

INTRODUCTION:

Forging is a manufacturing process, it is required as a process of plastically deforming metal or alloys to a specific shape by a compressive force exerted by some external agents like hammer, press, rolls or by an upsetting machine of some kind.

The portion of work in which the forging is done is termed as the forge and the work mainly performed by the heavy hammers, forging machines and presses. Forging process is among the most important manufacturing technique since forged items are used in small tools, rail road equipments and automobile industries.

Smithing is the art of forging metals as iron, into any desired shape. In this process, jobs are heated in open fire or hearth and subsequently hammered to get desired shape. In smithing, relatively small sized jobs are used and for the operations on them small power hammers and hand hammers are used. The fuel used for furnace may be coal/coke or charcoal.

TOOLS USED IN SMITHY SHOP:

The tools used in Smithy shop are broadly classified as:

- (i) Supporting tools
- (ii) Striking tools
- (iii) Holding tools
- (iv) Cutting tools
- (v) Finishing and Shaping tools.

L. SUPPORTING TOOLS:

As the name suggests, these tools are used to give support to

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the job while in operation.

Some supporting tools are described below:

(a) anvil ~

- It is the most commonly used smithy tool without which we cannot perform any smithing operation.
- It is used as a support when hammering is performed. It is made up of wrought iron or cast steel.
- The top surface of anvil has some square and other round shaped holes. This is used when the hot pieces are inserted into them to get the desired shape. In particular it is used for bending operation.

The round hole is called Principal hole is used for bending small workpieces and a holdie hole is used to hold square shank tools swage and fullers.

(b) swage block ~

- It is also a supporting tool used in forge shop.
- It is made up of cast iron or cast steel.
- It is used for bending, squaring, heading and forming operations.
- It may be used either flat or edgewise in its position. For general applications, width of swage block is 0.25 m or slightly more than 0.5m.

2. STRIKING TOOLS

The different types of hammers used in forging operations are:

- Hand hammers used by smith.
- The sledge hammer used by striker.

Hand hammers are classified as :

- a) Ball peen hammers
- b) straight peen hammers
- c) cross peen hammers

The weight of these hammers vary from 0.5 kg to 2 kg. These hammer heads are made up of cast steel and ends are hardened and tempered. The striking surface is slightly convex.

sledge Hammer

It is used for heavy work only. It has flat ends on both sides. The weight varies from 4.5 to 5.5 kg. for ordinary work and around 9 kg for heavy work. The handle is made up of either cast iron or wood.

3. HOLDING TOOLS

Generally tongs are used for welding purpose. It is used for welding purpose. It is used for holding jobs and made up of mild steel.

Type of tongs:

- | | |
|------------------|------------------------------|
| (i) Flat tongs | (ii) Grod tongs |
| (iii) Ring tongs | (iv) straight-up fixed tongs |

- Flat tongs are used for holding jobs with rectangular cross-section.
- Grod tongs are used for general purpose and for picking up

work either straight or tapered.

- Ring tongs are for bolts, rivets and other circular cross-section jobs.
- Straight up fluted tong is used for square, circular and hexagonal bar stakes.

4. CUTTING TOOLS

Cutting tools are used for cutting and necking metals prior to breaking.

Chisels are cutting tools. They are of two types:

- Cold chisel
- Hot chisel

Cold chisel:

It is made up of tool steel with cutting angle of about 60° and its edge is hardened and tempered.

Hot chisel:

It is made up of low carbon steel and cutting angle is 30° . Its edge doesn't require hardening.

5. FINISHING AND SHAPING Tools

These tools are used to give desired forms and shape.

swages: Swages are used for work which has to be reduced and finished to round, square or hexagonal form. It is made up of high carbon steel. The swage may be separate top and bottom halves. These are made with half grooves of dimensions to suit the work being reduced. Swage consists of two parts; the top part

consists of a handle and bottom part consists of square shank which fits in handy hole in anvil face

Flatters : The flatter is used after the job has been forged into shape with hammer and the hammer marks can be seen on the job surface. Flatter is used to achieve better surface finish especially, when the surface area is large. It is used to provide smoothness and accuracy to the job or work.

