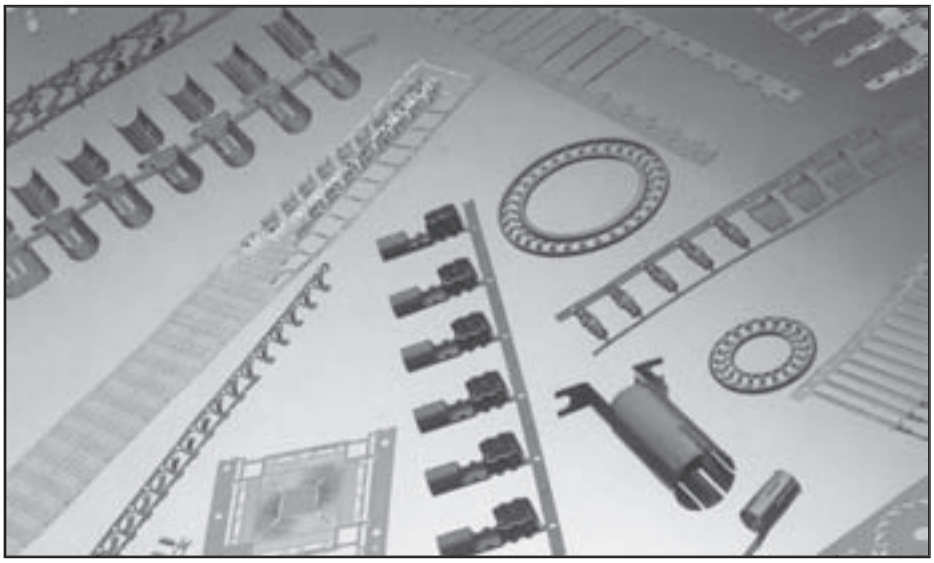
7 Advantages of Wire EDM for Die Making

Tool and Die Making

Wire EDM has revolutionized tool and die making. To understand the extent of the wire EDM revolution for stamping dies (Figure 7:1), let Carl share some history.



Courtesy Agie

Figure 7:1

Tool and Die Stampings

Old-Fashioned Tool and Die Making

In 1950, I started to work in a machine shop; one year later I became an apprentice tool and die maker in a large handbag frame plant in Brooklyn. The plant produced a large variety of handbag frames which required many kinds of fixtures and dies.

From 01 tool steel we milled, ground, or filed the form punch. The punch was then hardened in a gas-fired oven that had no temperature gauge. In those days, one learned early the necessary cherry red color to indicate that the punch was ready to be quenched in oil. After quenching, we used a gas torch to temper the punch to a light straw color.

Using the hardened punch as a template, we traced the pattern on a piece of tool steel colored with Dykem blue. We used a band saw to cut as close to the line as possible. We placed the hardened punch on top of the soft die section and placed both of them under a power press. The power press was bounced by hand until we

made an indentation into the soft die section.

Then we used a filing machine and hand files to remove the excess material. We brushed Dykem blue into the cavity, and the punch and die were again placed in the press to make a further indentation. Then the workpiece went back to the filing machine. We repeated this process over and over until a proper fit was made. Then we set the filing machine on an angle to produce the proper taper. The die was then hardened with hopes that the 01 tool steel would not distort when quenched in oil.

Then I took another position in a precision die shop in Long Island City, Queens, N Y. This shop was a new world of die making. Here we ground the die sections to exact specifications—some within .0001" (.0025 mm).

To make these dies we had no comparator or optical equipment. One worker used a large magnifier to check his die work for the proper clearance; but this made his eyes bloodshot from constantly looking through the magnifier. When my turn came to make these dies, I decided to grind the punch and die sections to precise dimensions. Instead of constantly relying on sight, I used a tenth indicator and gauge blocks to obtain the proper dimensions. See Figure 7:2.

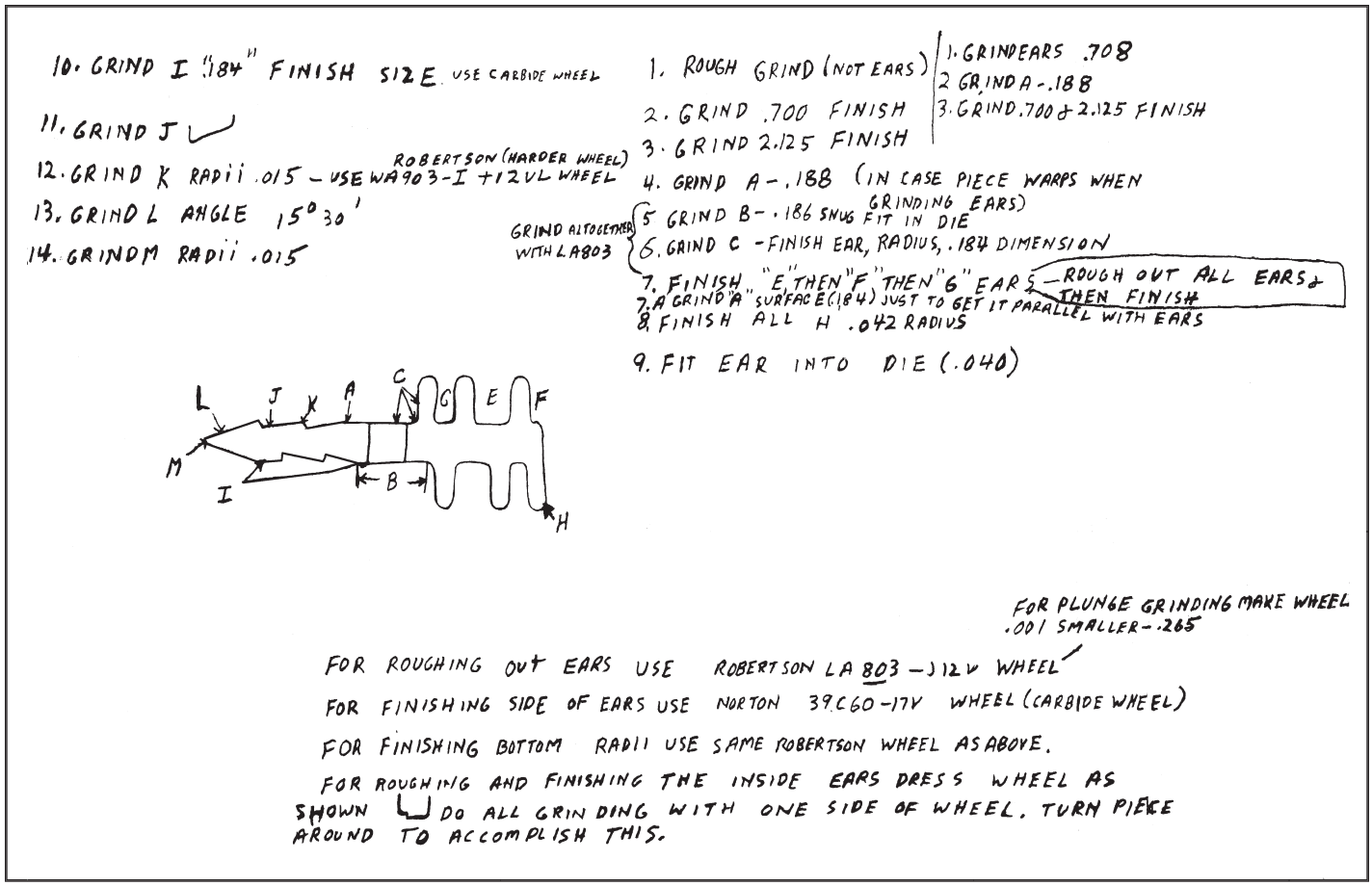


Figure 7:2

Author's handwritten shop sketch for grinding floral pick punches and dies. These dies ran continuously. The floral picks went into automatic dispensers, so no burrs were tolerated. The called-for clearance was between .0005″ (.013 mm) to .001″ (.025 mm).

