# 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*



## 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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## BASIC TECHNICAL INFORMATION FOR REAMERS

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 utilitized 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.

# REAMER GUIDE

## BASIC TECHNICAL INFORMATION FOR REAMERS



## 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.

WORLD CLASS
MADE IN USA

# REAMER GUIDE

## 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

GENERAL PURPOSE | MATERIAL SPECIFIC | COOLANT FED

## 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

REAMERS

| 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**<br>ALUMINUM ALLOY<br>COPPER ALLOY (TOUGH)<br>LEAD ALLOY<br>NON-METAL & PLASTIC<br>ZINC ALLOY | **GENERAL PURPOSE TYPES** | | | | | | | | |
| | 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 |
| | **MATERIAL SPECIFIC TYPES** | | | | | | | | |
| | 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 |
| | **COOLANT FED TYPES** | | | | | | | | |
| | 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**<br>ALUMINUM BRONZE<br>BRASS<br>BRONZE<br>MAGNESIUM ALLOY<br>NICKEL SILVER | **GENERAL PURPOSE TYPES** | | | | | | | | |
| | 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 |
| | **MATERIAL SPECIFIC TYPES** | | | | | | | | |
| | 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 |
| | **COOLANT FED TYPES** | | | | | | | | |
| | 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**<br>DUCTILE CAST IRON<br>GRAY CAST IRON<br>MALLEABLE CAST IRON<br>NODULAR CAST IRON | **GENERAL PURPOSE TYPES** | | | | | | | | |
| | 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 |
| | **MATERIAL SPECIFIC TYPES** | | | | | | | | |
| | 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 | 466 - pg. 82 | 462 - pg. 83 | 466 - pg. 82 | 462 - pg. 83 | 466 - pg. 82 | 462 - pg. 83 | 466 - pg. 82 | 462 - pg. 83 |
| | **COOLANT FED TYPES** | | | | | | | | |
| | 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**<br>LOW STRENGTH STEEL<br>MEDIUM STRENGTH STEEL<br>HIGH STRENGTH STEEL<br>TOOL STEEL | **GENERAL PURPOSE TYPES** | | | | | | | | |
| | 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 |
| | **MATERIAL SPECIFIC TYPES** | | | | | | | | |
| | 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 |
| | STRAIGHT | 480 - pg. 74 | – | 480 - pg. 74 | – | 480 - pg. 74 | – | 480 - pg. 74 | – |
| | 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 |
| | **COOLANT FED TYPES** | | | | | | | | |
| | 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**<br>IRON BASE ALLOY<br>NICKEL BASE ALLOY<br>300 SERIES STAINLESS<br>400 SERIES STAINLESS<br>PH SERIES STAINLESS<br>TITANIUM ALLOY | **GENERAL PURPOSE TYPES** | | | | | | | | |
| | 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 |
| | **MATERIAL SPECIFIC TYPES** | | | | | | | | |
| | 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 |
| | **COOLANT FED TYPES** | | | | | | | | |
| | 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 | – |

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

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

**REAMER SELECTOR**

| CHIP CLASS | 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** |
| | | ABRASIVE - OVER 10% SILICON | HSS | Cobalt | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** |
| **40** | **NON-FERROUS** SHORT CHIPS | SOFT - FREE MACHINING | HSS | HSS | HSS | HSS | **CT** | **CT** | **CT** | **CT** | **CT** |
| | | HARD - HIGH TENSILE | HSS | Cobalt | Cobalt | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** |
| **60** | **CAST IRONS** | SOFT - 120 TO 220 Bhn | HSS | HSS | HSS | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** |
| | | MEDIUM - 220 to 300 Bhn | HSS | Cobalt | Cobalt | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** |
| | | HARD - OVER 300 Bhn | HSS | Cobalt | **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** |
| | | MEDIUM - 176 TO 275 Bhn | HSS | Cobalt | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** |
| | | HARD - OVER 275 Bhn | Cobalt | Cobalt | **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** |
| | | MEDIUM - 276 TO 425 Bhn | HSS | Cobalt | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** |
| | | HARD - OVER 45 Rc | Cobalt | **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** |
| | | MEDIUM - 276 TO 425 Bhn | Cobalt | Cobalt | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** |
| | | HARD - OVER 45 Rc | Cobalt | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** | **CT** |
| **140** | **HIGH TEMP ALLOYS** | ALL CONDITIONS | **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 | Regrind reamer with equal chamfer height |
| | Incorrect margins | Regrind reamer with narrower margins for reaming higher tensile materials |
| | Excessive spindle runout | Use bushing — .0002"/.0003" over reamer diameter |
| | Chatter | 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 |
| | Insufficient cutting action | Specify reamer with positive radial rake to reduce cutting pressure — may produce slightly larger diameter holes |
| 2. OVERSIZED HOLES<br>TAPERED HOLES<br>BELL MOUTH HOLES | Misalignment | Check fixturing & setup for possible causes; use floating holder if necessary |
| | | Consider using precision bushings or piloted reamers |
| | Incorrect feed and/or speed | Verify feeds & speeds (see pages 8 & 9) |
| 3. EXCESSIVE TOOL WEAR | Improper stock removal | Change pre-ream hole size to leave 2 to 3% of tool diameter |
| | Excessive reaming pressure | Decrease feed rate (see "Feeds & Speeds" Chart on pages 8 & 9) |
| | | See solution for "improper stock removal" in #3 |
| | Misalignment | 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 | See solution for "excessive reaming pressure" in #3 |
| | Misalignment | See solution for "misalignment" in #2 |

