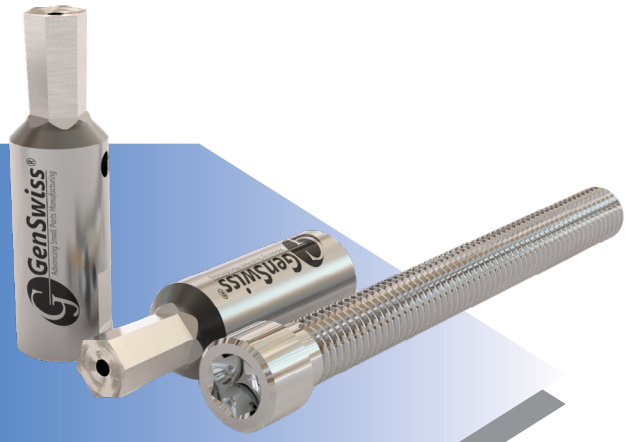
GenSwiss®
Advancing Small Parts Manufacturing

BROACHING OPERATIONS

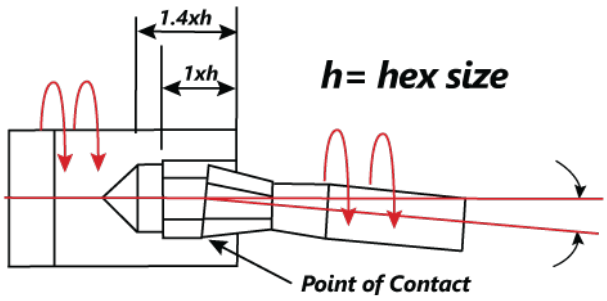
USE RECOMMENDATIONS



Rotary Broaching

Rotary Broaching can be performed on turned parts as well as CNC machining centers or transfer-machine. The only difference being that the broach holder is rotated in the machine spindle and the part is stationary instead of the reverse condition on a lathe. Orientation of a profile and part can be accomplished with a drive on the spindle nose which maintains the exact angular position required. To produce parts successfully there are some basic rules that must be followed.

Cutting Principle



The tool is held at a 1° angle relative to the part centerline and has a 1° 30” clearance angle built in. The face of the broach tool is the pivot of the 1° angle and is placed on centerline with the part. As the tool comes in contact with the part, friction drives the broach to rotate synchronously. The cutting edge is kept on center and the rest of the tool oscillates around the part centerline with a wobble effect. With the face of the tool and part at a relative 1° angle, only the leading point of the tool is cutting and not the entire profile. The wobble effect moves the leading edge to rotate in and out of the cut like a cam. It shears the shape into the part with a scalloping effect as it advances forward. This reduces the required thrust force up to 80% when it is at the optimum feed.

Coolant

Usual coolant or cutting oil can be used, however it is typically unnecessary as rotary broaching produces little heat. Also, excessive coolant in the broach pilot hole can result in hydraulic lockup during broaching. Vented broaches can solve this problem if encountered.

Broach Preparation

A 60° or 90° chamfer, slightly bigger than the largest dimension of the broach, is essential for and easy start of the broach. When exact concentricity is required, counter bore the hole at the same size as the measured profile across corners, boring approximately .020” deep will provide the best results.

Drilling The Hole

For internal broaching, the pilot hold (p) should be drilled approx. 1% bigger than the diameter across the flats of a hex shape (h). This percentage can be reduced in free cutting material and increased as machinability decreases. In mild steel we recommend the following tolerances.

h = hex broach diameter / p = pilot hole diameter

h=.059” - .118”	h=.118”-.236”	h=.236”-.394”	h=.394”-.630”	h> .630”
p= h+.001”-.002”	p= h+.0015”- .0035”	p= h+.0025”-.005”	p= h+.004-.008”	p= h+.006”-.012”

Drill Radius Not Allowed

When a drill radius is not allowed along the broached walls of the part, tool life and bearing life will be reduced. When exact concentricity is required, c’bore, drill and pre-bore the hole which will keep the broach concentric when it enters the hole. With such a tight fit push back may result as the broach becomes a hydraulic ram. This pressure can be relieved with a vent hole supplied in the broach tool.

Drilling Depth

Drill the hole as deep as possible to leave room for chip accumulation. We recommend a depth of 1.3 to 1.5 times the length of the profile depth. Failure to drill to an adequate depth will cause premature tool life and will damage the broach head.

Centering the Broach

Nothing is more important than having the cutter centered as close as possible to the center of the work piece. Improper center setting will cause an uneven hole configuration, oversize holes and spiraling. The maximum eccentricity should not exceed 0008”. To simplify setup on more accurate Swiss Type and Gang Machines, use our (on-center) 2160 Series holders. For easier setting on conventional CNC and other machines, use our gauges 6189 or 6199 with the adjustable type broaching heads.

Broaching Rotation Speed

For best results, start the broach operation at a slow rotation, and then increase the speed when it is in full contact. We recommend for the first 1mm a reduced speed of 500 rpm max.