To produce these floral pick dies, the clearance between the punch and die was between .0005 to .001" (.0127 to .0254 mm). There could not be any, "Opps." These floral picks came in stacks and were placed in automatic machines, there could not be any burrs on them.

This is one of the notes I wrote making this precision floral pick die: “Grind flat with .016 radius (.40 mm). Move cross feed .001 (.025 mm) at a time. Leave .0003 (.0076 mm) over for finish grinding. Then touch front and back off .0002 (.005 mm), then grind flat. Use dresser three times.” See Figure 7:3.

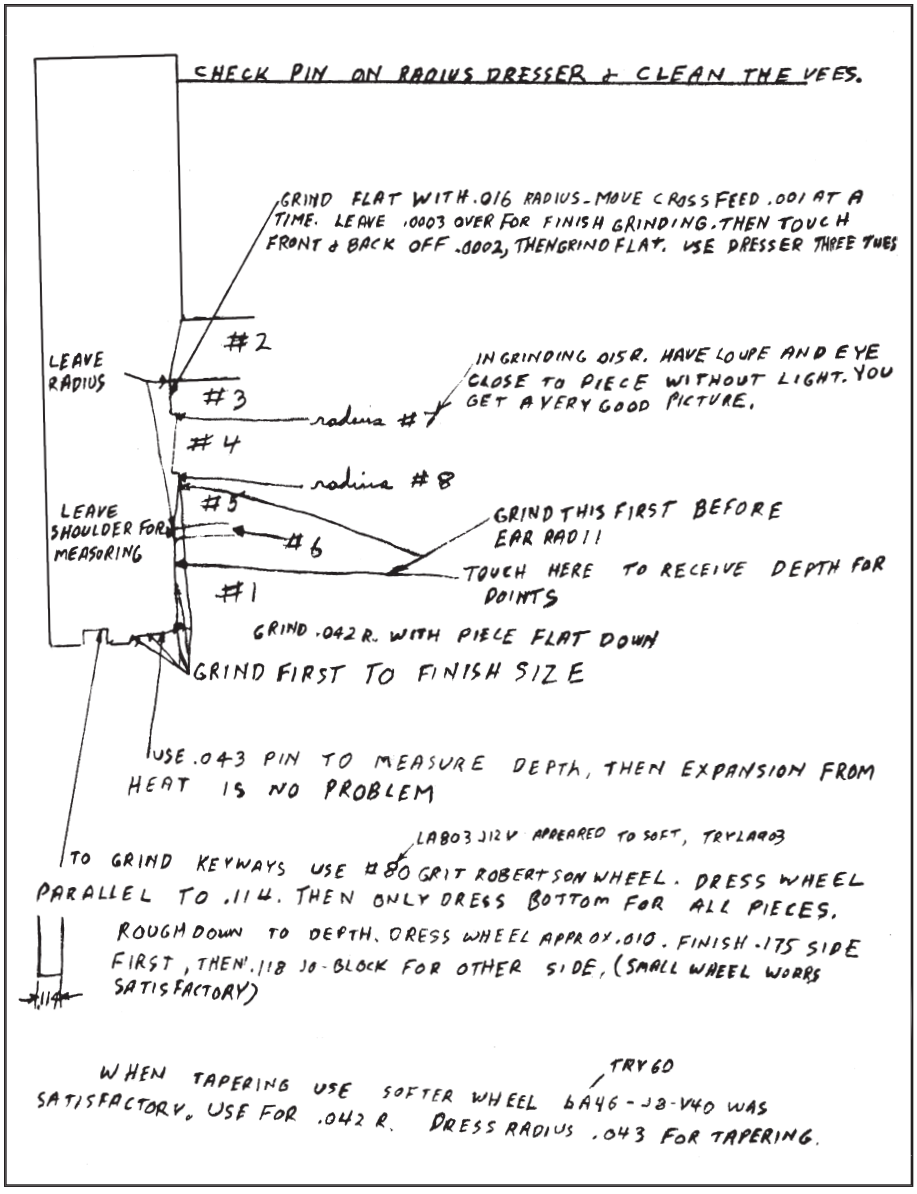


Figure 7:3

Old-Fashioned Precision Die Making

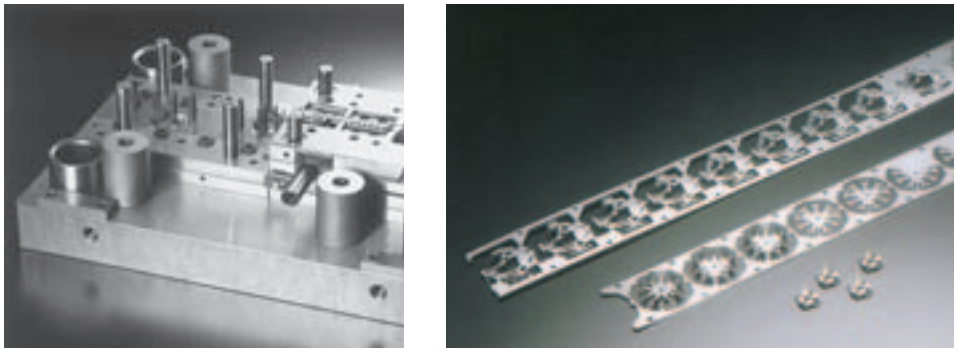
Note the tight tolerances the author wrote for grinding the tip of the floral pick die section:

“Grind flat with .016 (.40 mm) radius. Move crossfeed .001 (.025 mm) at a time. Leave .0003 (.0076 mm) over for finish grinding. Then touch front & back off .0002 (.005 mm), then grind flat. Use dresser three times.”

The Revolution

To produce these precision dies, it required highly skilled tool and die makers. Then came wire EDM. Now by simply making a computer program of the shape, the production of a much better and more accurate tool was possible.

Tool and die makers are still needed to assemble tooling, but wire EDM has eliminated the need for those skilled die makers to make the many elaborate punch and die sections. Today, wire EDM performs that costly and laborious job. As a result, it has greatly reduced tooling costs, and at the same time produced superior quality dies. See Figure 7:4.



Courtesy Makino

Figure 7:4

Precision Tool and Die Machining

Advantages of Wire EDM Dies

1. One-Piece Die Sections

Previously complicated dies were sectionalized—this allowed the die sections to move. See Figure 7:5. Now with wire EDM, the die can be made from a solid block of tool steel producing a much more rigid die, as in Figure 7:6. In addition, sectionalized dies require much more mounting time than a one-piece die section.

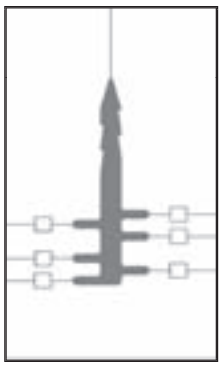


Figure 7:5

Sectionalized Die Sections

Figure 7:6

Solid Die Section

Wire EDM eliminates costly sectionalized dies and produces superior and less costly solid dies.

2. Exact Spare Parts

To keep up production, spare sections can be on hand in case of wear or breakage. Since computer programs can be stored, spare sections can be precisely duplicated without having the previous part.

3. Dowel Holes EDMed

When die sections or punches need to be changed due to wear or design change, dowel holes can also be EDMed. This produces exactly duplicated replacement die or punch sections.

4. Better Tool Steels

With wire EDM, dies and punches can be made with tougher tool steels, even tungsten carbide. These tougher tool steels produce much longer tool life.

5. Accuracy

Many wire EDM machines move in increments of at least 40 millionths of an inch (.00004"—.001 mm); therefore, they can maintain accurate forms and clearances.

