Production of Gold Findings by Stamping

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Introduction

Many of the techniques used in stamping findings today have their basis in methods used in the early industrial revolution. As the need for mass produced products outpaced the ability of craftsmen to fabricate them by hand, methods were developed to make them quickly and in quantity. The craftsman then lavished his skills on the tooling that generated the pieces rather than on the pieces themselves. This skill was then transferred to the product from the tools.

Simple machines such as screw presses were used to produce these early products, Figure 1. As machine builders refined manufacturing equipment, tooling designs were also improved and developed. However, the underlying principles of tool design are as valid today as they were in the beginning of mass manufacturing. To understand the process, the six-prong setting, Figure 2, will serve as an excellent illustration.

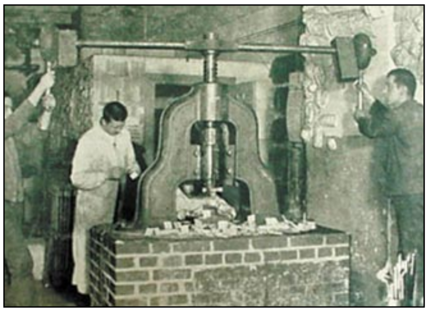


Figure 1 - A screw press in operation in 1915

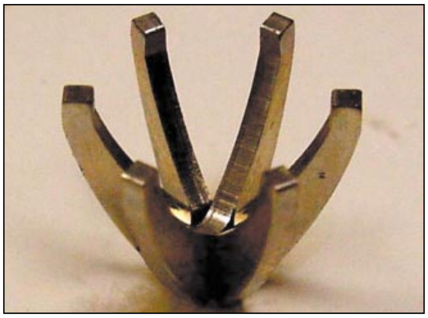


Figure 2 - A typical six-prong setting. Note the lack of solder in the joint allows a view of the interlock of the notches that hold the setting together

Material utilisation and condition

Gold sheet is fabricated and cut into strips for easy handling and efficient use of the raw material. The strip size is very important in gold stampings due to the material and fabrication costs. The more parts that are made from the least amount of material can be the difference between profit and loss. As the blanking die is designed, the proper nesting or orientation of the parts on the strip can help significantly, Figure 3.

Figure 3 - Efficient use of material due to close nesting of the blanks on the strip

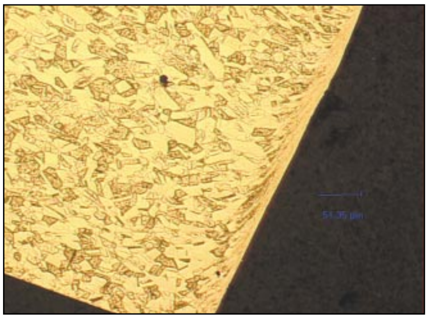


Figure 4 - Photomicrograph of the cut edge of the 14 karat white material used in the six-prong setting

The temper or hardness of the material is also of great importance in blanking. Initial instinct would suggest softer material working better. This is not always the case. Material that is harder will perform much better and will give a higher quality blank. This is because the softer metal tends to distort and pucker when pushed through the plate. It also has a far greater tendency to create burrs and cling to the tooling. Harder materials will blank out flatter and have minimal burrs. The blank will shear and break away from the strip and this will be evident from the edge, Figure 4. An ideal hardness for a typical 14-karat white setting is HV 250 on the Vickers hardness scale. Of course, the final use of the blank and the material that it's made from will determine the initial strip hardness.

Tooling design

Designing the tooling is governed by conditions that have a major impact on tool life and performance. The material thickness, temper and composition of the strip will determine the force needed to carry out the process. These factors also influence the clearance between the punch and plate. The following formula is used widely in determining the tonnage needed to blank or pierce a finding:

$$C = L.T.S$$

where C = Required tons, L = The total length of the cutting edge in inches, T = The material thickness and S = Material shear strength in tons

Using the example of the six-prong setting, the blank would be as follows: The total length of the cutting edge is 1.003" X material thickness of .020" X the shear

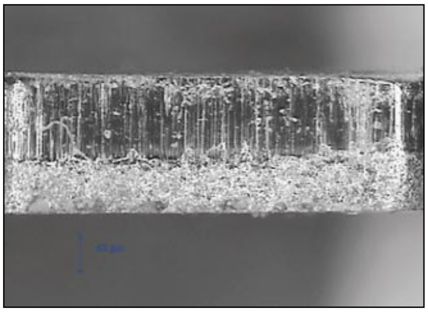


Figure 5 - Magnified view of the edge of the blank. This clearly shows the cut/break ratio

Figure 6 - This wedding band blank is a good example of improper gap between punch and plate. Note the large burr along the back edge

strength of 21 = 0.423 tons required to blank the piece.

