815-PRESS TOOLS

PART A

1. list out three stages of cutting
   - Plastic deformation
   - 2. Penetration (or) shear
   - 3. Fraction (or) break.

2. Write any one difference between roll feed and hitch feed
   ROLL FEED: ROLLERS ARE USED, rolling feed
   HITCH FEED: Grippers are used. Sliding feed

3. What is the purpose of knockout?
   to eject the piece part or waste section from the die

4. Define bend radius

BEND RADIUS:

- The bend radius is the minimum radius to which a blank can be bend without cracking.
- The factors influence the bend radius are, the angle of bend and length of bend, material properties and direction of bend in relation to grain.

For softer material, the minimum bend radius is equal to the thickness of metal.
Hardened material requires proportionality larger bending radii than soft materials.

5. Name any two types of friction variables
   - Lubricant
   - blank holding force
   - surface finish
6. What is the purpose of V ring?

Functions of ‘v’ ring:

- The ‘V’-ring is a characteristic feature of fine blanking dies.
- It runs in the form of a raised serrated jag at a defined distance from the blanking line and is pressed into the scrap web.
- Its function, is to hold the punched material outside the blanking line and to prevent lateral flow of the material during the blanking process.
- It serves to apply compressive stress to the sheet metal, so improving the flow process.

7. Mention the applications of fine blanking.

Office machinery industry, electrical industry, watch industry, automobile industry, photography, audio and video, aircraft industry, Gear teeth and various chain wheels.

8. What is neutral axis?

NEUTRAL AXIS:

- A neutral axis is the plain area in the bend metal where all strains are zero.
- If the stresses developed in the fibers are within elastic zone after the load is removed, component gets back to its original form. In this condition the neutral axis is in the middle of the material thickness.
- When stresses developed less or more than elastic limit and less than ultimate tensile stress, the component changes its form permanently. In this case the neutral axis lies towards inner side of the bend.

9. Write any three advantages of hydraulic press.

1. High pressure and force can be obtained.
2. Noiseless and smooth operation takes place.
3. Tonnage adjustable from zero to maximum.

10. Explain notching and perforating operation.

Perforating

In a punching operation, the process of cutting of more number of holes is called perforating.
**Notching:**

The operation of removing a small amount of material from the edges of the strip or blank is called notching. This operation removes metal from either or both edges of the strip. Notching serves to shape the outer contours of the workpiece in a progressive die or to remove excess metal before a drawing or forming operation in a progressive die.

11. **Mention the uses of pilots and the types of pilots**

- The pilot is a device used to position and register the strip. This is termed as registering.
  1. Direct pilots
  2. Indirect pilots

12. **Name the types of bending dies.**

The various types of bending dies are,

1. V-bending
2. Channel bending
3. U-bending
4. Ring bending
5. Tube bending
6. Curling
7. Wiping

13. **What is the difference between coining and embossing?**

Coining is the process of pressing cold material in a tool so that it flows into the engraved profiles on the die face.
Embossing is a shallow forming operation. The work piece material is displaced between a male and female surface. The finished product will have depressed form on one side and a raised form on the other.

Embossing is used to stiffen and strengthen a sheet metal part or to impart a raised or depressed design on the surface of the part.

14. What do you mean by draw beads?

In forming or drawing process, a material-restraining action can be provided by draw beads. These inserts not only secure the material in a given position, they further prevent its wrinkling during forming action.

There are two basic types of draw beads: mold-type draw beads and lock-type beads. Mold-type bead allows for some material movement in the area between the bead itself and the punch; the lock-type bead takes away that possibility.

15. Write the advantages of SMED

ADVANTAGES of SMED:

- Increased capacity
- Increased flexibility
- Increased efficiency
- Reduced inventory

16. Explain the work hardening during fine blanking.

MATERIAL STRESS AND PROPERTIES:

The grains of the metal microstructure are subjected to a cold forming process by the blanking punch prior to the point of separation.

This grain deformation calls for a formable, material with a high formability, i.e.
with a high degree of ultimate elongation and fracture necking.

The cold forming of the grains increases from the die-roll to the burr side of the part, and decreases from the cut surface towards the center of the work piece.

At a certain distance from the surface, the grains which make up the microstructure are no longer affected by the fine blanking process.

The fine blanking capability of steels is determined on the basis of their chemical composition, their degree of purity, their micro structure, their treatment and the prevailing mechanical and technological conditions. Starting with soft, unalloyed steels with low carbon content, fine blanking capability increases on principle with an increasing proportion of carbon and a higher alloy content.