6. Die Repairs

Broken dies can be saved by replacing the damaged section with a wire EDMed insert, or the damaged area can be hard welded and then wire EDMed. See Figures 7:7 and 7:8

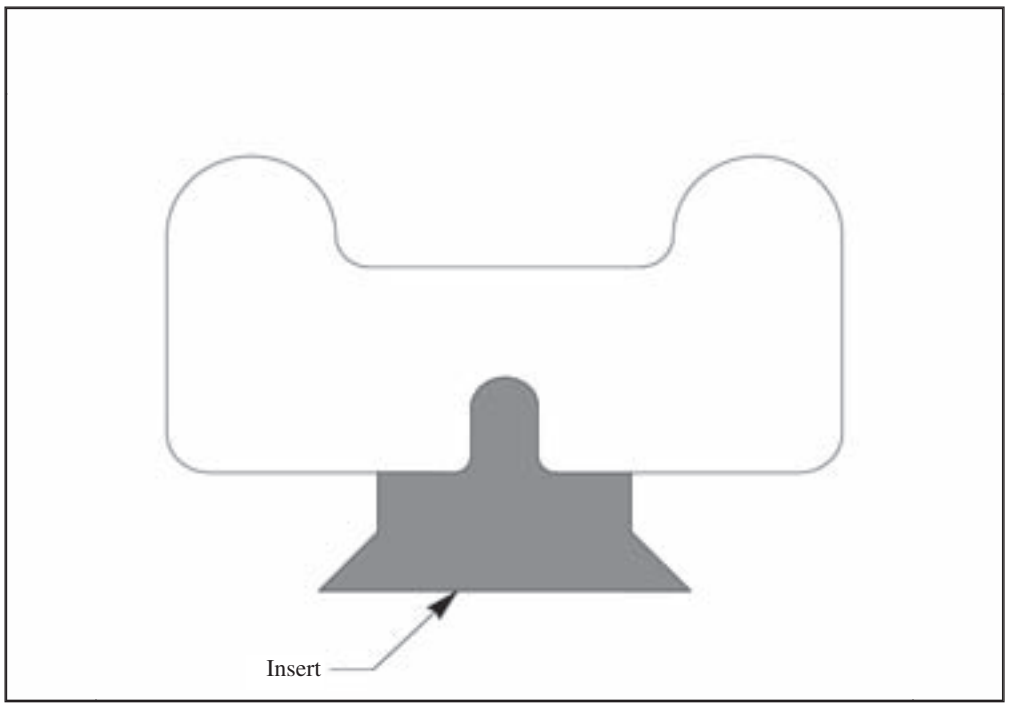


Figure 7:7

Damaged Die Section Repaired With an Insert

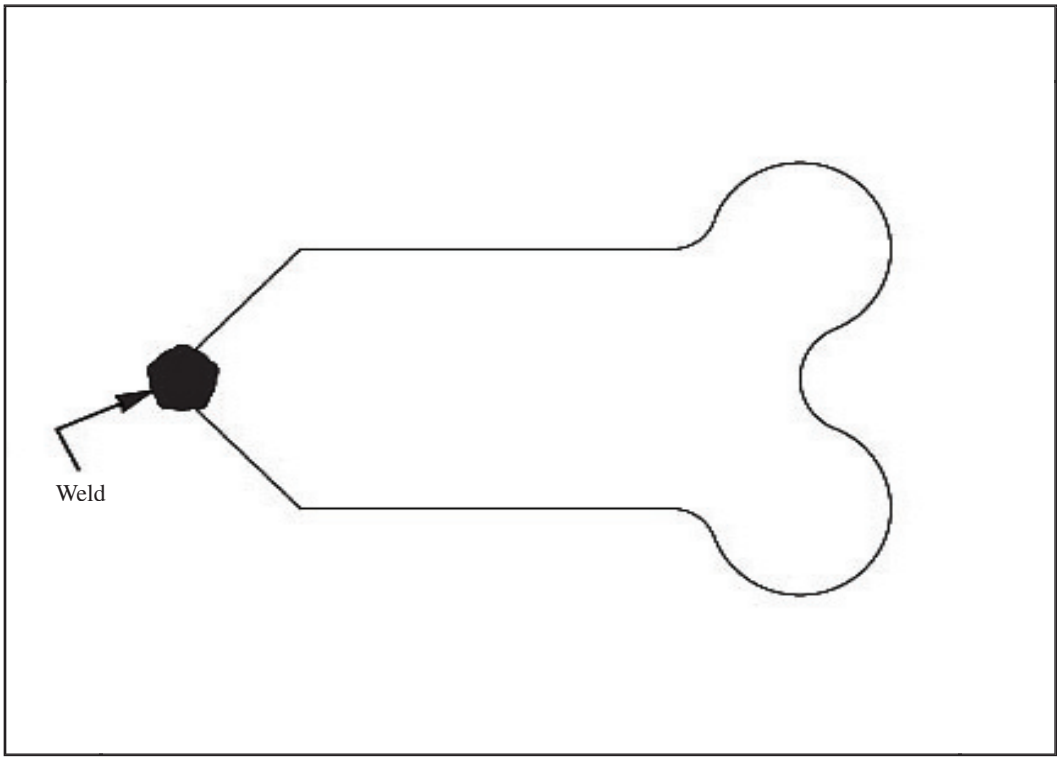


Figure 7:8

Damaged Die Section Repaired With Welding and EDMing

7. Fine Textured Finish

The fine textured surface produced from wire EDM produces longer tool life because of improved surface retention of lubricant.

8. Eliminates Distortion

Punch and dies can be wire EDMed after heat-treatment. This eliminates the distortions that are created in heat-treating.

9. Inserts for High Wear Areas

If certain areas in the die have a larger wear ratio, inserts can be designed for these wear areas. Then instead of sharpening the entire die, inserts can be installed even with the die in the press.

10. Smaller Dies

Wire EDM allows the building of smaller progressive dies, thereby reducing costs.

11. Longer Lasting

A die lasts only as long as its weakest link. Dies last longer because wire EDM produces exact die clearance which allows the dies to last longer between sharpening, and allows dies to be sharpened much deeper.

12. Punches and Dies From One Piece of Tool Steel

A punch and die can be produced from one piece of tool steel as illustrated in Figure 7:9.

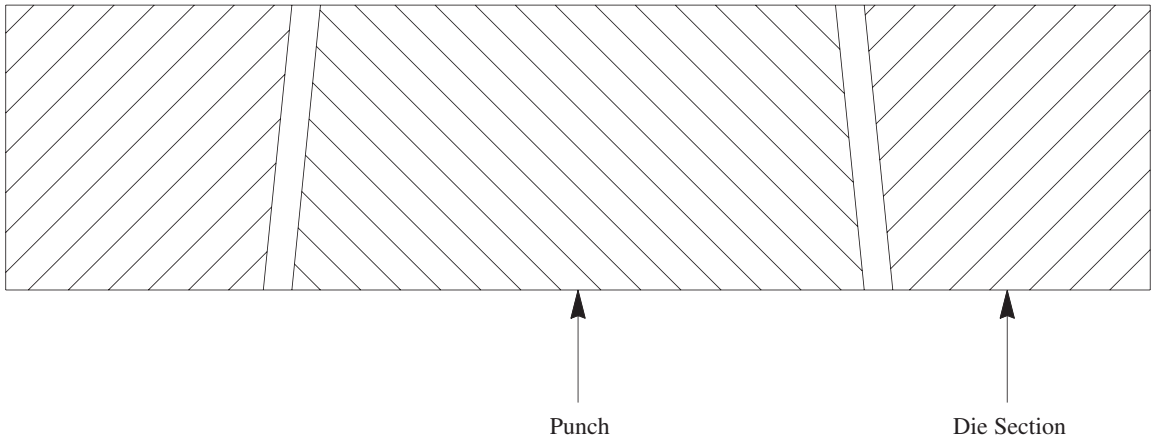


Figure 7:9

Punch and Die Made From One Piece of Tool Steel

13. Cutting Stripper and Die Section Together

Often the stripper may be mounted on the bottom of the die section and cut simultaneously with the die section as shown in Figure 7:10. This significantly reduces the cost when strippers are required.