Not only the size of the piece but also the number of parts that are to be run by the tool determine selection of the press used. Small quantities dictate inexpensive tooling that may be run in a foot press. Many short run tools cannot justify the expense of mounting in a die set due to their infrequent runs. These tools are aligned in the press and held with universal fixtures. Here, the tool designer is forced to produce a less efficient tool to make the project profitable.

During the design phase, one rule that applies is the punch to metal thickness ratio. In this case, using a punch with a smaller diameter than the metal thickness will always break the punch. Even a thin section of an irregular shaped punch will not hold up to material thicker than itself. The clearance between punch and plate is also important in controlling burrs. The punch size is what always determines the size of the part, while the plate gap has a direct relationship to the quality of the part. Too much gap or clearance will result in burrs and poor shear/break ratio. This ratio is evident in the appearance of the cut edge of the part. In most industries, the ideal cut portion should be one third of the material thickness while the remainder is fractured away from the strip. However with jewelry, the ratio is often one half or more cut to arrive at a better appearance on the edge, Figure 5. Handmade tools will frequently show a higher proportion of fracture due to the gap enlargement caused by frequent sharpening of the plate. An example of a too large gap is shown in Figure 6.

Tool manufacture

The selection of tool steel is fairly straightforward and is determined by the design and application of the tool. Many steel suppliers have suggested uses for all of their products and they publish information detailing heat treating and ideal tempers for each. Generally, for a blanking or piercing tool O2 steel is a common choice. This is steel that is in the oil quenchable family of tool alloys and it's ideal for many applications. The steel is heat treated at 1525°F (830°C) for 1 hour then quenched in an oil bath to cool it at a uniform rate. The initial Rockwell hardness test should be HR 63 on the C scale. After tempering at 440°F (227°C) for 1 hour, the final Rockwell C reading should be HR 58 to 60.

Traditionally, common machines and hand tools are used to make the punches and plates. This low-tech method requires a high level of hand/eye coordination as well as many years of experience and training. The design of the part being manufactured is marked out on the surface of the plate. A series of holes are carefully drilled within the scribe lines all the way through the steel plate. From the back, the holes are then drilled larger and then the material between them is removed on a Milling machine. This is carried out to a depth of approximately 0.250 inch (6.4mm) from the top of the plate. A jewelers saw blade is then inserted into one of the holes and the material is cut away very close to the line. After all of the material is removed from between the lines, the remainder is filed away on a filing machine and a very slight angle is cut into the wall of the plate. This angle aids the ejection of the parts but it also has the disadvantage of shortening the life of the tool after repeated grinding. If the wall is straight or has a negative angle or bulge, the parts will stack up in the plate and cause serious damage to the tooling or deform the parts. Extremely sharp corners will present the possibility of cracking during heat-treating but a slight radius in the corners will prevent this from happening. Before heat treating the plate, a material stripper can be added to. This pulls the remaining

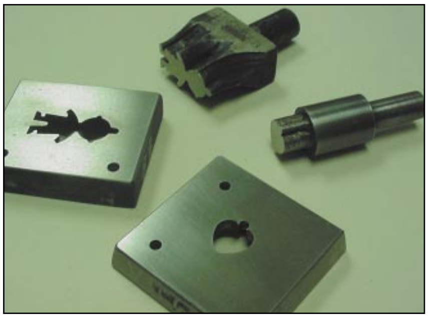


Figure 7 - Typical handmade charm blanking tools. They use the press stripper to remove the scrap material

strip from the punch after the part is blanked. There are many types of strippers, some are fixed to the plate, some to the punch, while others are part of the press.

Using the traditional method, the punch is machined to a rough shape and the plate is used to shear away the excess material. This is done slowly so that the side of the punch is not gouged. Milling and/or chiseling between each push removes any built up material. The punch is then heat treated and sharpened along with the plate.

Even in high tech shops, the traditional method is still used. In companies that have large inventories of old tools and dies it can be the only efficient way to replace old damaged tooling. Since many of these tools were made by hand, they are not symmetrical. Measuring and duplicating the complex radii and forms is possible but very time consuming without the aid of 3D scanners or optical comparators. It's sometimes easier to repair the tool the old way. Figure 7 shows some typical handmade blanking tools.

