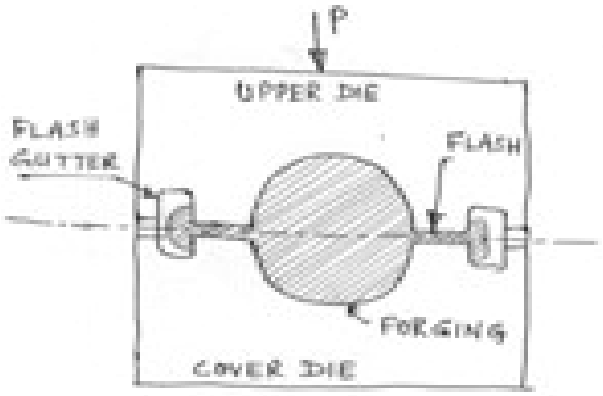
DIE DESIGN PARAMETERS



CLOSED DIE FORGING.

1. **Parting Line**
   - is at the largest c/s of the part
   - is a st. line at centre for simple shapes
   - may not be in a single plane for complex shape

2. **Flash and Gutter**
   - Flash material is allowred to flow into a gutter
   - Prevents unnecessary increase of forging load (because of excess/ extra flash)

- Guidelines for flash and clearance between dies:
   - 3% of max. thickness of the forgings
   - The length of the land = 2 to 5 times the flash thickness

3. **Draft Angles**
   - For easy removal of forgings from the die
   - Similar to draft <u>in casting design</u>
   - Internal draft angles are larger – 7^o- 10^o
   - External draft angles are smaller – 3^o- 5^o

4. **Fillet :** It is a small radius provided at corners.
   - To ensure smooth flow of metal into die cavity

- To improve die life
- As a general rule, should be as large as possible

- Small fillet radii lead to;

  - Improper metal flow
  - Rapid wear of die
  - Fatigue cracking of dies

5. Die material : requirements are

- Strength and toughness at elevated temperature
- Hardenability and ability to harden uniformly
- Resistance to mechanical and thermal shocks
- Wear resistance – to resist abrasion wear due to scales present on work piece

Selection of proper die material depends on :

- Die size
- Composition and properties of work piece
- Complexity of shape- no of performing steps
- Forging temperature
- Type of forging operation
- Cost of die material
- No. of forgings required
- Heat transfer from work piece to dies

- **Die materials used:**
- Tool and die steels with Cr, Ni, Mo, Va

Die Manufacturing: It consists of the following steps:

- -- Initially castings
- – then forged
- – finally machined and finished to required shape and surface finish

Material Flow Lines in Forgings:

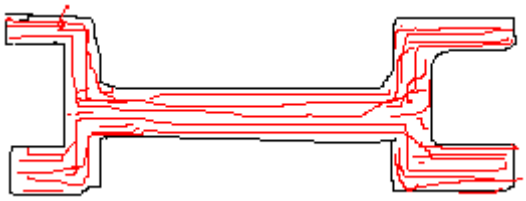


Fig. Material Flow Lines

- The deformation produced by forging gives a certain degree of **directionality** to the microstructure of the work material.
- Due to this, second phases and inclusions are oriented parallel to the direction of greatest deformation.
- When magnified, this appears as flow lines or fiber structure, **a major characteristic** of all forgings.

Limitation of flow lines:

- Flow lines (fiber structure) lead to lower tensile ductility and lower fatigue properties in the direction normal to it (in transverse direction).
- Hence **optimal balance** between ductility in longitudinal and transverse directions is very essential. (Deformation limited to 50% to 70% reduction in c/s area.

Source : http://elearningatria.files.wordpress.com/2013/10/mp3_unit3_forging_final.pdf