



# REAMER GUIDE

## BASIC TECHNICAL INFORMATION FOR REAMERS



HANNIBAL CARBIDE would like to inform you of some basic technical knowledge regarding reamers. Following these guidelines will reduce overall set-up time, while increasing productivity. Selecting the right tool, proper stock removal and correct speeds and feeds are all important and covered here in the HANNIBAL Reamer Guide. Ream it right the first time with HANNIBAL.

.....from the Hannibal Technical Team

REAMERS

### FLUTE STYLES

#### **Straight:**

Best suited for non-chip forming materials, i.e. cast iron, bronze and free cutting brass. Preferred hole condition would be a thru hole.

#### **Right Hand Spiral:**

Designed to pull the chip out of the hole in a blind hole application. Due to aggressive flute geometry, a right hand spiral may cut slightly oversized. Effective in bridging interruptions, such as keyways, cross-holes, etc. Excellent in highly ductile materials.

#### **Left Hand Spiral:**

Excellent in thru holes, as the flutes tend to push the chips out ahead of the reamer. Effective in bridging interruptions, such as keyways, cross-holes, etc. Good for reaming hard materials. Should provide the very best size and finish.

#### **Expansion Reamers:**

Designed for high production runs in abrasive materials, when size or finish can be rapidly lost. Expand the diameter by turning the screw clockwise. The tool is now ready to be reground back to its original diameter and resharpened. This process should produce like new tool performance.

### COOLANT OPTIONS

#### **Center Fed Coolant (axial):**

Center fed coolant design is used for blind hole reaming. Combine center fed coolant with right hand spiral for maximum chip clearing ability in highly ductile material.

#### **Flute Fed Coolant (radial):**

Flute fed coolant design is used for thru hole reaming. Effective in a cavity large enough for chip clearance. Flute fed coolant will flush the chips ahead of the reamer, providing the best hole size and finish.



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While developing optimum conditions will require some investment in time, it will be beneficial by reducing cycle times and getting the best possible tool life. There are several elements to evaluate in this section. These elements are key to maximizing tool efficiency.

### OPTIMUM OPERATING CONDITIONS

#### Stock Removal:

2%-3% of the reamer diameter will normally be appropriate stock removal when reaming.

Example: a .500" diameter tool would remove .010"-.015" of stock.

Example: a 1.0" diameter tool would remove .020"-.030" of stock.

These examples cover finish reaming.

When your application calls for a rough ream, stock removal can be up to 5%

See "Pre-Ream Drill Size Chart" on page 26.

#### Runout (TIR) Concerns:

One of the most overlooked areas in reaming.

It is critical to the function of the tool to be running concentric with the machine spindle.

Some of the most important areas to consider include:

**Tool Holders** - precision collets and hydraulic chucks are widely used for straight shank tools. When using hydraulic chucks be sure shank diameter tolerance is acceptable. If using taper shank reamers make sure holders are free from dirt, grit and burrs that could cause the shank to not seat properly.

**Tool Overhang** - Use the shortest tool possible. Runout multiplies rapidly as the distance from the spindle increases.

**Rigid Fixturing** - Make sure the part piece is secure. Movement of the piece may cause tool breakage, oversized holes, poor finish and would shorten tool life.

**Checking TIR** - Check the reamer diameter with a dial indicator (at the circular margin). Ideally a reamer should run within .001" TIR.

#### Coolant feeding reamers:

Coolant induced thru the reamer should be utilized when possible.

Benefits include better finishes, superior tool life and the ability to increase speeds and feeds.

#### Speeds and Feeds:

Reaming is a finishing operation and the correct combination of speed and feed is critical to tool life. Proper speeds & feeds must be run to achieve size, straightness and finish. See pages 8 and 9 for starting speed and feed information and further guidelines.

#### Tool Geometry and Carbide Grade:

Geometry may be altered to obtain optimum performance and extend tool life.

