First mag drill to drill 3" deep
- First mag drill with positive slug ejection
- First mag drill with safety switch
- First mag drill with thru the tool coolant system
- First mag drill with quill feed spindle
- Quality American Made Products

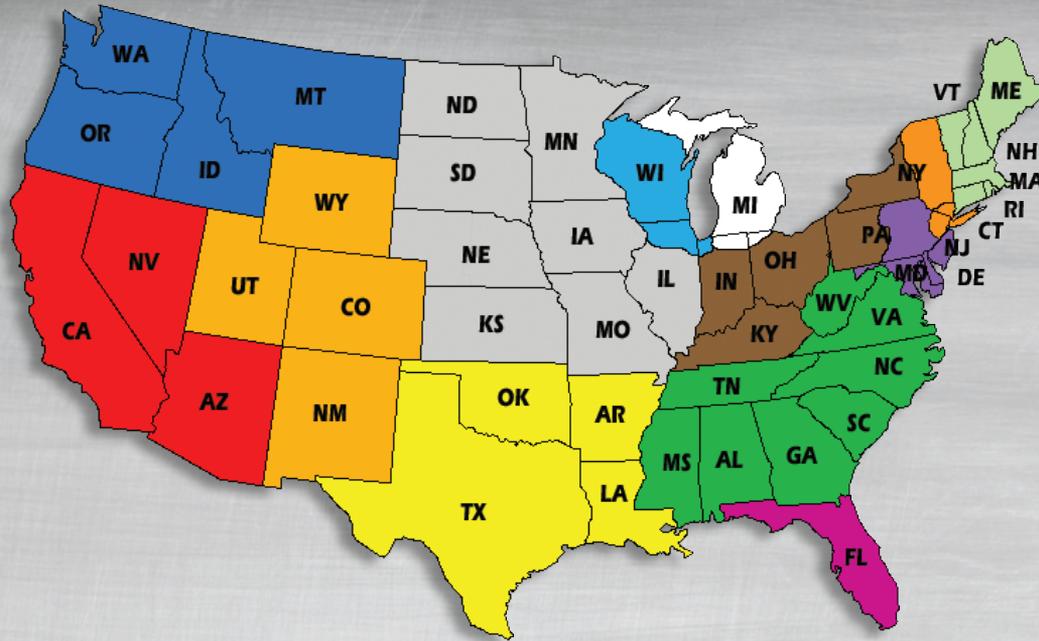


PORTABLE MAGNETIC DRILLS

		HMD130	HMD900	HMD904	HMD905	HMD906	HMD927	HMD2MT	HMD920	HMD918	HMD934
		Low Profile	Fabricating						Heavy Duty Drilling		
Cutters	RotaLoc Plus™		With Adapter	With Adapter	With Adapter	With Adapter	With Adapter	With Adapter	With Adapter	With Adapter	
	"12,000-Series"										
	Copperhead™ Carbide Tipped										
Model Specifications	Diameter Min./Max.	7/16" to 1-3/8" (12 - 35mm)	7/16" to 1-1/2" (12 - 38mm)	7/16" to 1-1/2" (12 - 38mm)	7/16" to 2" (12 - 50mm)	7/16" to 2" (12 - 50mm)	7/16" to 1-5/8" (12 - 41mm)	7/16" to 1-5/8" (12 - 41mm)	7/16" to 2-3/8" (12 - 60mm)	7/16" to 2-3/8" (12 - 60mm)	5/8" to 3-1/16" (16 - 77mm)
	Depth Max.	1" (25mm)	2" (50mm)	2" (50mm)	2" (50mm)	2" (50mm)	2" (50mm)	2" (50mm)	3" (76mm)	6" (152mm)	4" (100mm)
	Cutter Mounting	Bayonet Style	3/4" Double Flat	3/4" Double Flat	3/4" Double Flat	3/4" Double Flat or Fusion2™	3/4" Double Flat				
	No-Load R.P.M.	450	450	450	250 / 450	350 / 650	250 / 450	250 / 450	250 / 450 / 700	250 / 450	70 / 120 / 200 / 332
	Model Weight	23.8 lbs (10.8 kg)	27.7 lbs (12.6 kg)	30 lbs (13.6 kg)	35 lbs (15.9 kg)	35 lbs (15.9 kg)	43 lbs (19.5 kg)	40.2 lbs (18.1 kg)	49 lbs (22.2 kg)	44.2 lbs (20.1 kg)	72 lbs (32.6 kg)
	Thru-the-Tool Coolant										
Available Accessories	Carrying Case Included										
	Swivel Base			Optional	Optional	Optional	Optional		Optional		
	#2 Morse Taper								With Adapter	With Adapter	
	Pipe Adapter						Manual Mode				
	Tap Attachment						Manual Mode				
	Vac-Pad™										
	Coolant Bottle			Optional	Included	Included	Included	Included	Included	Pressurized	Included
	Countersink Kit						Manual Mode				
	Twist Drill Adapter						Manual Mode				
	Ratchet Drive										
	Arbor Extender						Manual Mode				
	Drill Chuck						Manual Mode				
	RotaLoc™ Spindle Adapter						Manual Mode				