There is no precise limit based on the content of carbon and alloy materials from which fine blanking capability can be said not to exist.

The microstructure of a material has influence on the properties of the cut surface, the dimensional stability of the part and the service life of dies.

PART-C

17a (i) write the importance of cutting clearance

(ii) Explain the effect of (1) optimum cutting clearance (2) excessive cutting clearance.

CUTTING CLEARANCE:

- It is the intentional dimensional variation or gap between the punch cutting edge and the die cutting edge.
- Clearance is always expressed as the amount of clearance per side. The amount of clearance depends upon the kind, thickness and hardness of the work material.
- The clearance is necessary to allow the fracture to meet when break occurs.
- Proper optimum cutting clearance is necessary to the life of the die and the quality of the piece part or stamping.
- Excessive cutting clearance results in objectionable piece part characteristic.
- Insufficient cutting clearance causes stresses and tears on cutting member and greater punching efforts.
Optimum cutting clearance:
- When the cutting clearance is optimum a small edge radius is formed.
- The edge radius is the result of initial plastic deformation during the first stage of shear action.
- The second stage of shearing action results in highly burnished band, which is called as “cut band”.
- Always the dimension of a press work component is measured along the cut band.
- The thickness of the cut band is usually 1/3 the thickness of the stock material.
- The remaining 2/3 portion of the cut is called the break.

Excessive cutting clearance:
- The gap between the punch and the die is comparatively more in this case.
- The stock material reacts to the initial pressure in a manner approaching forming rather than cutting. Therefore the edge radius becomes larger.
- It does not blend smoothly with the cut band. The cut band becomes smaller.
- The break shows greater irregularities.
- Heavy burs are noticeable all along the cut contour.
- The burr results from the dragging of the material.

17 b) write short notes on (1) electromagnetic press (2) triple action press

Electromagnetic presses

In these presses the ram movement is given by the application of electromagnetic forces.

Triple action press:
- A triple action press is provided with three slides two of which are located above and one within the bed.
- Such presses are used for complicated deep drawing operations on sheet metal.
- The triple action presses are particularly used when some forming (or) embossing is to be done on the base of the presses.
After the drawing of the vessel, the third slide is operating to emboss the base and then move the pressing away from the die.
The types of blank feeding devices are

- Manual feeding
- Hopper feeding
- Dial feeds
- Chute feeding
- Push feeding
- Lift and transfer devices
- Robots

**Hopper Feeds:**

- A hopper is a mechanism in which parts are dumped without orientation.
- It may be a funnel or a bin which performs orientation and discharge of parts to tracks for use in machines of all types.
- Hoppers and orienting devices depend upon gravity. The discharge track usually consists of inclined rails on which parts slide.
- If a part is not properly oriented in the track it will fall off the track. Chamfers, rounded edges, flanges or grooves are used for orientation.
- The various types of hoppers are oscillating and rotary hoppers, barrel hoppers, inclined hoppers and vibratory bowl feeder.
- This kind of device usually consists of three parts: a vibrating conveyor, a baffle (guide rails) and a pusher. The vibrating conveyor is for sorting the blanks. The vibrations of the container separate the parts and they move upwards in spiral grooves.
- From there they fall through a mechanism, which is controlled synchronously with the ram of the press, falling into a chute with guide rails which they slide down due to gravity.
- The pusher device then moves the blanks in front of the die.

The formed parts are knocked out by an ejector, which is part of the press.
(ii) What are the major components of die set and write the advantages of die set?

DIE SETS

The die set consists of a bottom plate and a top plate together with guide pillars and bushes. The guide pillars and bushes align the top and bottom plates.

The advantages of die sets are:

- Accuracy of set up.
- Improved quality piece part.
- Increased die life.
- Minimum set up time.
- Easy maintenance.
- Alignment of punch and die.
- Easiness of storing.

Parts of die set:

1. Upper shoe
2. Lower shoe
3. Guide pillar
4. Guide bush
5. Shank

Types of die set:

Die sets are generally classified as

1. Catalogue die set or standard die set
2. Special or Non-standard die set

Types of Standard die set:

Standard die sets are generally classified as

1. Rear pillar or Back pillar die set
2. Center pillar die set
3. Diagonal pillar die set
4. Four pillar die set

Parts of die set:

1. Upper shoe
2. Lower shoe
3. Guide pillar
4. Guide bush
5. Shank
18 b) explain with neat sketch, a suitable die for producing washer component.