Material specific carbide grades are beneficial in reaming material of a specific hardness & condition. Hannibal offers stocked material specific reamers in most all styles.



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### DEVELOPING OPTIMUM SPEED AND FEEDS

- Most reamer manufacturers will provide you with a starting point for speeds and feeds. It is very important to remember when optimizing your cycle that increasing feed will give you quicker cycles than running higher SFM at lower feed rates.
- With the surface feet per minute (SFM) at the manufacturers low range, begin trying to increase the feed rate. Increase in small increments, .001 - .0015 per revolution. Continue to increase the feed until an undesirable condition develops. This could be an unacceptable finish, a bell, tapered, or egg shaped hole, or poor size. At this point return to the previous feed rate. You are now at or close to the optimum feed rate.
- Increase the speed in increments of 10-20 SFM. Like the feed, increase until undesirable conditions appear, then return to the previous SFM. You should now be at or near the optimum speed and feed. It may also be necessary to fine-tune these numbers after a few runs to achieve the very best tool life.
- As you seek the optimum speed and feed for your application, look and listen for signs or sounds that could save you time. Listen for the reamer squealing upon entry—this means speed or feed is too high or alignment is poor. Examine the chip for size and color. Examine the finish for signs of chatter.

### AVOIDING PROBLEMS – Common Problem Areas to Avoid.

- **Improper Tool** - make sure you are using the correct flute style and tool type.
- **Stock Removal** - HANNIBAL recommends 2-3% of the reamer diameter as a starting point for stock removal. 2% for steels and tough alloys, 3% for non-ferrous materials and cast irons. Solid carbide & carbide tipped reamers must have adequate stock to remove or they will rub in the hole and generate excessive heat, which leads to premature tool wear.
- **Improper Speeds & Feeds** - The right combination of speeds and feeds is critical to tool life and consistent size and finish. Getting the correct starting points is a key element. Reaming is a finishing operation and proper speeds and feeds must be run to achieve size, straightness and finish.
- **Poor Fixturing** - If the fixturing cannot hold the piece securely and in line with the spindle, then producing a good finish will be very difficult. A reamed hole is only going to be as good as the machine and fixturing used to machine and hold the part.
- **Excessing Runout (spindle or tool holder)** - Runout leads to poor finishes, oversized, tapered, and bellmouth holes, as well as poor tool life. Floating holders or bushings can sometimes be used to compensate for runout, but the best solution is to fix the problem.
- **Improper Coolant** - Make sure the coolant you are using is recommended for reaming your particular materials. Many coolants will prove effective for reaming if the concentration level is maintained with specifications. Take the time to check the levels on a regular basis.
- **Improper Sharpening or Geometry** - If a new tool works fine, but fails to perform after resharpening, the problem is obvious. However, depending on the hardness and condition of the material you are reaming, the tool geometry may need to be altered to get optimum performance and tool life. Geometries most often changed are the circular margins, radial rake, and the primary chamfer clearance.
- **Material Changes (hardness and/or condition)** - Castings lead the way in inconsistency. Hard spots, free carbides, and scale can all lead to inconsistent results when reaming. A heat treatment that varies just a few points from part to part can cause problems.



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## BASIC TECHNICAL INFORMATION FOR REAMERS

