Finishing a Fillet

Sound design criteria, especially on highly stressed parts such as jet engine components, calls for fillets or specific radii at the junction of most angles.

Problems encountered in finish machining of fillets can often be traced to the approach made in the rough-machine operations.

The amount of stock left for finishing and the shape and condition at the surface of this stock are affected greatly by the tool path and insert configuration used in roughing.

It is not uncommon for a programmer to call for a tool having the specific radius of the fillet and do the entire operation with this tool. This radius is usually small, therefore the tool is weak and must be indexed or changed typically to complete the operation.

There are a number of effective methods available to accomplish these corners, all of them superior to the common method of multiple passes with the weak radius tool.

Method 1 *(Figure 49)*

#1 – The material is roughed using a .500" *(12,7 mm)* diameter round insert. This leaves a .250" *(6,35 mm)* corner radius. In addition, stock for finishing has been left on both walls.

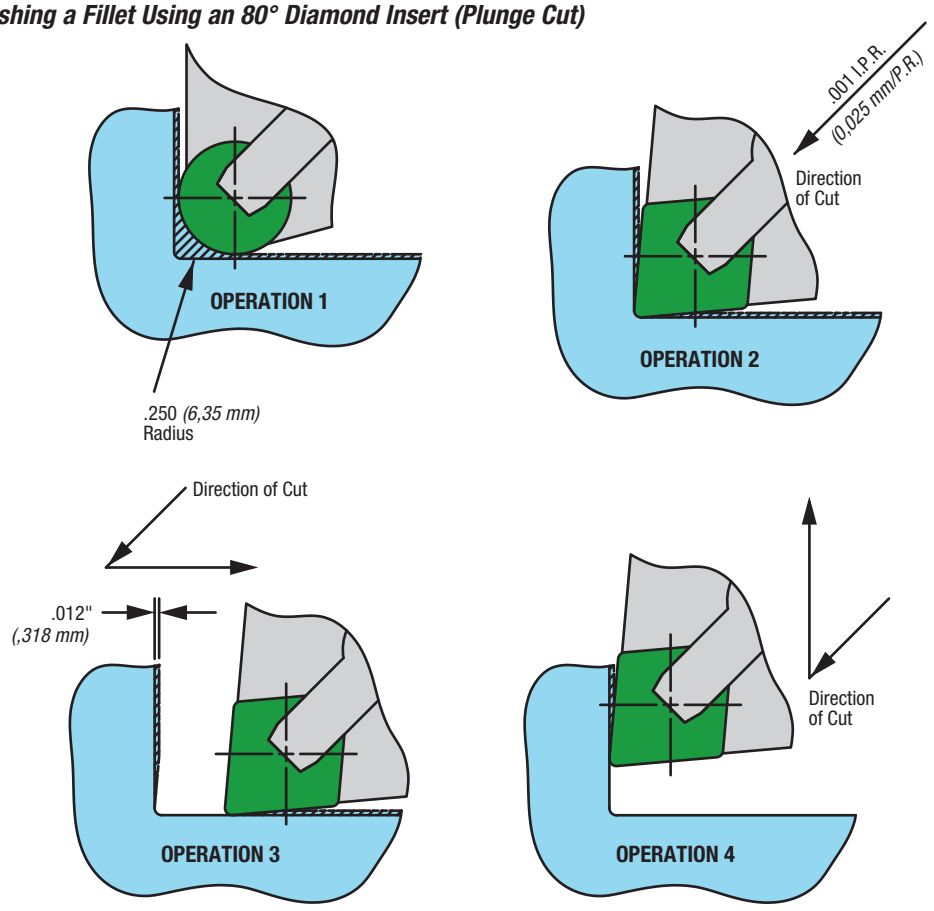
#2 – The finished radius is now generated by plunging the 80° Diamond-shaped insert finishing tool at 45° into the corner. This plunging operation spreads the effect of the work-hardened surface across the nose of the tool without notching it. In addition, the tool is supported by equalized forces on both sides. Also a clean, accurate radius is produced.

#3 – The tool is then drawn across one of the faces to produce the finished surface. The long 5° reverse lead angle inherent in the 80° Diamond insert will produce a good finish without damage to the cutting edge.

#4 – The second wall is finished by turning the tool to the corner and feeding out in the other direction, again working on the long-lead angle.