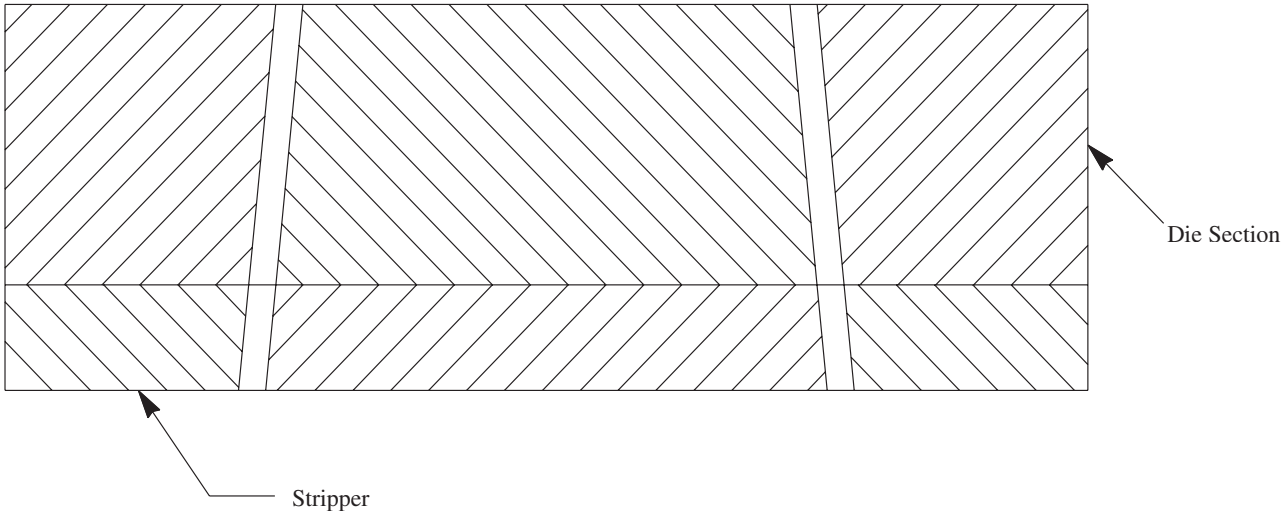


Figure 7:10

Cutting the Stripper and Die Section Together

Wire EDMing Punch and Die Sections

Punches

A. Large Punches

When mounting large punches to a die set, as shown in Figure 7:11, they can be held onto the die set by putting dowels and screws directly into the body of the punch.

Caution: Use large enough dowels and particularly large enough screws to prevent the punch from moving in case of misfeeds on the power press. Also leave enough metal around the die section to avoid the die from cracking. This is especially important when stamping thick materials.

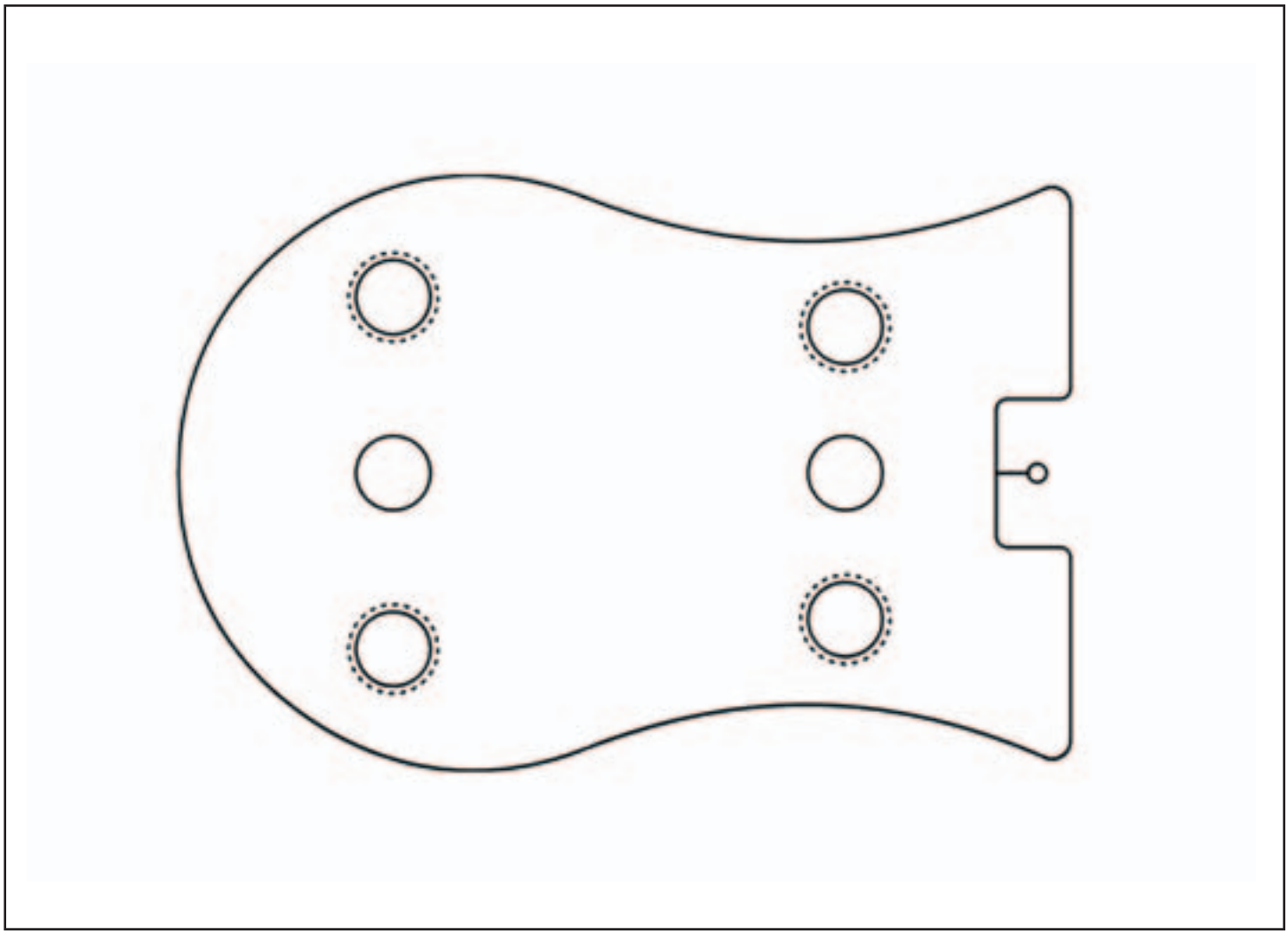


Figure 7:11 Large Punches
Bolt large punches directly to punch holder.

B. Holding Small Punches

Let's take a small punch where one is unable to mount dowels and screws into it as illustrated in Figure 7:12. There are various methods of holding small punches like these. The following illustrations will demonstrate how to hold such small punches.