### HANNIBAL PRE-REAM DRILL SIZE CHART

REAMERS

REAMER DIAMETER FRACTION - DECIMAL (NOMINAL)	HOLE SIZE TO LEAVE 2%	DRILL SIZE TO LEAVE 2%	HOLE SIZE TO LEAVE 3%	DRILL SIZE TO LEAVE 3%
1/8 - .1250	.1225	31	.1213	3.0mm
9/64 - .1406	.1378	29	.1364	3.4mm
5/32 - .1562	.1532	24	.1516	25
11/64 - .1719	.1685	19	.1667	4.2mm
3/16 - .1875	.1838	14	.1819	15
13/64 - .2031	.1990	5.0mm	.1970	9
7/32 - .2188	.2144	5.4mm	.2122	4
15/64 - .2344	.2297	1	.2274	5.7mm
1/4 - .2500	.2450	C	.2425	6.1mm
17/64 - .2656	.2600	6.5mm	.2576	F
9/32 - .2812	.2756	I	.2728	6.9mm
19/64 - .2969	.2910	7.3mm	.2880	7.25mm
5/16 - .3125	.3063	7.75mm	.3031	N
21/64 - .3281	.3215	8.1mm	.3183	O
11/32 - .3438	.3370	8.5mm	.3335	8.4mm
23/64 - .3594	.3522	S	.3486	8.8mm
3/8 - .3750	.3675	9.25mm	.3638	23/64
25/64 - .3906	.3828	9.6mm	.3789	V
13/32 - .4062	.3982	10.0mm	.3941	25/64
27/64 - .4219	.4135	10.4mm	.4092	13/32
7/16 - .4375	.4288	10.8mm	.4244	27/64
29/64 - .4531	.4440	11.2mm	.4395	7/16
15/32 - .4688	.4594	11.6mm	.4547	29/64
31/64 - .4844	.4747	12.0mm	.4699	15/32
1/2 - .5000	.4900	31/64	.4850	12.2mm
33/64 - .5156	.5053	1/2	.5000	12.6mm
17/32 - .5312	.5206	33/64	.5153	13.0mm
35/64 - .5469	.5360	17/32	.5305	13.4mm
9/16 - .5625	.5513	35/64	.5456	13.8mm
37/64 - .5781	.5665	9/16	.5608	14.2mm
19/32 - .5938	.5820	37/64	.5760	14.5mm
39/64 - .6094	.5972	19/32	.5911	14.9mm
5/8 - .6250	.6125	39/64	.6063	15.3mm
41/64 - .6406	.6278	5/8	.6214	15.7mm
21/32 - .6562	.6431	41/64	.6365	16.1mm
43/64 - .6719	.6585	21/32	.6517	16.5mm
11/16 - .6875	.6738	17.0mm	.6669	16.8mm
45/64 - .7031	.6890	11/16	.6820	17.2mm
23/32 - .7188	.7044	45/64	.6972	17.6mm
47/64 - .7344	.7197	18.2mm	.7124	18.0mm
3/4 - .7500	.7350	18.5mm	.7275	18.3mm
49/64 - .7656	.7502	18.9mm	.7426	18.8mm
25/32 - .7812	.7656	19.3mm	.7578	3/4
51/64 - .7969	.7810	19.7mm	.7730	49/64
13/16 - .8125	.7963	20.1mm	.7881	25/32
53/64 - .8281	.8115	20.5mm	.8034	51/64
27/32 - .8438	.8270	20.8mm	.8185	13/16
55/64 - .8594	.8422	21.25mm	.8336	53/64
7/8 - .8750	.8575	21.6mm	.8488	27/32
57/64 - .8906	.8728	22.0mm	.8639	55/64
29/32 - .9062	.8881	22.5mm	.8790	7/8
59/64 - .9219	.9035	22.8mm	.8942	57/64
15/16 - .9375	.9188	23.25mm	.9094	29/32
61/64 - .9531	.9340	23.5mm	.9245	59/64
31/32 - .9688	.9494	24.0mm	.9397	15/16
63/64 - .9844	.9647	24.4mm	.9549	61/64
1 - 1.0000	.9800	24.75mm	.9700	31/32

This chart allows for drill oversize based on study done by the United States Cutting Tool Institute



# REAMER SELECTION GUIDE BASED ON HOLE CONDITION



## CARBIDE LENGTH

- Use flute long carbide for hole depths exceeding maximum shallow depth (shown in table to right)

Hole Diameter	Max. Shallow Hole Depth
.1875" thru .3125"	.500"
.3126" thru .7188"	.625"
.7189" thru 1.0625"	.750"
1.0626" thru 1.5000"	.875"