Wire EDM (electrical discharge machining) and CAD/CAM (computer aided design and computer aided manufacturing), Figure 8, have changed the way that blanking and piercing dies are made. The accuracy and the speed are vast improvements over the traditional methods. Shapes that were difficult to produce with conventional methods are now common place. The angle of the sidewall is uniform and can be made longer to improve die life. The wire itself will impart a slight radius to the corners of the plate reducing the chance of cracking. The punch size and clearance can also be regulated to give maximum performance. The stripper can be machined in place, reducing set-up time and alignment problems. Punches can be wire cut and they will match the plate with almost no fitting other than to remove the start/stop nub that remains. With symmetrical designs the punch can be inserted several ways into the plate, reducing the chance of damage due to operator error during the set up. The usable punch life is commonly increased from 3/8 inch (9.5mm) to one inch (25.4mm).

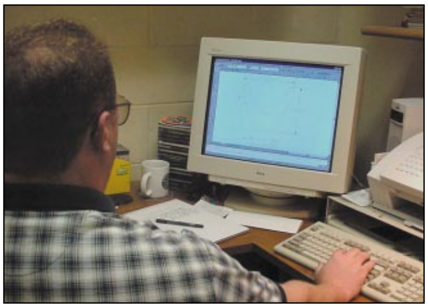


Figure 8 - Tool design taking place on a CAD/CAM system

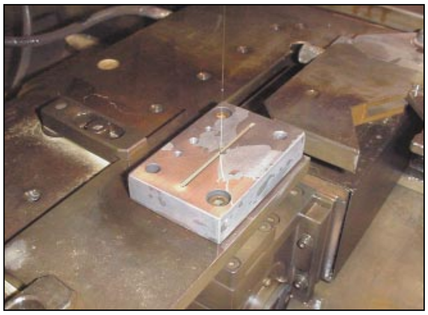


Figure 9 - The tools are cut with a wire EDM machine to a tolerance of .0002" (0.005mm)

A major advantage of wire EDM is that the steel can be heat treated in advance and cut later. This eliminates the tendency of some steel shrinking or distorting during the heat treating process. If a traditionally made punch breaks and a new one is drawn out of an old plate, the new one may be larger due to the die life being reduced and the plate opening enlarged by repeated sharpening. With wire EDM, Figure 9, what you cut is repeatable from one tool to the next making repairs or replacements very easy.

Setting up the tools

Setting up blanking/piercing tools is easy if some basic rules are followed. First, the press should be lowered so that the punch has entered the plate. This is what will align the tools if they are not mounted in a die set. Any space between the punch and the plate must be equal in all places. When tightening the screws that hold the plate to the press, it's best to alternate between them so that the plate will not be pushed to one side. The depth must be set to cut all the way through the material but not enter the plate too deep. The deeper the punch penetrates the plate, the higher the material will go on the punch. On heavy material, this may cause problems due to the force needed to pull the scrap off with the stripper. Figure 10 shows the blanking tool for the six prong setting mounted.


Figure 10 - The finished six-prong setting blanking tool mounted in a die set and shown in operation


Figure 11 - The three blanks needed to assemble the six-prong setting and the scrap strips for each