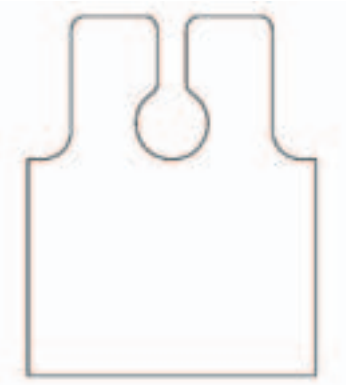


Figure 7:12 Small Punches

1. Footed (Figure 7:13)

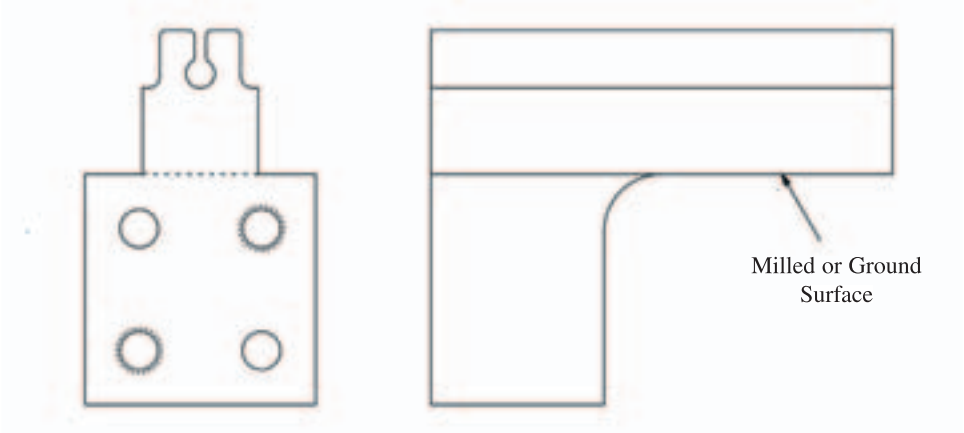


Figure 7:13 Footed Punch

2. Shoulder (Figure 7:14)

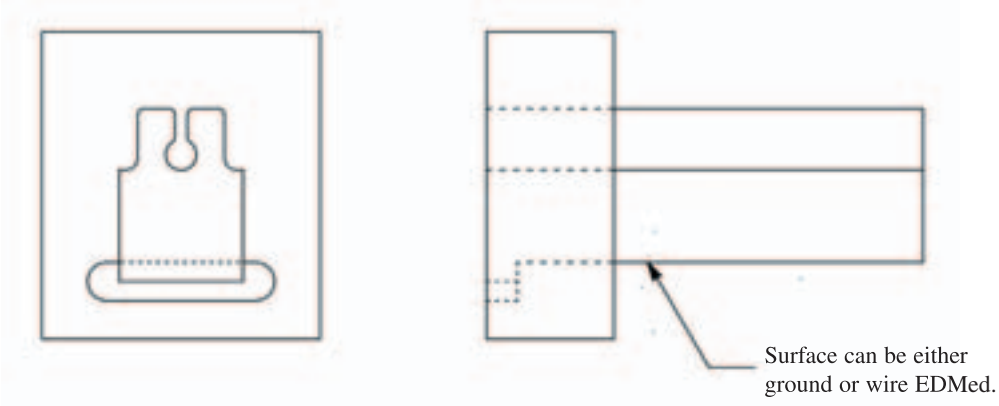


Figure 7:14 Shoulder Punch

3. Keyed In—Toe Clamps (Figure 7:15, 16)

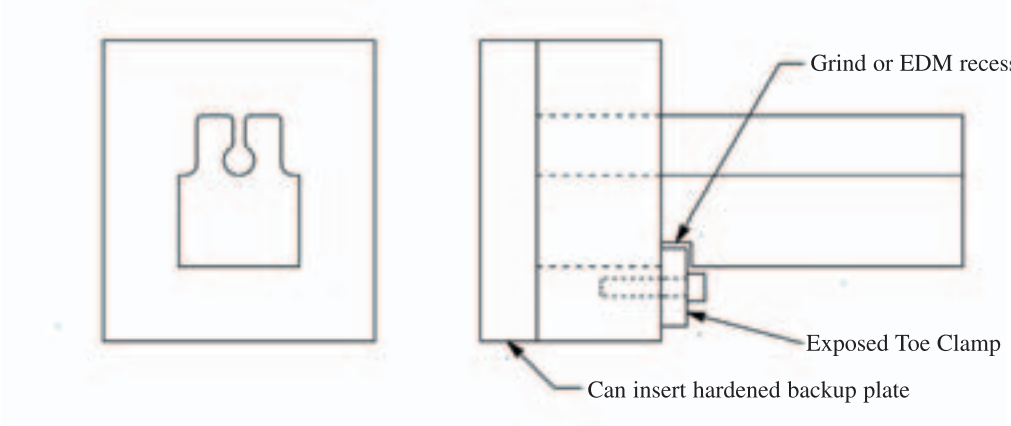


Figure 7:15 Keyed In-Toe Clamp

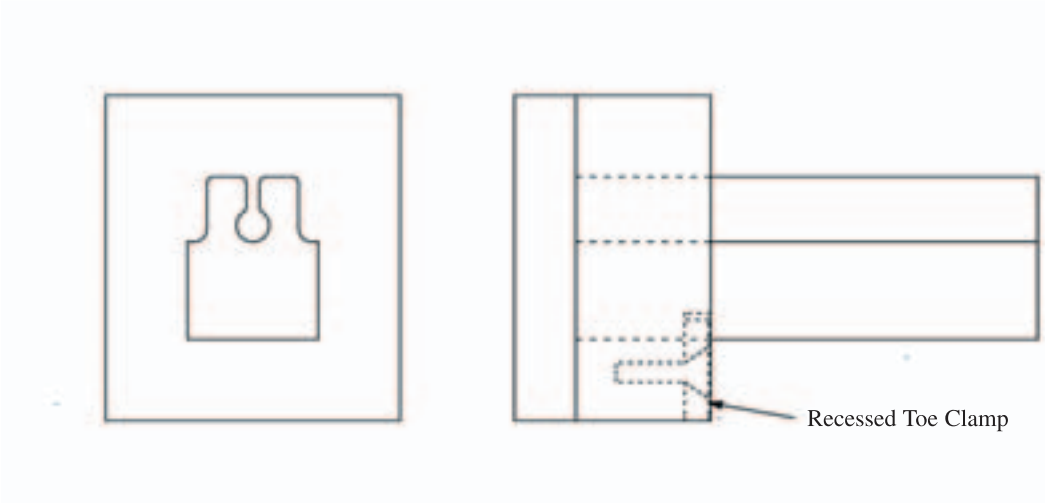


Figure 7:16 Recessed Toe Clamp

4. Keyed In—Keyway (Figure 7:17)

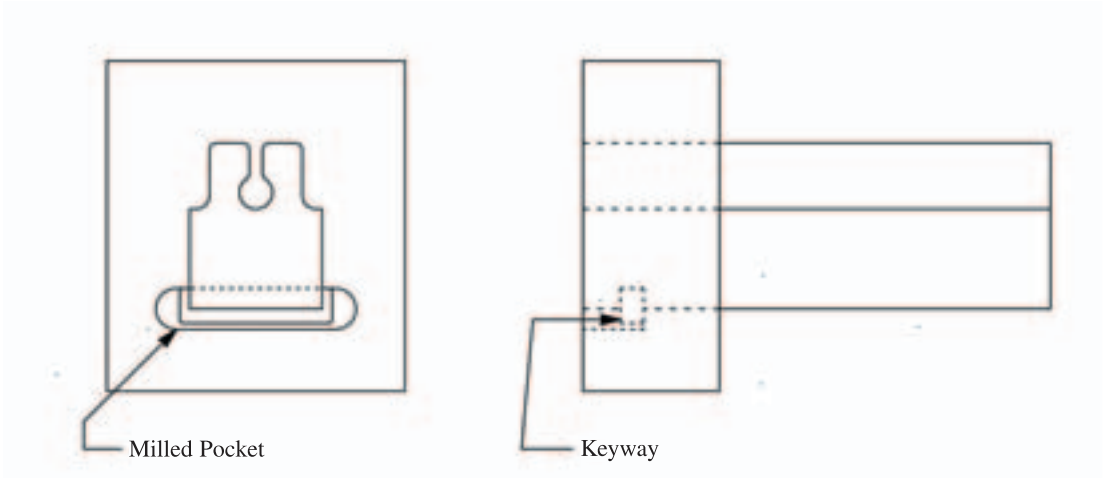


Figure 7:17 Recessed Keyway

5. Press Fit (Figure 7:18)

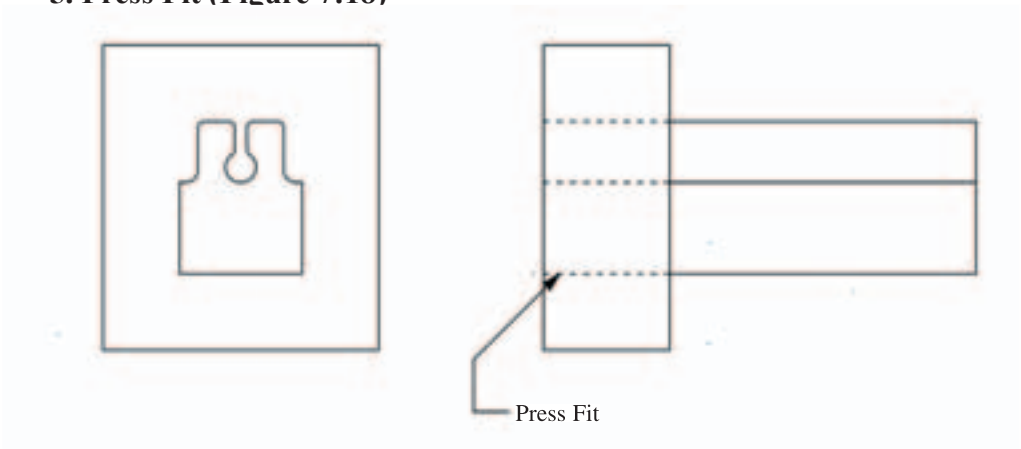


Figure 7:18 Press Fit
Not recommended for heavy stripping pressures.

