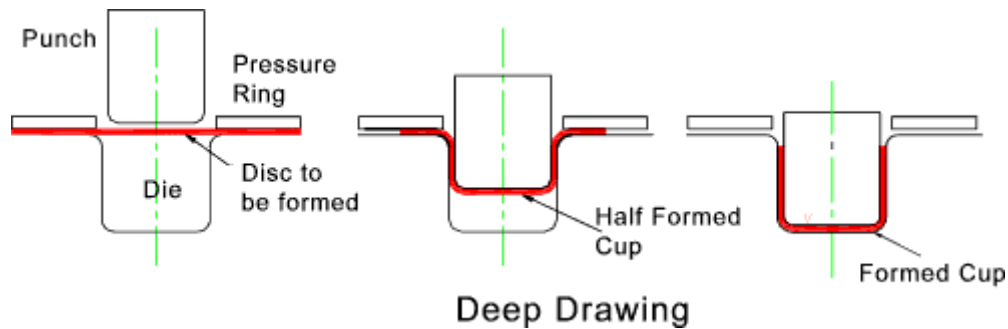


## ***Drawing process***

When the metal is forced through the die by a **tensile** force applied to the metal at exit of die it is called drawing, while when a **compressive** force is applied at the entry of the die it is called extruding.

### ***Deep drawing***

The important features of deep drawing are shown in the figure below. The pressure ring bears on the upper surface of the blank preventing wrinkling of the metal as it is drawn radially over the upper surface of the die. There is the option of applying pressure to the base of the cup using a pressure pad. Thinning results from this process, the worst being at the bottom radius as a result of drawing the full disc diameter inward under the pressure ring. The thinning is the least at the top of the cup



**Fig.9 Deep Drawing**

Objects that have depth to them such as cylinders, pans, or domes typically are fabricated with a deep draw forming method. Deep Drawing of sheet metal is used to form containers or objects with depth. The process is accomplished with the use of a hydraulic or mechanical press. The process of deep drawing begins with a flat sheet metal blank held on the upper surface of the die.

### **Deep Drawing Operations**

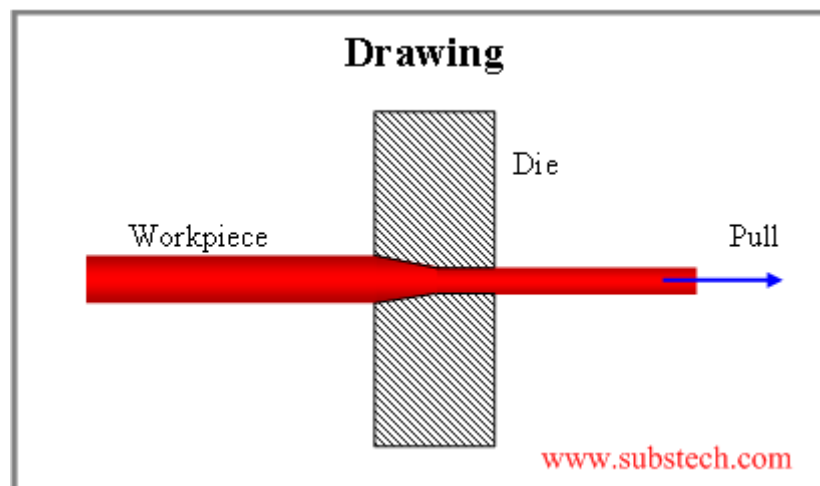
**1. Ironing:** It is the operation in which the thickness of the shell wall is reduced and its surface smoothed. The die and punch set used is similar to that of drawing operation except that the clearance between the die and punch is smaller than that used in the drawing operation. The material gets compressed between punch and die, which reduces the thickness and increases the height of the cup. The thickness of the shell wall can be reduced up to 50% in a single operation.

**2. Redrawing:** When the ratio of the blank diameter and the final cup diameter is too large, the drawing operation is performed in more than one stage. The successive drawing operations after the first one are known as redrawing.

**3. Reverse drawing:** In this process, a drawn cup is subjected to bending in the opposite direction to its original drawn direction. This reverse drawing results in strain softening.

## Wire Drawing

To manufacture long slender products (wire, tube), material is drawn through a die. The material is deformed by compression, but the deformation force is supplied by pulling on the deformed end of the wire or rod.



**Fig.10 Wire drawing**

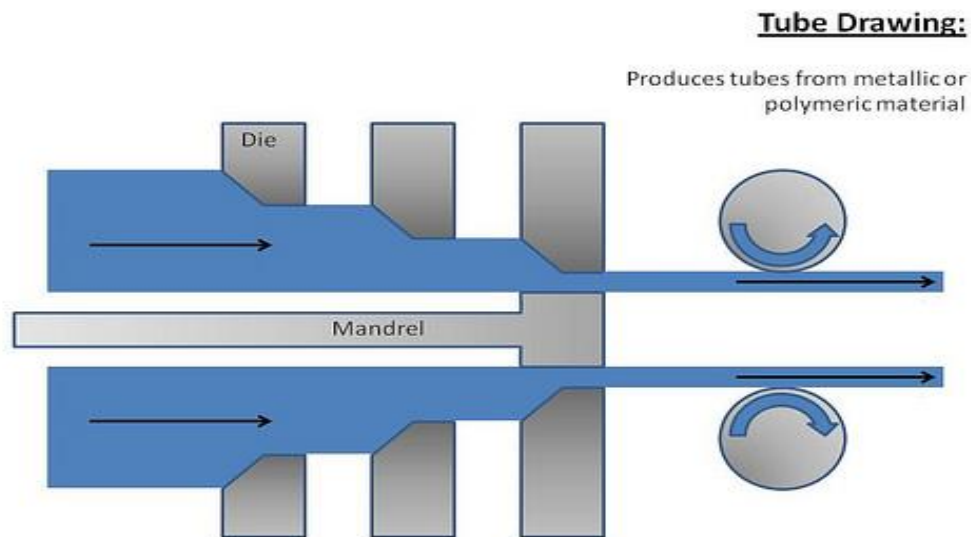
Wire drawing is an operation to produce wire of various sizes within certain specific tolerances. The process involves reducing the diameter of rods or wires by passing them through a series of wire drawing dies with each successive die having smaller bore diameter than the one preceding it. The drawing force must not exceed the strength of the drawn wire. Typically this means that the maximum reduction (as area, not diameter) attainable is less than 50%. In practice reduction is usually limited to 20-30% to avoid frequent breakage. The final wire size is reached as the wire passes through the last die in the series.

### Applications of Wire Drawing

Wire drawing is used for the manufacture of fine wires for electrical and electronic equipment, cables, springs, musical instruments and shopping carts, etc.

## Tube Drawing

Tube drawing normally makes tubes to size from hollow 'tube shells' produced by extrusion. They are then cold drawn to size by a sequence of passes.



**Fig.11 Tube Drawing with a stationary mandrel**

The common methods of tube drawing are: Tube sinking, Tube drawing with a plug or stationary mandrel and Tube drawing with a moving mandrel.

### 1. Tube sinking

This method is generally not preferred since no support is provided on the inner surface of the tube and as a result wall thickness may little increase.

### 2. Tube drawing with a plug

In this method tubes of greater dimensional accuracy are obtained because of the proper support provided both at the inner and outer surfaces of the tube.

### 3. Tube drawing with a moving mandrel

This method is similar to that of a plug drawing except the difference that in this case a movable mandrel is used. Because of the movable mandrel, friction is minimized but the mandrel has to be removed by rolling, hence there is a little increase in the diameter of tube. This results in reduction of dimensional tolerances.