## FLUTE STYLES

- Straight Flutes - Good in a wide variety of applications
- Right Spiral Flutes - Tend to bridge interruptions such as keyways, slots or intersecting holes; Good chip clearing ability for ductile materials and blind holes
- Left Spiral Flutes - Also tend to bridge interruptions; Good for cast irons, heat treated steels and other hard materials  
Do **not** use in blind holes
- Expansion Reamers - Economical for abrasive materials

MATERIAL CHIP CLASS	FLUTE STYLE	THRU HOLE				BLIND HOLE				
		SHALLOW		DEEP		SHALLOW		DEEP		
		STR. SHANK	TPR. SHANK	STR. SHANK	TPR. SHANK	STR. SHANK	TPR. SHANK	STR. SHANK	TPR. SHANK	
20 ALUMINUM ALLOY COPPER ALLOY (TOUGH) LEAD ALLOY NON-METAL & PLASTIC ZINC ALLOY	<b>GENERAL PURPOSE TYPES</b>									
	SPIRAL	420 - pg. 68	422 - pg. 70	440 - pg. 42	-	410 - pg. 68	412 - pg. 70	-	-	
	STRAIGHT	400 - pg. 46	402 - pg. 54	450 - pg. 56	452 - pg. 62	400 - pg. 46	402 - pg. 54	450 - pg. 56	452 - pg. 62	
	EXPANSION	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	
	<b>MATERIAL SPECIFIC TYPES</b>									
	SPIRAL	433 - pg. 86	-	482 - pg. 87	-	432 - pg. 84	-	442 - pg. 85	-	
	STRAIGHT	407 - pg. 76	472 - pg. 80	457 - pg. 78	453 - pg. 81	407 - pg. 76	472 - pg. 80	457 - pg. 78	453 - pg. 81	
	EXPANSION	464 - pg. 82	461 - pg. 83	464 - pg. 82	461 - pg. 83	464 - pg. 82	461 - pg. 83	464 - pg. 82	461 - pg. 83	
	<b>COOLANT FED TYPES</b>									
	SPIRAL	427 - pg. 96	-	427 - pg. 96	-	411 - pg. 94	-	411 - pg. 94	-	
	STRAIGHT	416 - pg. 92	-	416 - pg. 92	-	414 - pg. 90	-	414 - pg. 90	-	
	40 ALUMINUM BRONZE BRASS BRONZE MAGNESIUM ALLOY NICKEL SILVER	<b>GENERAL PURPOSE TYPES</b>								
SPIRAL		420 - pg. 68	422 - pg. 70	440 - pg. 42	-	410 - pg. 68	412 - pg. 70	-	-	
STRAIGHT		400 - pg. 46	402 - pg. 54	450 - pg. 56	452 - pg. 62	400 - pg. 46	402 - pg. 54	450 - pg. 56	452 - pg. 62	
EXPANSION		465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	
<b>MATERIAL SPECIFIC TYPES</b>										
SPIRAL		433 - pg. 86	-	482 - pg. 87	-	432 - pg. 84	-	442 - pg. 85	-	
STRAIGHT		407 - pg. 76	472 - pg. 80	457 - pg. 78	453 - pg. 81	407 - pg. 76	472 - pg. 80	457 - pg. 78	453 - pg. 81	
EXPANSION		464 - pg. 82	461 - pg. 83	464 - pg. 82	461 - pg. 83	464 - pg. 82	461 - pg. 83	464 - pg. 82	461 - pg. 83	
<b>COOLANT FED TYPES</b>										
SPIRAL		427 - pg. 96	-	427 - pg. 96	-	411 - pg. 94	-	411 - pg. 94	-	
STRAIGHT		416 - pg. 92	-	416 - pg. 92	-	414 - pg. 90	-	414 - pg. 90	-	
60 DUCTILE CAST IRON GRAY CAST IRON MALLEABLE CAST IRON NODULAR CAST IRON		<b>GENERAL PURPOSE TYPES</b>								
	SPIRAL	420 - pg. 68	422 - pg. 70	440 - pg. 42	-	410 - pg. 68	412 - pg. 70	-	-	