COMMON SMITH FORGING OPERATIONS

So many work are carried out by means of heating the work-piece and hammering operations.

The typical smithing forging operations are:

- | | |
|-------------------------|--------------------------|
| 1> Upsetting or Jumping | 2> Drawing down |
| 3> Setting down | 4> Punching and drifting |
| 5> Bending | 6> Forge welding |
| 7> Cutting | 8> Fullering |

1. Upsetting :

Upsetting or heading is a process of increasing the thickness of a bar at the expense of its length and is brought about by end pressure. The pressure may be obtained by driving the end of the bar against the anvil, by supporting on anvil and hitting with hammer or clamping with the wise and hitting with hammer.

2. Drawing down or swaging :

It is the process of increasing the length of bar at the expense of its width or thickness or both. Associated figure explains this. 'A' represents the original stock. 'B' shows stock after the hammering with straight peen hammer or with a fuller and sledge and 'C' shows the finished forging after the hammer has been used.

3. Setting down:

It is localised drawing down or swaging operation. In other words it may be said as the process of local drawing down effected by set-hammer or set. usually, the work is followed at the place where the setting down commences.

4. Punching:

This is a process of producing holes, generally cylindrical by using hotpunch over the pritcher hole of anvil, over a cylindrical die, or over a hole of correct size in swage block.

5. Bending:

Bending is an important operation in forging and is one very frequently used. This may be classified as angular or curvilinear. Bending may be done over the anvil face, over the anvil horn, in special form such as swage block edges or for bar stocks, by inserting the end in the pritched hole and bending the bar with wrench or tong.

When metal is bent, the layers of metal on the inside are shortened and those on the outside are stretched. This causes a bulging outside at the bulging of sides at the inside, and a

radius on the outside of bend. If a perfect square is required, additional metal must be worked to the place where the bend occurs when this is bent. The additional metal will go to the corner. Gradual bends may be used by using the beak of the anvil as a former or metal may be bent around the bar of correct radius held in a vice.

6. welding or shutteling:

It is perhaps the principal operation by the smith. The metal which remains plastic over a wide range of temperature is most easily welded, and in this respect wrought iron and mild steel have some advantages over other metals. The first essential to the production of sound weld is that the surface in contact must be perfectly clean, both mechanically and chemically so that cohesion will take place when the metal is in a plastic state. A protection to the metal is coating of flux which covers surface of the metal and supports the prevention of air. Fluxes which are commonly used in forge welding consist of clean quartz sand, calcined borax or a mixture of 4 parts of borax with one part of sal-ammoniac. A forge weld is made by hammering together the ends of the two bars which have been formed to correct shape and heated to the welding temperature in a forge fire. The method of preparing the pieces of metal for welding known as scarfing - This involves the shaping of the ends of the pieces to be welded so that they will unite at the center. Four forms of welded joint commonly employed are:

- (i) The lap or scarf weld, in which the ends are prepared so that they may be welded one upon the other, with the joint in an inclined direction.
- (ii) The butt weld in which ends of pieces are joint and are butted together, the weld being between the ends at right angle to the length of pieces.
- (iii) The 'T' or jump weld, in which one piece is placed at the center of another right angle to each other in form of inverted 'T'.
- (iv) The split, fork or 'V' weld or splice, in which the ends are brought to the shape of fork and long respectively.

7. cutting:

The cutting-off is a form of chiselling whereby a longpiece of stock is cut into several specified lengths, or a forging is separated (cut-off) from its stock. For hot chiselling, steel must be heated in a black-smith's hearth or furnace to be light cherry red heat i.e. from 850°C to 950°C . When cutting with chisel, the hammers blows are directed on to the chisel head, which must be slightly rounded.