6. Peened Edge (Figure 7:19)

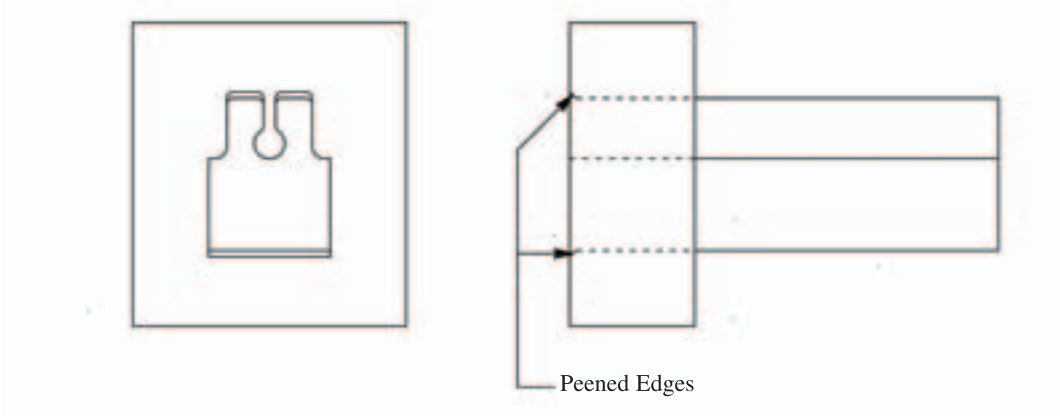


Figure 7:19 Peened Edge
Not recommended for heavy stripping pressures.

7. Dowel Pin Reamed (Figure 7:20)

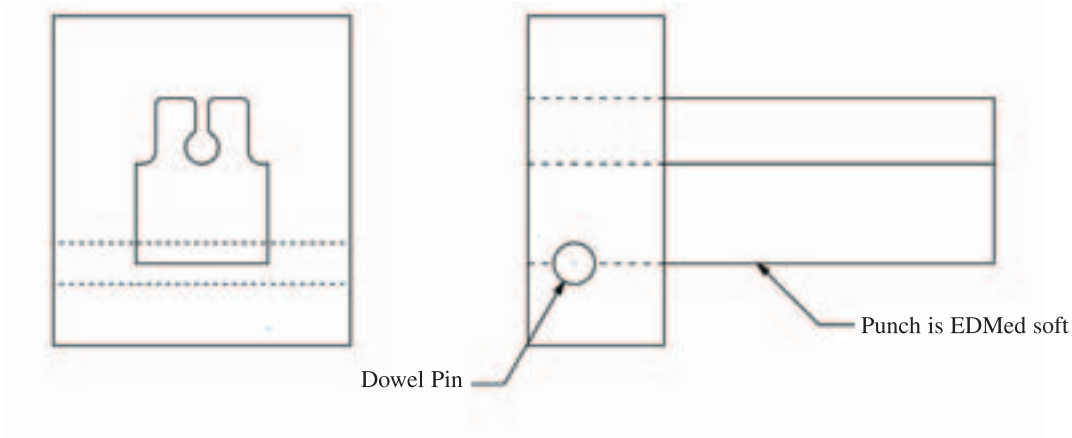


Figure 7:20 Dowel Pin
Punch is EDMed before heat-treating.

8. Dowel Pin EDMed (Figure 7:21)

Should the pressed fit or the peened fit ever come loose, a dowel hole can be EDMed.

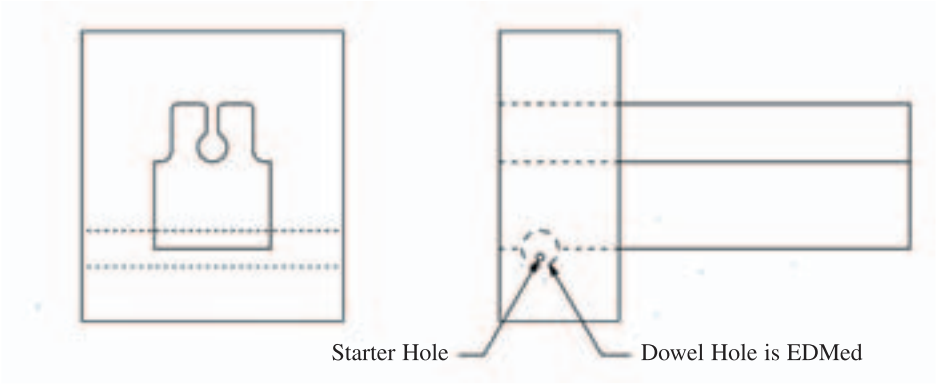


Figure 7:21 Dowel Pin EDMed

9. Set Screws (Figure 7:22)

Should the pressed fit or the peened fit ever come loose, a slot can be ground and set screws used.

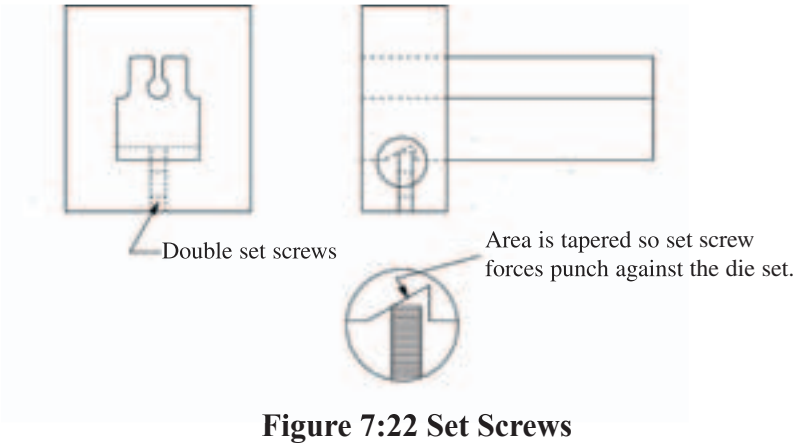


Figure 7:22 Set Screws
Not recommended for heavy stripping pressures.

10. Socket Head Cap Screw (Figure 7:23)

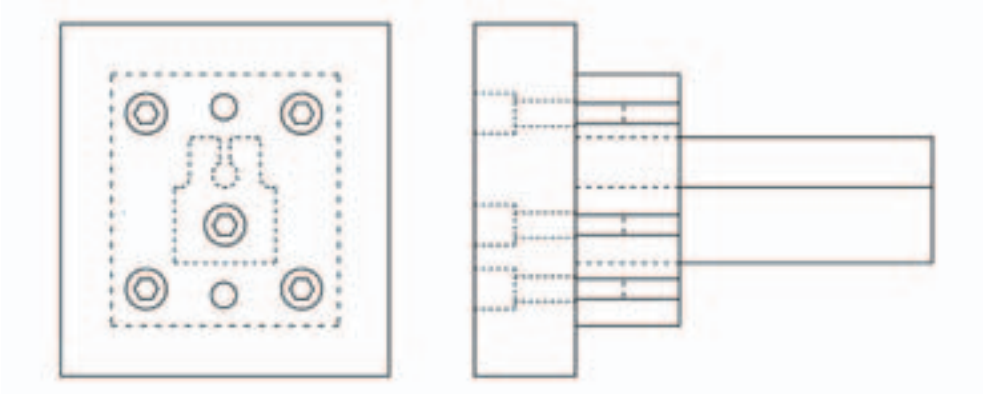


Figure 7:23 Socket Head Cap Screw
EDM punch holder and hold punch with a socket head cap screw.