	STRAIGHT	400 - pg. 46	402 - pg. 54	450 - pg. 56	452 - pg. 62	400 - pg. 46	402 - pg. 54	450 - pg. 56	452 - pg. 62	
	EXPANSION	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	
	<b>MATERIAL SPECIFIC TYPES</b>									
	SPIRAL	437 - pg. 86	-	483 - pg. 87	-	436 - pg. 84	-	443 - pg. 85	-	
	STRAIGHT	408 - pg. 76	473 - pg. 80	458 - pg. 78	454 - pg. 81	408 - pg. 76	473 - pg. 80	458 - pg. 78	454 - pg. 81	
	EXPANSION	468 - pg. 82	462 - pg. 83	466 - pg. 82	462 - pg. 83	466 - pg. 82	462 - pg. 83	466 - pg. 82	462 - pg. 83	
	<b>COOLANT FED TYPES</b>									
	SPIRAL	428 - pg. 96	-	428 - pg. 96	-	413 - pg. 94	-	413 - pg. 94	-	
	STRAIGHT	426 - pg. 92	-	426 - pg. 92	-	424 - pg. 90	-	424 - pg. 90	-	
	80 - 100 - 120 LOW STRENGTH STEEL MEDIUM STRENGTH STEEL HIGH STRENGTH STEEL TOOL STEEL	<b>GENERAL PURPOSE TYPES</b>								
SPIRAL		420 - pg. 68	422 - pg. 70	440 - pg. 42	-	410 - pg. 68	412 - pg. 70	-	-	
STRAIGHT		400 - pg. 46	402 - pg. 54	450 - pg. 56	452 - pg. 62	400 - pg. 46	402 - pg. 54	450 - pg. 56	452 - pg. 62	
EXPANSION		465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	
<b>MATERIAL SPECIFIC TYPES</b>										
SPIRAL		439 - pg. 86	-	484 - pg. 87	-	438 - pg. 84	-	444 - pg. 85	-	
STRAIGHT		409 - pg. 76	474 - pg. 80	459 - pg. 78	455 - pg. 81	409 - pg. 76	474 - pg. 80	459 - pg. 78	455 - pg. 81	
EXPANSION		468 - pg. 82	463 - pg. 83	468 - pg. 82	463 - pg. 83	468 - pg. 82	463 - pg. 83	468 - pg. 82	463 - pg. 83	
<b>COOLANT FED TYPES</b>										
SPIRAL		429 - pg. 96	-	429 - pg. 96	-	415 - pg. 94	-	415 - pg. 94	-	
STRAIGHT		435 - pg. 92	-	435 - pg. 92	-	434 - pg. 90	-	434 - pg. 90	-	
140 IRON BASE ALLOY NICKEL BASE ALLOY 300 SERIES STAINLESS 400 SERIES STAINLESS PH SERIES STAINLESS TITANIUM ALLOY		<b>GENERAL PURPOSE TYPES</b>								
	SPIRAL	420 - pg. 68	422 - pg. 70	440 - pg. 42	-	410 - pg. 68	412 - pg. 70	-	-	
	STRAIGHT	400 - pg. 46	402 - pg. 54	450 - pg. 56	452 - pg. 62	400 - pg. 46	402 - pg. 54	450 - pg. 56	452 - pg. 62	
	EXPANSION	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	465 - pg. 64	467 - pg. 66	
	<b>MATERIAL SPECIFIC TYPES</b>									
	SPIRAL	439 - pg. 86	-	484 - pg. 87	-	438 - pg. 84	-	444 - pg. 85	-	
	STRAIGHT	409 - pg. 76	474 - pg. 80	459 - pg. 78	455 - pg. 81	409 - pg. 76	474 - pg. 80	459 - pg. 78	455 - pg. 81	
	EXPANSION	468 - pg. 82	463 - pg. 83	468 - pg. 82	463 - pg. 83	468 - pg. 82	463 - pg. 83	468 - pg. 82	463 - pg. 83	
	<b>COOLANT FED TYPES</b>									
	SPIRAL	429 - pg. 96	-	429 - pg. 96	-	415 - pg. 94	-	415 - pg. 94	-	
	STRAIGHT	435 - pg. 92	-	435 - pg. 92	-	434 - pg. 90	-	434 - pg. 90	-	