Method 1

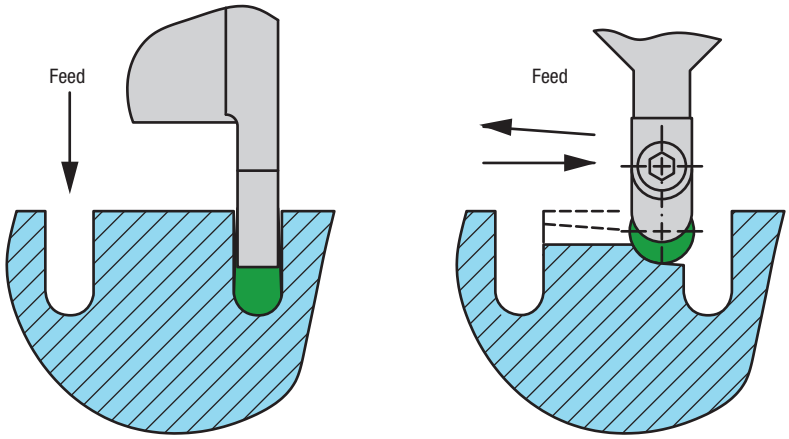
Figure 49 – Finishing a Fillet Using an 80° Diamond Insert (Plunge Cut)



Method 2

Figure 50 – Finishing a Fillet Using a Grooving Tool and a Round Insert

Very small radius fillets on parts are often produced with the fewest problems by using a grooving tool on the first operation. A grooving tool is self-stabilizing and always moving forward into clean material. This results in efficient machining without tool notching and produces an accurate corner radius. The remaining material is then removed by ramping cuts with a round insert.

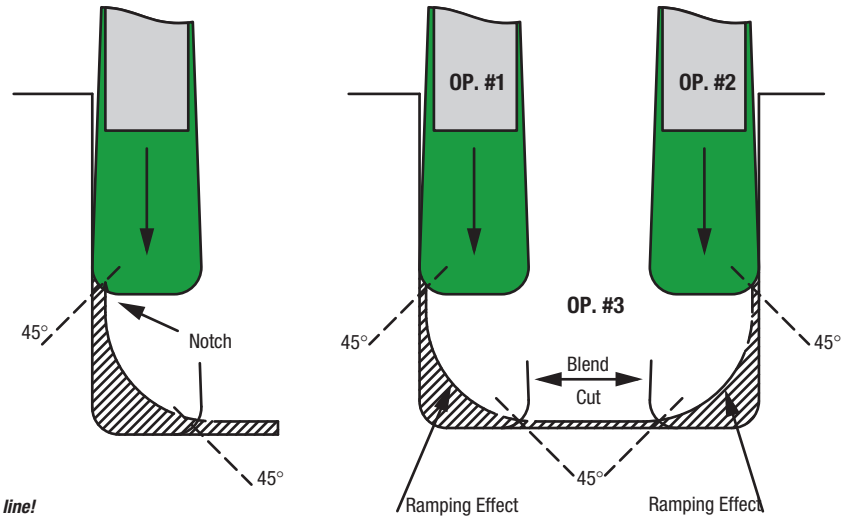


Method 3

Figure 51 – Turning to a Shoulder in Cavities with V-Bottom Grooving Inserts

This example shows the profiling of the groove or cavity using a V-bottom grooving insert. It is important to keep the finish stock very light on the sides so that the cut is below the 45° mark on the insert radius. This will vary with the radius needed. The larger the radius, the greater the stock can be. *(See Figure 22)*

In the corner itself, we use the "ramp" inherent in the radius left by the round insert used for roughing to reduce or eliminate "notching" of the tool. This is a further benefit of roughing with round inserts or profiling the corner in the program.



Watch the depth-of-cut line!

Greenleaf Sales
Phone: 814-763-2915 • 800-458-1850 • Fax: 814-763-4423
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Method 4

Figure 52– Ramping Effect on Shoulder Cuts

In this method, a CNGN452 (12 07 08) insert is shown in the finish operation on a fillet roughed with a RNGN45 (12 07 00) insert leaving a .250" *(6,3 mm)* radius. The finish operation is performed by feeding several times into the fillet. It is essential when the wall is reached to *immediately* raise the tool vertical to remove the scallop which would otherwise be left on the wall. This material will tend to cool and present a hardened, irregular surface needing a subsequent operation *(Figure 46)*. The finish passes described will tend to notch the tool and should be programmed at various depths to reduce this effect. The final pass should be less than the 45° line of the tool nose radius *(Figure 22)*.