

# ROTARY BROACHING BASICS

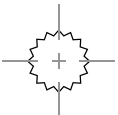
239-628-4800

## ROTARY BROACHING INSTRUCTION GUIDE

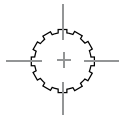
This guide provides some basic rules and tips for successfully producing forms using the rotary broaching process.

*Rotary Broaching can be performed on a manual or CNC lathe, mill or other turning center. The only difference is that in a mill, the rotary broach tool holder is rotated in the machine spindle and the part is stationary whereas in a lathe the tool holder is stationary and the part is turning.*

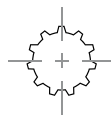
If you have any questions or need additional assistance please contact one of our support members at 239-628-4800 or by visiting <http://www.polygon-solutions.com/rotary-broaching>



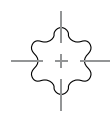
SERRATION



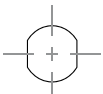
SPLINE



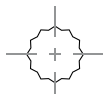
INVOLUTE



SIX-LOBE  
HEXALOBULAR



DOUBLE  
'D'



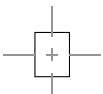
DOUBLE  
HEXAGON



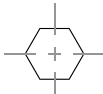
DOUBLE  
KEYWAY



DOUBLE  
SQUARE



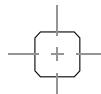
RECTANGLE



HEXAGON



SQUARE



SPUN  
GROUND

*Thank You For Your Business!*

# ADJUSTMENT-FREE TOOL HOLDER SET-UP

The Polygon Solutions tool holders have completely sealed bearings. Therefore, there is no need for constant greasing.

Our tool holders are completely adjustment-free and require minimal set-up. Centering the rotary broach as close as possible to the center of the workpiece is extremely important. Oversized forms or uneven form configuration can result from improperly centered broaching. As long as the toolholder block on your turret, or machine spindle on a mill, is centered with your workpiece, simply insert the Polygon Solutions tool holder and clamp it down.

## **IMPORTANT:**

**DO NOT attempt to locate center off the rotary broach or any part of the tool holder.**

## Coolant:

Rotary Broaching is generally a very low heat operation. However, it is recommended that coolant or cutting oil be used. When broaching tough materials like stainless steel, titanium or Inconel, Polygon Solutions recommends the use of our specially formulated cutting fluid. This cutting fluid is applied by adding a few drops to the tip of the broach prior to it engaging the workpiece to greatly reduce thrust requirements & tool wear. *Order Part #: CF-004*

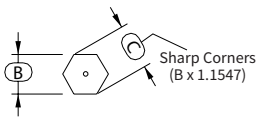
# PART PREPARATION GUIDE

## Pre-Drill Hole Diameter:

Internal rotary broaching requires a pre-drill hole. It is strongly recommended that the hole diameter is larger than the minor diameter of the form being broached. Below are formulas for recommended pre-drill diameters for hex, square and hexalobular (torx) forms. When broaching custom forms such as serration, spline or involutes, it is recommended to pre-drill .002" - .005" larger than the minor diameter of the form.

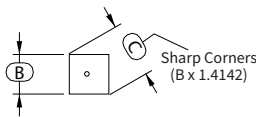
### Hexagon Forms:

**Pre-Drill Hole  $\varnothing = B \times 1.03$**



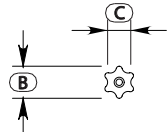
### Square Forms:

**Pre-Drill Hole  $\varnothing = B \times 1.10$**



### Torx Forms:

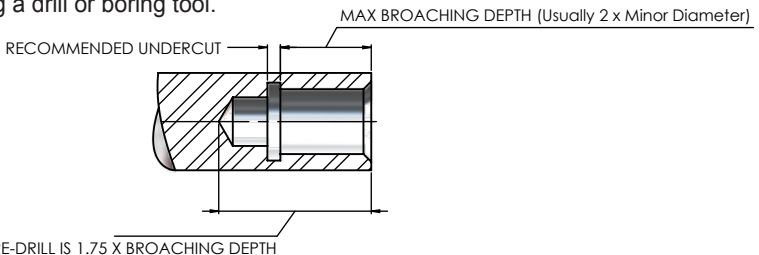
**Pre-Drill Hole  $\varnothing = C \times 1.03$**



\*These percentages may be reduced for free cutting material and should be increased in materials with tougher machinability. If you are bound by the ANSE Standard of no more than 20% stock removal, your pre-drill is 1.0066 X A/F for hexagons and 1.0198 X A/F for squares.

## Pre-Drill Hole Depth:

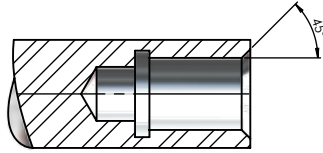
If not broaching a through hole, the pre-drill hole must be as deep as possible. The pre-drill hole depth must be greater than the broaching depth to allow for chip accumulation. The minimum depth Polygon Solutions recommends to avoid excessive chip packing is 1.3 to 1.75 times the depth of the form being broached. If possible, an undercut just beyond the depth of the broached form will allow the chips to break away cleanly. Alternatively, chip removal can be achieved using a drill or boring tool.



