Cold Forming

Cold forming is a process by which metal is placed in between tow dies, which are then pressed together. As the dies come together the metal will take the shape of the die. The main advantage of forming metal using this process is that it provides for the highest strength of a given section of steel. Some of the disadvantages are that there is a limitation as to how much metal can be moved in the process and wear of the dies is much greater than other processes.

Casting

Casting is a process by which the metal is heated until it reaches a liquid state and then is poured into a die or mold. Once the metal solidifies the part is ready for machining or, depending on the application, really for use. The main advantage of using a casting is that you can form most any shape or configuration. Also, there is a very little if any die wear. The problems incurred with a casting are that the metal will have no microstructure left after the liquid state therefore the metal will have a low impact strength. Additionally, because of the liquid state the metal is prone to air bubbles and the inclusions with in the structure.

Forging

Between cold forming and a casting is the forging process. Th raw material is heated to an approximate temperature of 2200 degree F. At this point the metal is in a plastic state but is at a temperature low enough to maintain the structural properties of the metal. The metal is then pressed into a die cavity under force to achieve the desired form. The main advantage to using the forging process is to achieve a high strength to weight ratio. Similar to cold forming, one limitation of the forging process is that only so much metal can be moved with each blow.

There are two basic types of machines that do the forging, a press and a Hammer (or drop forging). Presses generally operate at constant speeds and are load restricted. Hammers are either dropped or propelled down with a gas. They tend to be energy restricted, but are faster then a press. Size, shape, complexity of the forging, strength of work piece, production rate, accuracy, noise level and cost are all factors that should be considered in choosing a press or a hammer. Generally a press is used with aluminum, magnesium, beryllium, bronze, and brass. Hammers are usually preferred for use with steel, titanium, copper and refractory metal alloys. Its also not uncommon to use both hammers and presses for different operations of a forging system.

There are primarily two methods of forging; Hammer (or drop) forging and an Upset forging. In a hammer forging, there are typically three dies that the parts must pass through. Each die will have multiple impressions to accommodate 2-6 parts. In the first die, called the rougher, the top of the die drops down and forms the parts into the rough shape of the finished part. In the second called the blocker, the material is moved into an even closer configuration of the final part. The third die, called the finisher, forms the parts into the final configuration. After the third die you will have a “platter” of parts each part is then cut out and the flashing (excess metal) is trimmed off and you are left with the final product. The main disadvantage of this process is that there will be a large amount of scrap metal after the final process.

The second forging process is an upset forging. The main differences between the hammer and the upset forging process are that only 1 part is ran through each die and only the area to be formed is heated. Similar to a hammer forging the part is heated but now, maybe only at one end. The part then passes through the three dies and any excess metal is trimmed. The primary benefit will be lower material cost due to less scrap.

In summary, each of the four metal forming methods described above has advantages and disadvantages that must be evaluated for any given application. Cold forming is best when a minor displacement of material is involved. Casting is good for relatively low load applications with complex forms. Hammer forgings are good for small parts requiring further machining. Upset forgings are best specified for larger and longer parts requiring close tolerances.

There are several ways to tell a forging from a casting. Visual inspection and microstructure analysis are the most common. Visual inspection is the easier of the two. The forging will generally appear smoother and be more tapered then the casting. The taper is normally around 7degrees. Also the parting line on a forging is going to be thicker then that of a casting.

Stamping

Stamping is the process of forming sheet metal products with pressure. The machine or machines form the material through a series of bends and shears. This is generally done with sheet metal due to restrictions on thickness. A simple example of a stamping is the automobile body panel. It starts as a straight sheet and over a series of stampings it is formed to shape and has holes punched in it for the door handle and lock.