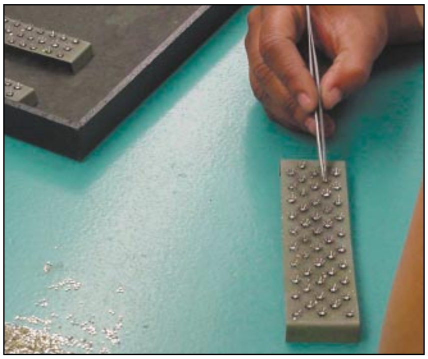


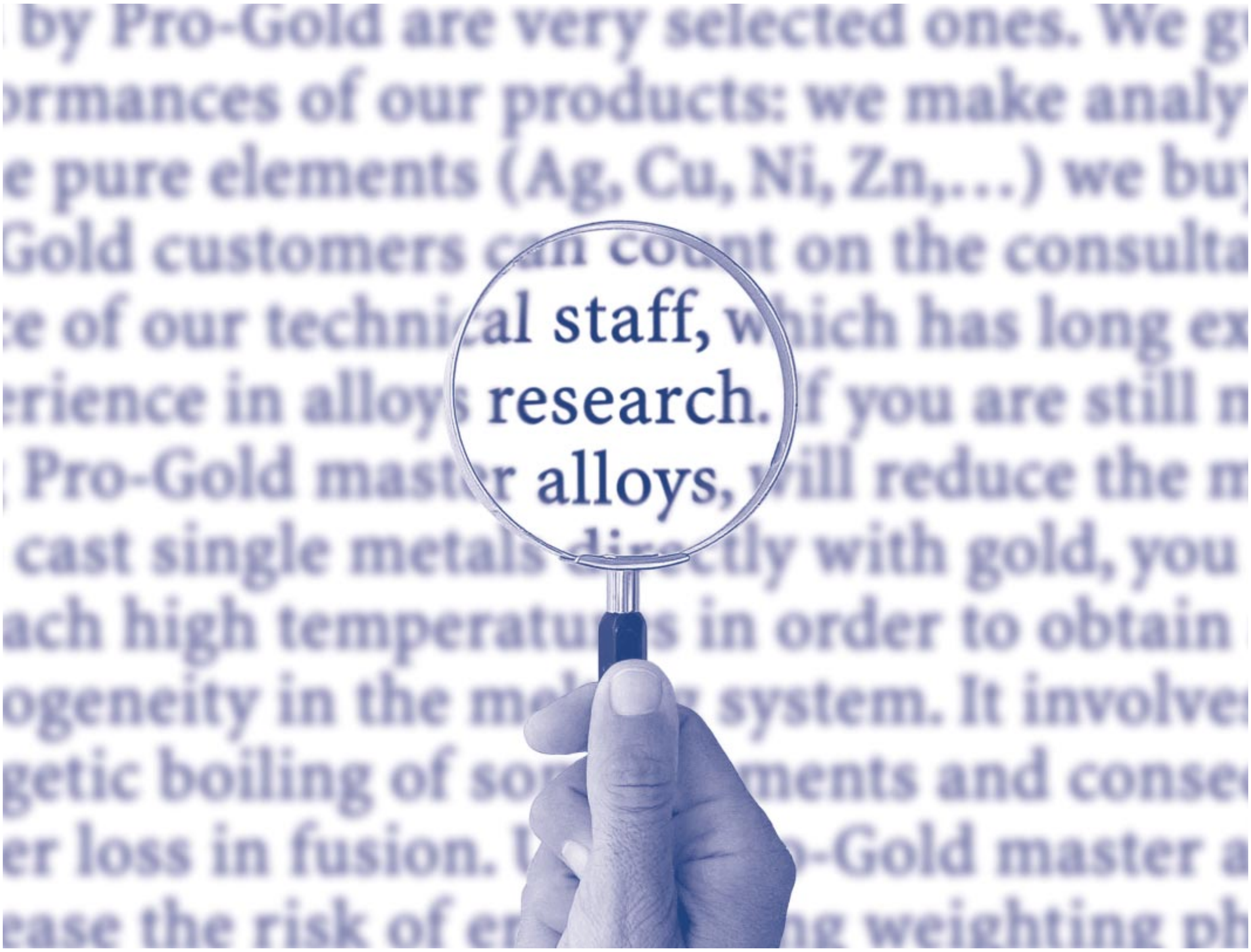
Figure 12 - Racked settings having chip solder being dropped into them prior to heating

Figure 13 - Final inspection of the settings prior to shipping

When blanking, the material must cover the opening in the plate. If half of the piece is blanked, it can result in the punch shifting and the tool being seriously damaged. Lubricants are a must for this operation. Common lubricants such as spindle oil work very well; another good choice is Marvel Mystery Oil (available in many automotive supply stores). These lubricants prevent the material from clinging to the punch as well as aiding the cutting process.

The strips can be fed into the die by hand or in cases of large quantities, an air feed can be used to quickly handle this operation. An air feed advances the strip in unison with the stroke of the press. This enables the operator to run the job at the full rate of the press cycle time.

After the parts are blanked for the six-prong setting, Figure 11, they are assembled using the series of interlocking notches to hold them together. Each of the blanks is inserted in turn into a jig that aligns them to each other. They are pressed together and placed in a rack with the prongs up. A small chip of solder is dropped into each one, Figure 12, and the entire rack is run through a furnace for soldering. The furnace contains an atmosphere of dissociated anhydrous ammonia that protects the settings from oxidation. When the settings emerge from the furnace, they are inspected to make sure the solder has flowed properly, Figure 13, and, if so, they are ready for shipping.



Optimising the workability of gold and silver is our goal. Using innovative alloys are able to solve the most common production problems. Giving to gold ductility, malleability, castability, brightness and resistance to oxidation. Reducing the scraps. Our Research department projects and systematically tests the performances of our products, using the most advanced analysis instruments. Pro-Gold: exclusive know-how is at your complete service.

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