HOUGEN® CUTTER COMPARISON CHART

							
Tool Series:	RotaCut™	Holcutter™	Carbide Holcutter™	RotaLoc™	RotaLoc Plus™	12,000-Series™	Copperhead™
Diameter Range Min. / Max.	1/4" to 1-1/2" (6mm - 25mm)	11/16" to 3"	11/16" to 3"	1/2" to 1-1/16" (12mm - 26mm)	7/16" to 1-3/8" (12mm - 35mm)	7/16" to 3-1/16" (12mm - 77mm)	9/16" to 3" (14mm - 60mm)
Max. Depth of Cut	1/4" to 1/2" (6.4mm - 12.7mm)	1/8" (3.2mm)	1/8" (3.2mm)	3/4" - (19mm) Stack Geometry	1" - (25mm) Stack Geometry	1" to 6" (25mm to 152mm)	1" to 6" (25mm to 152mm)
Mounting	3/8" or 1/2" Triple Flat Shank	3/8" Triple Flat Shank	3/8" or 1/2" Triple Flat Shank	Bayonet Style	Bayonet Style	3/4" Double Flat or Fusion2™ Shank	3/4" Fusion2™ Shank
Cutter Material(s) Available	M2 HSS	M2 HSS	Carbide Tip	M42 HSS or Carbide Tip	M42 HSS	M2 HSS or M2 TiN Coat	Carbide Tip
Can be Resharpener	===== Disposable =====						
Available Grind Down (Within Limits)							
Max. Application Hardness Rating	275 BHN (28.5 HRC)	275 BHN (28.5 HRC)	450 BHN (47.2 HRC)	350 BHN (37.7 HRC)	350 BHN (37.7 HRC)	275 BHN 325 BHN (TiN)	450 BHN (47.2 HRC)
Recommended Lubrication	Slick-Stik™ or RotaGel™	Slick-Stik™ or RotaGel™	Slick-Stik™ or RotaGel™	Slick-Stik™ or RotaGel™	Slick-Stik™ or RotaGel™	RotaMagic™	RotaMagic™
Aluminum	===== High RPM & Fast Feed Rates Suggested =====						
Mild Steel							
Harder Steel	Good	Good		Better	Better	Standard - Good TiN - Better	
Stainless Steel	Good	Recommend Speed Reducer		Good	Good	TiN Coat or Premium Recommended	



Hougen Regional Sales Agencies

Your Link to Field Service, Sales Support
and Training

Find yours at: www.hougen.com

Follow Us for All the Latest Info



HOUGEN MANUFACTURING, INC.

3001 Hougen Drive • Swartz Creek, MI 48473 USA
Ph: (810) 635-7111 • Fax: (810) 635-8277
info@hougen.com • www.hougen.com