## PART PREPARATION GUIDE (continued)

### Lead-In Chamfer:

A 45° lead-in chamfer, slightly larger than the major diameter of the broach, is essential for successfully rotary broaching an internal form. In tougher material a 30° chamfer may work better.



CHAMFER MUST BE LARGER THAN THE MAJOR DIAMETER OF THE BROACH FORM

## SPEEDS AND FEEDS

Many factors affect speeds and feeds including material being broached, major and minor diameters and the form being broached. Polygon Solutions recommends starting with a minimum feed rate of .001-.003" IPR at 600-800 RPM.

It is a good practice to slow your RPMs to 50-100 when first engaging the part until you reach a depth of .020" or until the broach is deeper than your lead-in chamfer. After that point, you can speed up your RPM and feed rate accordingly. This will prevent the broach from skipping around on the face of the chamfer which can cause unsightly witness marks from the tool entering the part. This process will also reduce the risk of chipping or fracturing the rotary broach which can diminish tool life.

***\*Never rapid out of the part, but rather feed out at a rate of .010" IPR.***

## BROACHING TOUGHER MATERIALS

When broaching material such as stainless steel, titanium or Inconel you should always use an upgraded broaching material such as PM M-4 or PM T-15.

Alcrona Pro coating is also very beneficial when broaching exotic materials.

Sometimes stoning the sharp edges of the broach will also help with tool life.

When broaching 4140 it is best to use a broach made from M-42.

If you are attempting to remove a lot of material using a rotary broach you may need to pre-mill or otherwise remove some of the material before broaching.

This can be achieved by using our alignment brake which will allow you to maintain orientation of the broach to your pre-milled form. You can also use a roughing and finishing broach with our alignment brake.



Polygon Solutions has an innovative alignment tool that adapts to our tool holder which makes the alignment of the form very easy to achieve. Polygon's alignment brake allows you to orientate or time the broach to align with another feature of your part. This alignment tool also allows you to break the normal boundaries and limitations! For example, if you need to broach a form to a flat bottom hole where you cannot pre-drill deeper than you need to broach, this alignment tool allows you to broach in sections. That is, you can broach half way down, come out and remove the chips with the pre-drill and then return in the same hole holding the same orientation and finish the form to a flat bottom. This alignment tool can also be used to align multiple passes. The biggest limitation of rotary broaching is tooth height of the form. Polygon Solutions has now solved this issue by making a roughing and finishing broach to achieve a larger tooth on a serration or involute spline. For more information call 239-628-4800.

# TROUBLESHOOTING GUIDE

ISSUES	POSSIBLE PROBLEMS	RECOMMENDATIONS
Skid or witness marks on chamfer area of workpiece	Broach may be skipping around on chamfer area of the workpiece at initial contact	Reduce your spindle speed to 50-100 RPM during initial contact with the workpiece at a feed rate of .001" IPR. Once you reach a depth of .010" - .020" increase back to the recommended speeds / feeds.
Form is spiraling or getting smaller towards the bottom of the workpiece	This can occur when broaching an extra deep form or from excessive chip accumulation	Reverse the spindle direction half way through your workpiece. For deeper holes reverse spindle back and forth several times. Also try: • Pre-drill a larger pilot hole • Add an undercut to break chips
Broach is chipping or has poor tool life	<p>Incorrect broach material/coating</p> <p>Improper workpiece preparation</p> <p>Inaccurate speeds and feeds</p>	<p>For stainless steel you should use broaches made from PM M-4. Use PM T-15 for harder or exotic materials like titanium / Inconel. Consider a coating like Alcrona Pro or our broaching cutting oil.</p> <p>Be sure that your pre-drill is large enough and deep enough. Be sure that you have a sufficient lead-in chamfer.</p> <p>Slow down your speeds and feeds especially at initial contact with the workpiece.</p>
Chip remain in the bottom of the part	Missing undercut	<p>Chips may be cleared out from the bottom of the part by going back in with the same drill used to pre-drill the pilot hole.</p> <p>A small undercut may be added at the end of the broaching depth prior to broaching the form.</p>
Form is off center / teeth larger on one side	<p>Tool holder is off center</p> <p>Deflection of broach</p>	<p>Polygon Solutions' tool holders are adjustment-free. Do not try to locate center off the holder or broach. Use the center of your toolblock or use your machine center.</p> <p>Reduce RPM during initial contact with workpiece.</p>
Machine is stalling or alarming	<p>Excessive chip accumulation</p> <p>Holder bearing failure</p>	<p>Pre-drill a larger pilot hole. It is recommended that you pre-drill as large as possible and as deep as possible.</p> <p>Check the bearing in the broach holder to see if it spins freely.</p>