REAMERS



# COST EFFECTIVE REAMER SELECTION CARBIDE TIPPED VS. HSS AND COBALT

REAMERS

REAMER SELECTOR	CHIP CLASS	1 FIND THE CLASS FOR MATERIAL BEING REAMED - SEE PAGES 6 & 7	2 DETERMINE MATERIAL CONDITION AND HARDNESS	3 DETERMINE TOTAL NUMBER OF HOLES TO BE REAMED, THEN LOCATE MOST COST EFFECTIVE REAMER ON MATERIAL CONDITION/HARDNESS LINE									
		MATERIAL CLASS	MATERIAL CONDITION/HARDNESS	TOTAL NUMBER OF HOLES TO BE REAMED									
				1	5	10	20	40	80	160	320	640	
20	NON-FERROUS LONG CHIPS		SOFT - UNDER 10% SILICON	HSS	HSS	HSS	HSS	CT	CT	CT	CT	CT	CT
			ABRASIVE - OVER 10% SILICON	HSS	Cobalt	CT	CT	CT	CT	CT	CT	CT	CT
40	NON-FERROUS SHORT CHIPS		SOFT - FREE MACHINING	HSS	HSS	HSS	HSS	CT	CT	CT	CT	CT	CT
			HARD - HIGH TENSILE	HSS	Cobalt	Cobalt	CT	CT	CT	CT	CT	CT	CT
60	CAST IRONS		SOFT - 120 TO 220 Bhn	HSS	HSS	HSS	CT	CT	CT	CT	CT	CT	CT
			MEDIUM - 220 TO 300 Bhn	HSS	Cobalt	Cobalt	CT	CT	CT	CT	CT	CT	CT
			HARD - OVER 300 Bhn	HSS	Cobalt	CT	CT	CT	CT	CT	CT	CT	CT
80	LOW STRENGTH STEELS		SOFT - 80 TO 175 Bhn	HSS	HSS	HSS	CT	CT	CT	CT	CT	CT	CT
			MEDIUM - 176 TO 275 Bhn	HSS	Cobalt	CT	CT	CT	CT	CT	CT	CT	CT
			HARD - OVER 275 Bhn	Cobalt	Cobalt	CT	CT	CT	CT	CT	CT	CT	CT
100	MEDIUM STRENGTH STEELS		SOFT - 150 TO 275 Bhn	HSS	HSS	HSS	CT	CT	CT	CT	CT	CT	CT
			MEDIUM - 276 TO 425 Bhn	HSS	Cobalt	CT	CT	CT	CT	CT	CT	CT	CT
			HARD - OVER 45 Rc	Cobalt	CT	CT	CT	CT	CT	CT	CT	CT	CT
120	HIGH STRENGTH STEELS		SOFT - 135 TO 275 Bhn	HSS	HSS	CT	CT	CT	CT	CT	CT	CT	CT
			MEDIUM - 276 TO 425 Bhn	Cobalt	Cobalt	CT	CT	CT	CT	CT	CT	CT	CT
			HARD - OVER 45 Rc	Cobalt	CT	CT	CT	CT	CT	CT	CT	CT	CT
140	HIGH TEMP ALLOYS		ALL CONDITIONS	CT	CT	CT	CT	CT	CT	CT	CT	CT	CT

CT=Carbide Tipped HSS=High Speed Steel

## DECREASE YOUR MACHINING COST PER HOLE REAMED WITH CARBIDE TIPPED REAMERS

Why is **total cost** per hole reamed **far lower** with **carbide tipped** reamers despite its higher initial cost?