# CARBIDE TIPPED REAMERS TECHNICAL INFORMATION



## REAMER BASICS

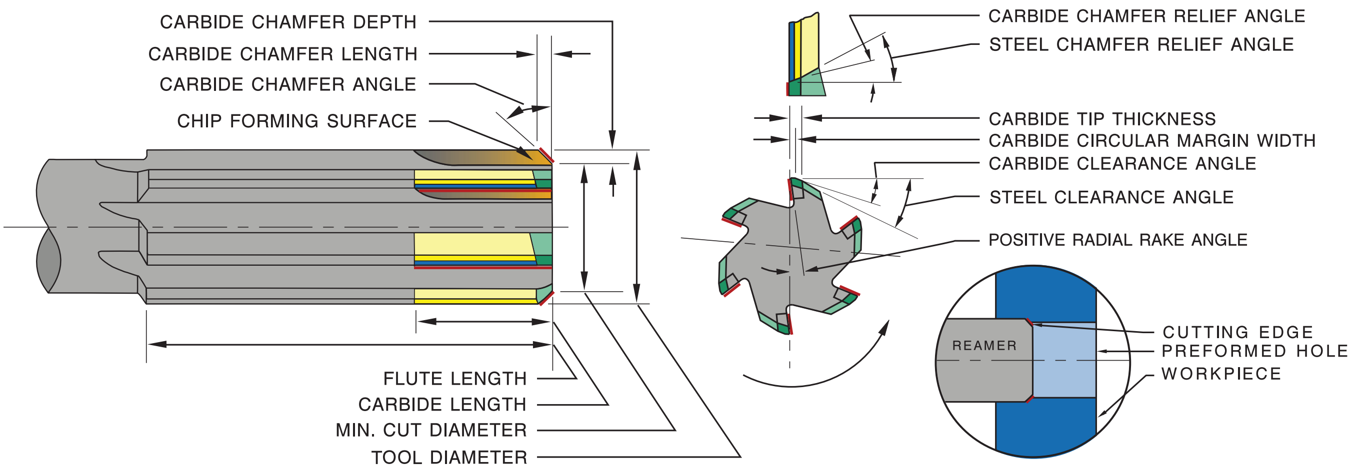
- The reamer is used to finish machine a previously formed hole to an exact diameter with a smooth finish. It should **not** be used to significantly enlarge a hole (max. 5% – depending on material and hardness).
- Carbide tipped reamers are especially appropriate for close tolerance reaming. Because 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 recieved 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" |
| ½" - 31/32" | .010" |
| 1" - 1½" | .013" |
| 1 9/16" - 2½" | .015" |

## REAMER TOLERANCES

- Tool diameter tolerance:
  **General purpose** & **Coolant fed**
  Thru 1½" tool diameter: plus .0003", minus .0000"
  Over 1½" tool diameter: plus .0004", minus .0000"
  **Material specific** (excluding coolant fed)
  Thru ½" tool diameter: plus .0002", minus .0000"
  Over ½" tool diameter thru ¾": plus .0003", minus .0000"
  Over ¾" 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"