11. Ball Bearings (Figures 7:24, 25)

To mount small punches with ball bearings, use a carbide ball end mill to put a radius indentation in the punch. Use the small end mill to the same depth as the punch to mill out the sides of the punch retainer. Put in hardened steel bearings to hold punch.

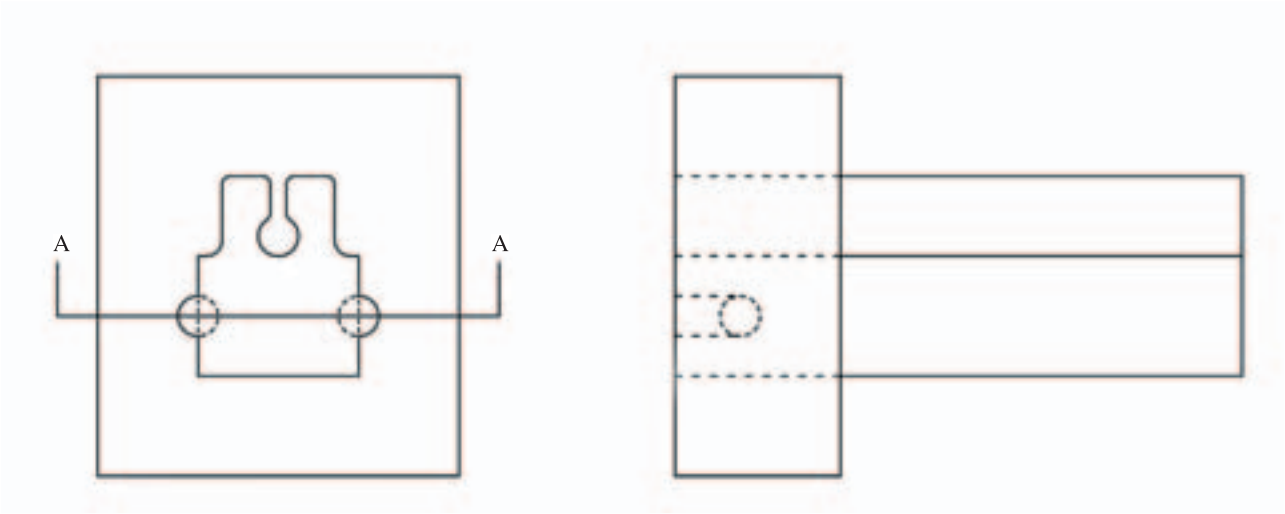


Figure 7:24 Ball Bearings

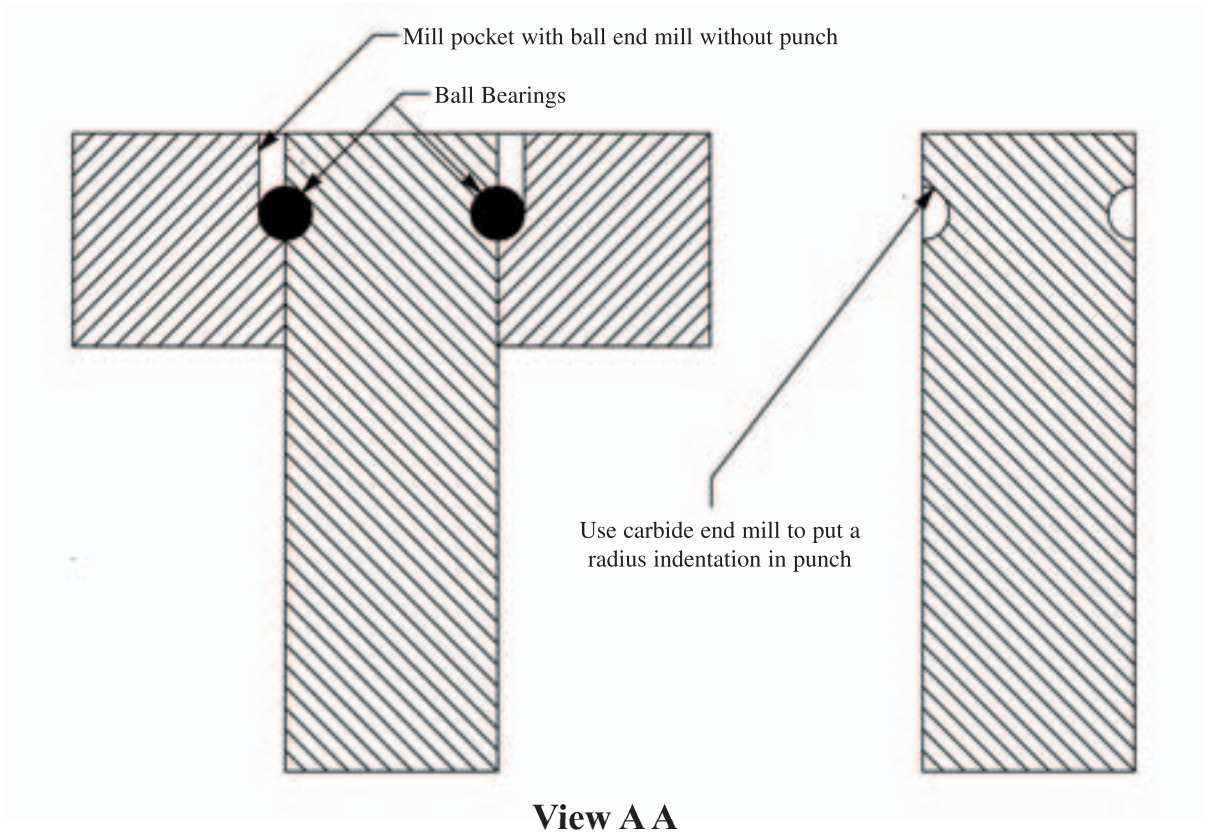


Figure 7:25 Ball Bearing Construction

C. Skim Cutting

On close tolerance dies, skim cuts are made depending on the accuracy of the punch and die sections. The die sections cause no difficulty in skim cutting, since the cavity is open. However, in skim cutting the punch, the punch has to be held with a tab. The tab is made in a straight section, and then cut off in the final cut and ground to size. See Figure 7:26.