Because of:

- Higher feeds & speeds due to heat resistant cutting edges — reduces machine cycle time per part
- Consistent quality — maintains hole size and surface finish far longer
- Longer tool life — reduces down time for tool changes



## REAMER PROBLEM SOLVING GUIDE CARBIDE TIPPED

REAMING PROBLEMS	POSSIBLE CAUSES	POSSIBLE SOLUTIONS
1. POOR FINISH	Unequal chamfers Incorrect margins Excessive spindle runout Chatter  Insufficient cutting action	Regrind reamer with equal chamfer height Regrind reamer with narrower margins for reaming higher tensile materials Use bushing — .0002"/.0003" over reamer diameter Increase feed and reduce speed rate Use power feed unless material is hard Use spiral fluted reamer Grind secondary lead angle immediately behind 45° chamfer Specify reamer with positive radial rake to reduce cutting pressure — may produce slightly larger diameter holes
2. OVERSIZED HOLES TAPERED HOLES BELL MOUTH HOLES	Misalignment  Incorrect feed and/or speed	Check fixturing & setup for possible causes; use floating holder if necessary Consider using precision bushings or piloted reamers Verify feeds & speeds (see pages 8 & 9)
3. EXCESSIVE TOOL WEAR	Improper stock removal Excessive reaming pressure  Misalignment	Change pre-ream hole size to leave 2 to 3% of tool diameter Decrease feed rate (see "Feeds & Speeds" Chart on pages 8 & 9) See solution for "improper stock removal" in #3 See solution for "misalignment" in #2
4. CROOKED HOLES	Drill walking or incorrect sharpening	Correct drilling operation — reamer will follow drilled hole Increase 90° included chamfer angle to 120° – 180°
5. TOOL BREAKAGE	Excessive reaming pressure Misalignment	See solution for "excessive reaming pressure" in #3 See solution for "misalignment" in #2



# CARBIDE TIPPED REAMERS TECHNICAL INFORMATION

## REAMER BASICS

- The reamer is used to finish machine a previously formed hole to an exact diameter with a smooth finish. It should **not** be used to significantly enlarge a hole (max. 5% – depending on material and hardness).
- Carbide tipped reamers are especially appropriate for close tolerance reaming. Because carbide is very highly resistant to wear, the reamer will produce accurate hole size and a smooth finish far longer than high speed steel or cobalt.
- The reamer is an end cutting tool, cutting only on the chamfer's edge at the outside diameter of the preformed hole.

The standard 45° chamfer angle provides effective cutting action for most materials.

### Reamer Types:

- General Purpose** – Superior performance over high speed steel and cobalt; good in a wide variety of materials
- Material Specific** – Excellent in large production runs due to material specific carbide & tool geometry
- Coolant Fed** – Exceptional performance and tool life using material specific reamer technology and coolant fed capabilities; maximizes feeds & speeds

### TECHNICAL REAMING GUIDE INFORMATION PAGES 23-29

Contact us for a PDF copy of "HANNIBAL'S Guide to Cost Effective Reaming." It includes:

