Shearing (manufacturing)

Shearing, also known as **die cutting**,[1] is a process which cuts stock without the formation of chips or the use of burning or melting. Strictly speaking, if the cutting blades are straight the process is called shearing; if the cutting blades are curved then they are shearing-type operations.[2] The most commonly sheared materials are in the form of sheet metal or plates, however rods can also be sheared. Shearing-type operations include: blanking, piercing, roll slitting, and trimming. It is used in metalworking and also with paper and plastics.

Principle

A punch (or moving blade) is used to push a workpiece against the die (or fixed blade), which is fixed. Usually the clearance between the two is 5 to 40% of the thickness of the material, but dependent on the material. Clearance is defined as the separation between the blades, measured at the point where the cutting action takes place and perpendicular to the direction of blade movement. It affects the finish of the cut (burr) and the machine's power consumption. This causes the material to experience highly localized shear stresses between the punch and die. The material will then fail when the punch has moved 15 to 60% the thickness of the material, because the shear stresses are greater than the shear strength of the material and the remainder of the material is torn. Two distinct sections can be seen on a sheared workpiece, the first part being plastic deformation and the second being fractured. Because of normal inhomogeneities in materials and inconsistencies in clearance between the punch and die, the shearing action does not occur in a uniform manner. The fracture will begin at the weakest point and progress to the next weakest point until the entire workpiece has been sheared; this is what causes the rough edge. The rough edge can be reduced if the workpiece is clamped from the top with a die cushion. Above a certain pressure the fracture zone can be completely eliminated.[3] However, the sheared edge of the workpiece will usually experience workhardening and cracking. If the workpiece has too much clearance, then it may experience roll-over or heavy burring.

Tool materials

- Low alloy steel is used in low production of materials that range up to 0.64 cm (1⁄4 in) thick
- High-carbon, high chromium steel is used in high production of materials that also range up to 0.64 cm (1⁄4 in) in thickness
- Shock-resistant steel is used in materials that are equal to 0.64 cm (1⁄4 in) thick or more

Tolerances and surface finish[edit]

When shearing a sheet, the typical tolerance is +0.1 inch or −0.1 inch, but it is feasible to get the tolerance to within +0.005 inch or −0.005 inch. While shearing a bar and angle, the typical tolerance is +0.06 inch or −0.06 inch, but it is possible to get the tolerance to +0.03 inch or −0.03 inches. Surface finishes typically occur within the 250 to 1000 microinches range, but can range from 125 to 2000 microinches. A secondary operation is required if one wants better surfaces than this.

Assembly is an important step for manufacturing solid products, especially when the shape of the product is complicated having multifarious geometrical features. It is neither feasible nor

economical all the times to directly produce a product having intricate shape. In such scenario, making small simple parts and joining them together is the best possible way. Joining consists of a large number of processes used to assemble two or more parts together, irrespective of their composition, properties, features, shapes, etc.

By definition, joining is one of the manufacturing processes by which two or more materials can be permanently or temporarily joined or assembled together with or without the application of external element in order to form a single unit. Now-a-days a large variety of such joining techniques are available to cater the need of assembling a wide variety of materials in various ways for various processing or applications. Some of the commonly used joining processes are enlisted below.

- Welding
- Soldering
- Brazing
- Fasteners (including nut-bolt, nail, hook, clip, clutch, button, zipper, etc.)
- Adhesive bonding
- Resin bonding
- Cotter joint
- Knuckle joint, etc.

Topic: Welding – a permanent joining process

A permanent joining process does not allow easy dismantling of jointed parts without rupturing them. On the other hand, for temporary joints, jointed parts can easily be dismantled without any damage. Welding is the first and foremost example for permanent joining process where two or more materials can be joined by coalescence formation. On the other hand, fasteners, cotter joint, knuckle joint, etc. are examples of temporary joints.

There exist a number of various welding processes to weld a wide variety of materials in innumerable ways. Some of the common topics related to welding are enlisted below. You can directly read them by clicking on the corresponding links. To see all topics related to welding, you may browse all welding topics.

- **Introduction to welding**
    - Definition of welding
    - Complete list of welding processes
    - Classification of welding processes
    - Fusion welding
    - Solid state welding
    - Difference between fusion and solid-state welding
    - Autogenous welding
    - Homogeneous welding
    - Heterogeneous welding
- **Polarity in arc welding**

- Direct current straight polarity (DCSP)
- Direct current reverse polarity (DCRP)
- Difference between DCRP and DCSP
- Alternating polarity (AC)
- Which polarity gives better oxide cleaning?
- Which polarity gives better penetration?
- Which polarity gives maximum deposition rate?