A notch is first made about one-half the thickness or diameter of stock. After the stock is to be cut-off has been notched, the work must be turned through an angle of 180° and the chisel is placed exactly opposite the notch.

TYPES OF FORGING:

- Hand Forging

- Machine forging
- Drop forging

APPLICATIONS OF SMITH FORGING

- It is used to fabricate components like bolts, nuts, hooks, keys, tongs and spring.
- It is also used to fabricate agricultural tools and jinks used in various mechanisms.
- Strength: Forging reduces the risk of part failures. The process yields parts with high strength-to-weight ratio.

ADVANTAGES OF SMITH FORGING

- The smith forging components have high strength and give great resistance to impact and fatigue loads.
- It improves the grain structure of metal so that its mechanical properties are also improved.
- Better surface finishing can be easily achieved.
- Raw material loss is almost null.
- Close tolerances.
- High rate of production is possible.
- Parts can be welded easily due to fibrous structure.
- Uniformity of quality of parts.

DISADVANTAGES OF SMITH FORGING

- Very difficult to achieve accurate dimensions.
- Some metals may break while forging.
- There is some limitation to achieve the shape and size of

the job.

- high tool maintenance

Safety Precautions for Smithy

Safety should be in every demonstrator's mind, not only for the audience but for the self as well.

1. Work slow and always be aware of the audience.
2. Always wear your safety glasses and if possible have your viewers also.
3. Wear an apron. Not only it could negotiate but it could prevent injuries.
4. Talk about safety and be warned of sparks, sharp edges, and hot items. No matter how sincere he/she is, don't let others pick up tools or pieces you are working on.
5. Keep all the hot pieces (cut-offs etc.) under the forge and away from people. It may be best to quench all pieces to be on the safe side.
6. Have a first-aid kit handy. You never know when you might burn or cut yourself.
7. Forge welding is always fascinating to watch, but can be very dangerous. It is best not to forge weld if possible.
8. When using hammers, never cut off completely through stock. Use hammers to break end off.

JOB-1

AIM: To make a chisel from a square headed rod.

MATERIAL: Square headed rod.

TOOLS REQUIRED: (1) Heating Blacksmith furnace (2) Tongs (3) Anvil
(4) Hammer (5) Other relevant tools (Haltmer, etc.)

SEQUENCE OF OPERATION:

1. Heating
2. Hammering
3. Forming octagonal shape
4. Tapering one end
5. Finishing
6. Checking
7. Cooling

WORKING STEPS:

1. First, half length of bar stock was heated.
2. The heated end is put on the anvil, by holding the other end by tongs.
3. Hammering was carried out convert the square head to an octagonal headed bolt. The same operations was repeated on remaining half of bar length.
4. Now, the end of the octagonal bar was heated.
5. Forging to flat taper was done by hammering any two opposite faces.
6. The chisel was turned a quarter turn, and the narrow sides were hammered to make them parallel.
7. The blows were altered, four or fine on the wider surface, then four or fine on the narrow surface, until the chisel is in desired shape. The chisel was held in vertical and hammered on one end for finishing.

8. After the chisel was formed, heat treatment involving annealing and hardening was performed.

Result :

The desired chisel is obtained.

JOB - 2

Aim: To make a chisel (flat) on one end & point chisel on other end.

Material required: A square headed-rod.

Tools Required: Blacksmith furnace, tongs, half-peen hammer, anvil and other relevant tools.

Sequence of operations: 1. Heating 2. Hammering 3. Forming 4. Hammering
 5. Tapering 6. Finishing 7. Checking 8. Cooling

Working steps :

1. First half length of square bar is heated in smm furnace. Heated end was put on anvil by holding other end with tongs.
2. Make chisel on the heated end of rod in the same way as we have done in the last job performed.
3. Now at other end we make a pointed chisel. For this we heat the end and taper it on the edges to get the desired shape.
4. When the rod cools down, heat it again in furnace. Keep repeating the procedure until the desired shape is reached.

Result : The desired shape is obtained.

Teacher's Signature : _____