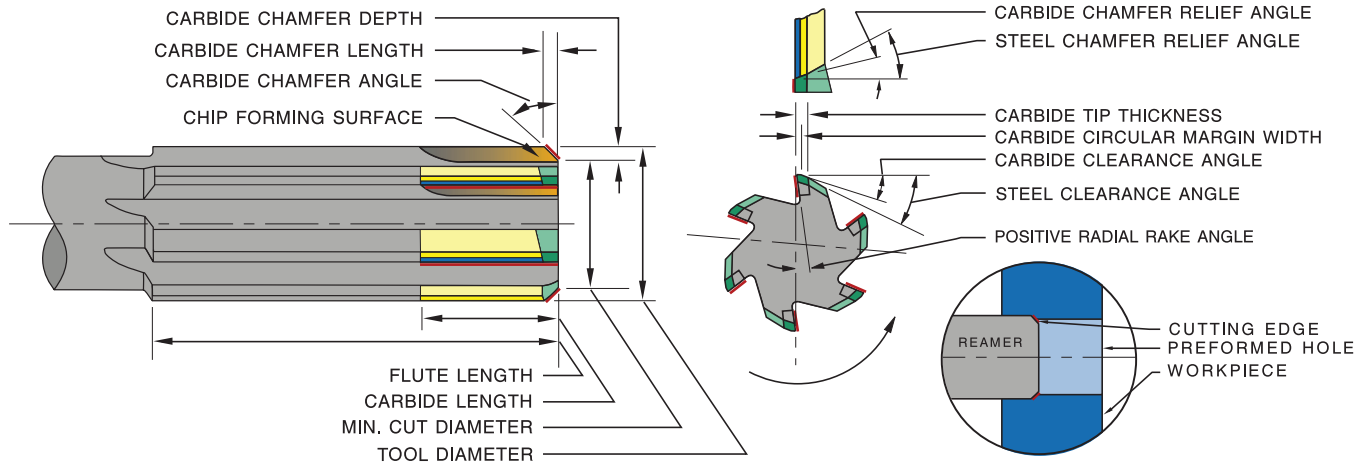
Reamer Expedite Fees: Order must be received by 2:00 PM CST

Does not apply to types 401, 403, 431, 441, 490, and EL Reamers

18 pieces max per diameter

Does NOT require air shipment of the product

Reamer Diameter	Service	Fee
Up to 1.0000"	24 Hour	75.00
Up to 1.0000"	48 Hour	50.00
Over 1.0000"	48 Hour	75.00
Over 1.0000"	72 Hour	50.00



## REAMER SPECIFICATIONS

- Geometry and carbide grade appropriate for material being machined
- Carbide tips brazed to tough hardened alloy steel body, except expansion reamers which are not hardened
- Polished flutes for easy chip flow
- ASME/ANSI B94.2; NAS 897; USCTI
- Precision ground cutting edges
- "Taper Shank No." refers to American Standard taper series (formerly Morse taper series) per ASME/ANSI B5.10
- Material specific reamer shanks are ground to next smallest shank diameter listed in NAS 897 if tool diameter is within .005" of shank diameter
- Expansion reamers can be expanded for regrinding as follows:

Tool Diameter	Guaranteed Minimum Expansion
5/16" - 15/32"	.006"
1/2" - 31/32"	.010"
1" - 1 1/2"	.013"
1 1/4" - 2 1/2"	.015"

## REAMER TOLERANCES

### Tool diameter tolerance:

#### General purpose & Coolant fed

Thru 1 1/2" tool diameter: plus .0003", minus .0000"

Over 1 1/2" tool diameter: plus .0004", minus .0000"

#### Material specific (excluding coolant fed)

Thru 1/2" tool diameter: plus .0002", minus .0000"

Over 1/2" tool diameter thru 3/4": plus .0003", minus .0000"

Over 3/4" tool diameter: plus .0004", minus .0000"

### Closer tool diameter tolerance pricing per tool:

Standard Tolerance	Modified to Closer Tolerance		
	.0003"	.0002"	.0001"
.0004"	\$1	\$3	\$5
.0003"	–	\$1	\$3
.0002"	–	–	\$3

### Shank diameter tolerance:

#### General purpose

minus .0005", minus .0015"

#### Material specific (NAS) & Coolant fed

Thru 23/32" tool diameter: plus .0000", minus .0010"

Over 23/32" tool diameter: plus .0000", minus .0015"