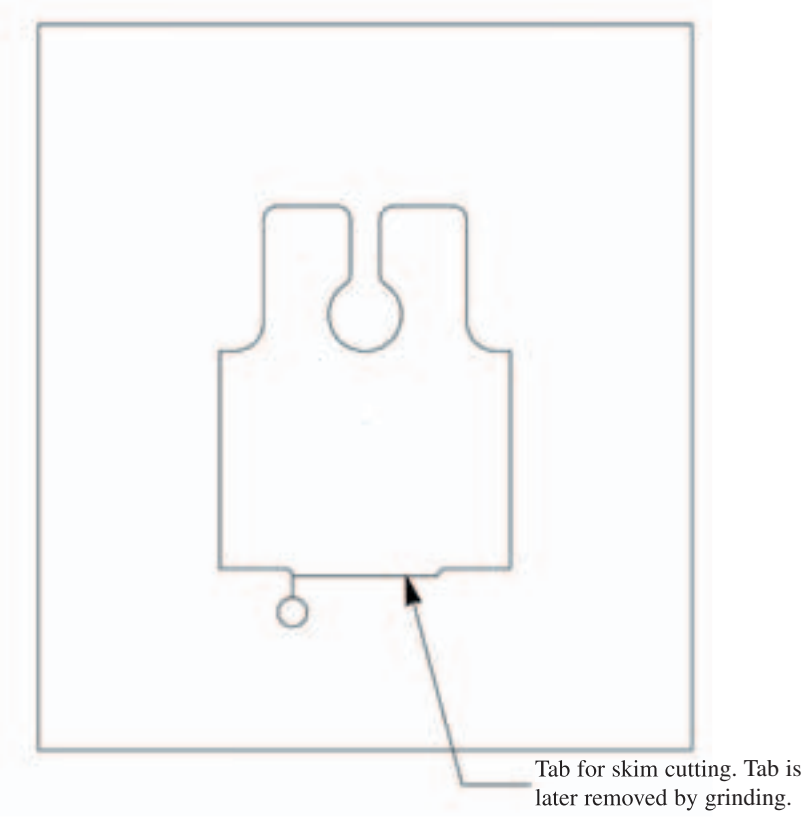


Figure 7:26 Skim Cutting Punches for Precision Dies

Die Sections

A. Heavy Blanking Dies

Always use a sufficiently large die block to avoid splitting when thick steel is being cut. The nominal cost is well worth not having to remake the die.

B. Avoid Sharp Corners

Sharp corners are the weakest area of a die section. When possible, avoid them.

C. Heat-Treating

Cut die sections in the heat-treated condition. This avoids heat treat distortions.

D. Large Die Sections

Large sections should be double and even triple tempered in order to remove all the stresses, particularly in close tolerance dies. Even then some stresses may remain. To ensure minimum stresses on precision dies, cut out the mid-section on a band saw, leaving at least a ¼ inch of wall, or put in relieving slots. For illustrations, see Chapter 5 "Understanding the Wire EDM Process."

E. Tapers

1. Taper and Land

Due to the accuracy of wire EDM, there is no need for large tapers. Dies can be made with a taper and land; however, most die sections can be tapered right up to the top of the die section. See Figure 7:27. With a ¼ degree taper, the die will only become .001 larger per side when .250 is removed.

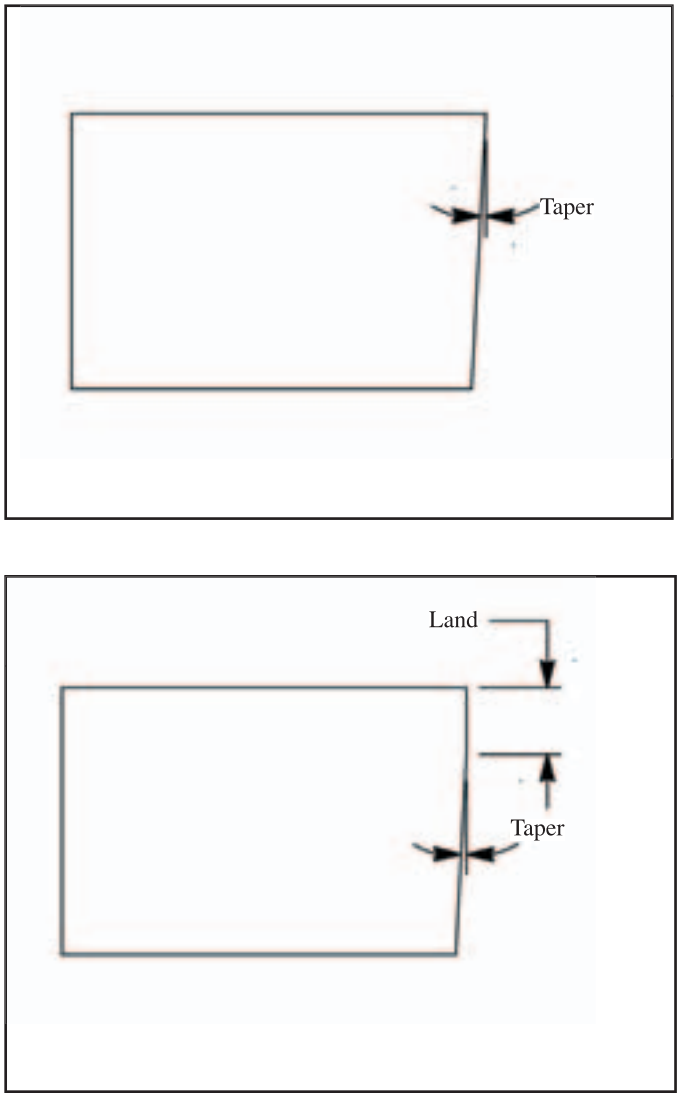


Figure 7:27 Taper and Land

2. Straight Cut and Taper

Wire EDM can go from taper to straight, as shown in the cut off punch and die in Figure 7:28. In areas where the punch can be supported in the die, stipulate a straight land to support the heel of the punch. This adds significant strength to the punch in case of a misfeed of the die.

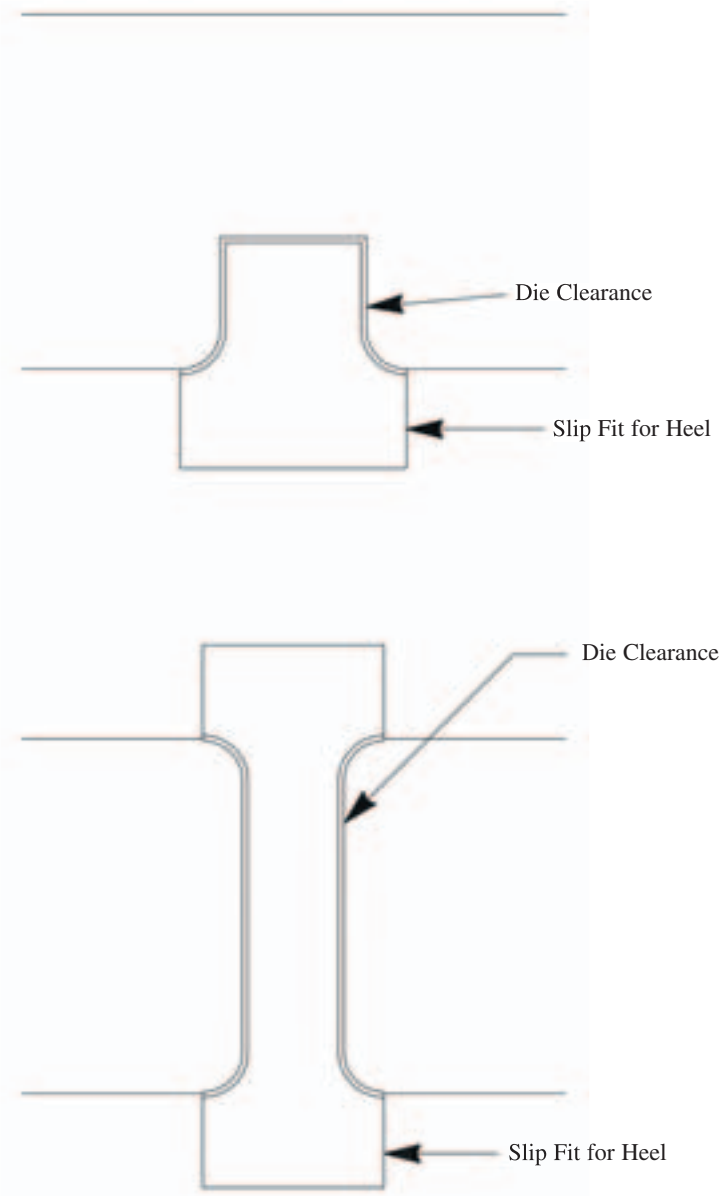


Figure 7:28 Straight Cut and Taper

Wire EDM has provided the tool and die designer with many options in building dies. In the next chapter, we will demonstrate one of the fastest and most cost effective ways to produce stamping dies.