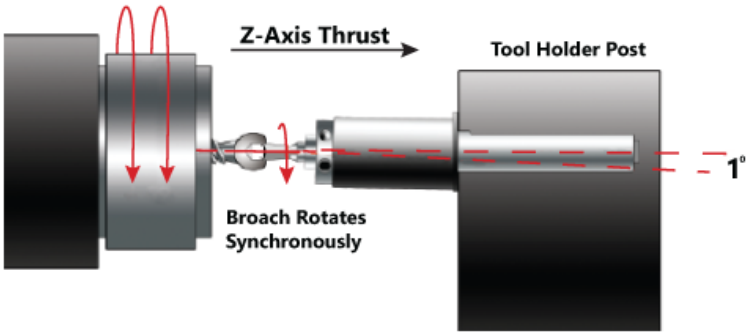
Feed Rate

The feed rate mainly depends on the material characteristics. In mild steel, 0.0012 to 0.0024 inches per revolution is recommended. If the machine thrust force is sufficient, the feed can be doubled as machinability increases. In most cases the maximum feed rate should not exceed 0.03 times the profile diameter. A slower feed rate will produce an improved finish with finer lines along the sidewalls of the broached hole. By increasing the feed rate, the cutting cycle will be faster, but the broaching lines will be more pronounced, leaving a coarse finish. **We do not recommend speeds over 2,000 rpm.**

Broach Sharpening

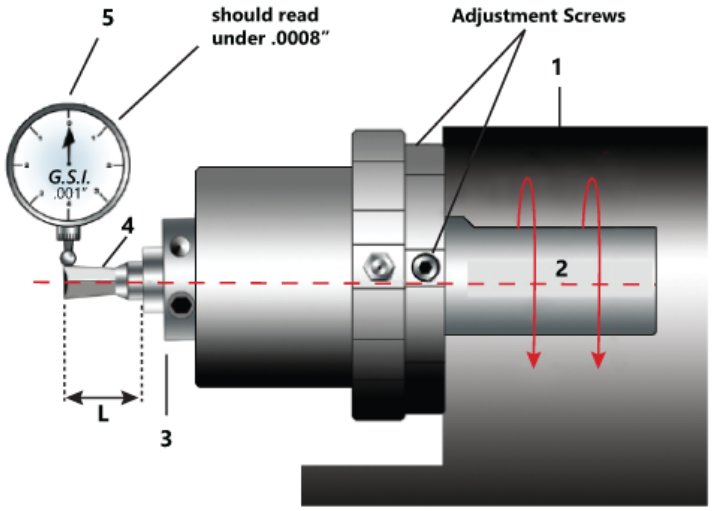
An external or internal broach tool can usually be sharpened one or two times if the tools are in reasonable condition. Only the front face will be re-sharpened with a cutting angle from 4 to 8°.

Series 2160



The 2160 line does not require centering with an indicator. These heads are designed for machines with more accurate centering built into the machine. This would include Swiss Type, Gang type, and small precision lathes, all of which are designed for small diameter precision turning. It is not generally recommended to use the 2100 series broach head on conventional CNC turret type lathes due to the centering inaccuracy associated with these lathes. With the 2100 series broach head it is essential to use the correct length broach. The overall length of the broaching bit is 28mm +0,30 -0,0 and the shank diameter is 8mm with an h5 tolerance. ****Failure to use the correct length broach OR hitting the bottom of the predrill hole will result in poor broach quality, corners chipping on the tool and damage to the bearing or head.**

Series 6180 and 6190



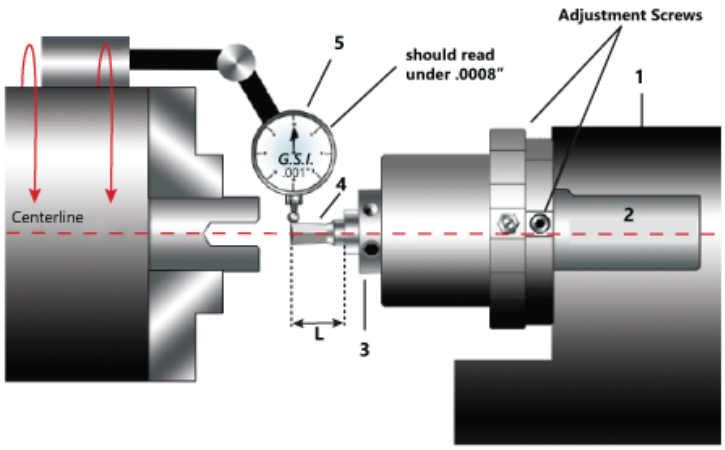
PCM broaching holder series 6180, 6190, are delivered adjusted within .0006" for our standard tools with a 55mm +0.3 length. The 6180 broach holder uses 8x28 and the 6190 uses 12x55. When tools with different lengths are used, it is essential to re-adjust the exact centering position. Experience has proven that turret bores are not in perfect alignment with the machine spindle after a certain working time. When misalignment is over .002 of an inch it is necessary to re-adjust the turret positioning to avoid broaching difficulties especially on small sizes.

Pre-Setting for exact centering:

Set the indicator tip (5) on the gage pin (4) at the correct "L". Rotate the holder shank (2) in the preset fixture (1) to obtain a max TIR of .0008". (Notice the oscillation of the gauge pin as it rotates with the holder)

Adjust the position using the 4 adjusting screws and upon completion clamp the head tight with the clamping screws; check again after clamping.

Adjusting Center On The Machine



Adjustment on the machine offers the advantage of correcting misalignment between the machine spindle and the turret bore. The main inconvenience is the adjustment is only valid for that one turret position.

With the gage pin (4) set to the proper "L", set the broach head in the turret station (1) to be used for broaching. Set the indicator (5) on to the spindle chuck with a magnetic base. Place the indicator tip on to the end of the gage pin. Rotate the chuck so the indicator sweeps the diameter of the pin.

Adjust the position using the 4 adjusting screws and upon completion clamp the head tight with the clamping screws; check again after clamping.