

METAL FORMING PROCESS

(A) ROLLING

It is a forming process on cylindrical rolls wherein cross-sectional area of a bar or plate is reduced with a corresponding increase in length. The metal is thinned and elongated by

compression and shear force but increased in width only slightly because of the high surface finish maintained on the rolls, the surface of stock is burnished by rolling action and attains a smooth bright finish.

This process is one of the most widely used of all metal working process, because of its high productivity and low cost. Rolling would be able to produce components having constant cross-section throughout its length. Many shapes such as I, L, T and channel section are possible, but not very complex shapes. It is also possible to produce special sections such as railway wagon wheels by rolling individual pieces.

DEFECTS IN ROLLING

1. Surface defects

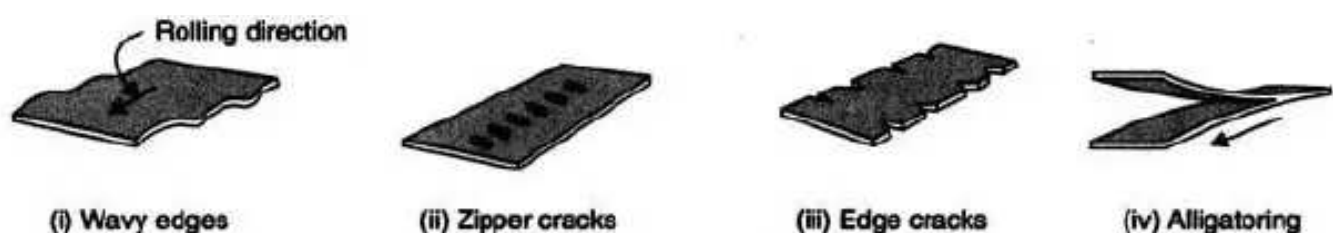
These defects may result from:

- Inclusions and impurities in the material
- Scale, rust, dirt
- Roll marks
- Other causes related to the prior treatment and working of the material.

2. Structural defect

These defects distort or affect the integrity of the rolled product.

- (i) **Wavy edges** are caused by bending of the rolls; the edges of the strip are thinner than the centre because of the edges elongate more than the centre and are restrained from expanding freely, they buckle.
- (ii), (iii) **Zipper cracks and edge cracks** – zipper cracks in the centre of strip and edge cracks are usually caused by low ductility and barrelling.
- (iv) **Alligatoring** is a complex phenomenon that results from inhomogenous deformation of the material during rolling or from defects in the original cast ingot, such as piping



(B) FORGING

It is the process by which heated metal by the application of sudden blows or steady pressure and characteristics of plasticity of material are made use of.

DEFECTS IN FORGING

1. **Cold shut** - it usually occur at corners and at right angle to surfaces. It is caused mainly by the improper design of the die wherein the corner and the fillet radii are small as a result of which the metal does not flow properly into the corner and ends up as a cold shut.
2. **Unfilled section**- it is similar to misrun in casting and occur when metal does not completely fill the die cavity. It is usually caused by using insignificant metal or insignificant heating of the metal.
3. **Flakes**- these are internal ruptures caused by improper cooling of large forging and can be reminded by following proper cooling practice.
4. **Scale pits**- these are irregular depression on the surface of forging. These are primarily caused because of the improper cleaning of the stock used for forging.
5. **Improper grain flow**- this is caused by improper design of the die which makes the flow of metal not following the final intended directions.
6. **Internal cracks**- these can result from too drastic a change in the shape of the raw stock at too fast a rate.
7. **Die shift**- this defect is caused by the misalignment of the two die halves, making the two halves of the forging to be of improper shape.
8. **Burnt and overheated metal**- this defect is caused by improper heating condition and soaking the metal too long.

(C) EXTRUSION

It is a process in which metal is caused to flow through a restricted orifice so creating an extremely elongated strip of uniform, but comparatively small cross-section. The operation is identical to the squeezing of toothpaste out of the toothpaste tube. It is also similar to the cold drawing except that the material is pushed; not pulled, through the hole in the die, and the operation is often carried out at high temperature.

DEFECTS IN EXTRUSION

- (i) **Extrusion defect-** it is most common defect in extrusion. It arises from the back flow of material, pushing the end face of the bullet into the core of the product. Such a defect weakens the product since the surface layer is normally contaminated by oxides.
- (ii) **Surface cracking-** sometimes the heat generated due to extrusion may raise the temperature of the job, resulting in the development of surface cracks. These cracks are intergranular and are usually the result of hot shortness; they occur especially with Al, Mg, and Zn alloys but are also observed with other metals, such as Mo alloys.
- (iii) **Internal cracking-** the centre of an extruded product can develop cracks variously known as centre burst, centre cracking, arrowhead fracture. These cracks are attributed to a state of hydrostatic tensile stress at the centre line of the deformation zone in the die.

(D) WIRE DRAWING

It is the process of reducing diameter of metal rods by drawing them through conical openings in die blocks.

DEFECTS IN WIRE DRAWING

- (i) Defects in drawing are similar to those in extrusion, especially **centre cracking**. The tendency for cracking increases with increasing die angle, with decreasing reduction per pass, with friction, and with the presence of inclusions in the material.
- (ii) Another type of defect is the formation of **seams**, which are longitudinal scratches or folds in the material. Such defects can open up during subsequent forming operation by upsetting, heading, thread rolling, or bending of the rod or wire.
- (iii) In **tearing**, due to high tensile stress cause thinning & failure of the metal in the cup wall. It occurs if die has a sharp corner radius.