There are number of methods and dies to produce a washer

1. Through blanking and then piercing
2. Using compound tool
3. Using progressive tool

So any answer may be correct

**COMPOUND TOOL:**

The compound die performs two or more cutting operations during one stroke of the press at one station only. In a compound die both the upper and lower member of the die set carry piercing and blanking elements which are directly opposed to each other. The piercing punches act in the opposite direction with respect to the blanking punch.

In a compound die the blanking punch also serves as the piercing die. The side walls of the cutting edges in blanking die opened by a knockout mechanism, which is actuated at the return stroke of the press. The knockout play is also used to support and guide punches. In piercing die angular clearance is provided to allow slugs to draw through the die.
Progressive tool perform two or more operations at different stages every time the ram descends. The stock strip is advanced through a series of stations that perform one or more distinct die operations on the work piece. The strip must move from the first through each succeeding station to produce with each stroke of the ram.

Progressive die are often made with many station. In some, blanks are cut at the first station and blank return to the strip by means of spring plate. When established the sequence of operations for progressive dies, piercing operations must be placed first. Irregularly shaped punches having frail projections that is hard to machine and likely to break after a few runs should be avoided of punching out a portion of the blank at one station and finishing it at another.

The principal advantage of a progressive die is the number of operations that can be achieved with one handling of the stock strip. The main disadvantage is that work piece may become dished as they are pushed through the die as they generally have very little support. Thin stock of soft materials may cause trouble by bending or
tearing around piloting holes, especially in die sets have may stations where the friction and inertia of the stock are considerable.

19a) Explain spring back and methods of overcoming spring back with a sketch

SPRING BACK:

- The elastic recovery of the sheet metal at the end of the bending operation when the pressure on the metal is relieved is called spring back. This causes change in the bend angle. The metal piece generally opens up slightly after the bending.
- Spring back value also depends on the angle of bend and material hardness.
- The spring back can be compensated by bending the corner to a lesser angle so that after spring back the required angle is obtained.
  - For low carbon steel spring back can be $1^0$ to $2^0$.
  - For medium carbon steel it can be $3^0$ to $4^0$.
  - For phosphour bronze and spring steel the spring back can be up to $10^0$ to $15^0$.

METHODS OF OVERCOMING SPRING BACK:

Spring back must be compensated in bending operations, otherwise the operation won't yield parts of the desired dimensions and shape. Several methods are used to overcome or counteract the effects of spring back:

Overbending:

- Over bending is the simplest way to compensate the spring back.
- A 2% addition to the angle of the bend is given as allowance for spring back in steel parts. This additional bending of parts is called as overbending.

Bottoming:

- Large, short-time loading or impact type loading applied at the bottom of the bend produces high compressive stresses that set or hold the bend.
A bead is placed on the punch at the bend area as shown in the Figure to produce local deformation.

**Limitations:**

- A problem with this form of handling spring back is that the deformation is not well controlled.
- Variations in the bead, the blank thickness and die and punch geometries produce different degrees of deformation.

**Stretch bending:**

In this method spring back is controlled by introducing additional plastic deformation into the blank. This addition of plastic deformation may be necessary if small strain is to be produced in the formed sheet.

In stretch bending the sheet is first stretched so that the blank is stressed past the yield strength. The sheet is then forced over the punch to obtain the desired contour. This prestressing before bending results in very little spring back.

**Air bending:**

- In air bending the entire bend length of work piece does not come in contact with the punch or die, and the work piece spring back. So the die need not have the profile resembling the work.
- The punch angle is less than the angle required on the work piece.
- The workpiece bend angle can be reduced by taking the press ram further down, where as the bend angle can be increased by reducing the stroke of the press.
- Spring back can be prevented in wiping dies by ironing the material. To iron the bend effectively the distance between the punch and die must be slightly less than the metal thickness.
19b) with a neat sketch, write short notes on (i) curling dies (ii) embossing dies.

(I) CURLING DIES:

A curling die rolls a raw edge of sheet metal into a roll, or curl, as shown in fig.

Purpose:

- To strengthen the raw edge, provide a protective edge, and improve the appearance of the product.
- The curl is often applied over a wire ring for increased strength.

Construction

- The curling die consists of top plate, bottom plate, knock out pad, curling die, curling ring, curling punch.
- The curling punch is fixed to the top plate.
- The curling die and curling ring is fixed on the bottom plate.
- A knock out pad is fixed inside the die for component ejection.
- A lubricant should be used during the curling operation.
- The size of the curling groove in the die is the same as the curl diameter on the part.
- The size of the curl is determined by the metal thickness.
- Generally it should not have a diameter of less than 4 times the metal thickness. When the groove diameter is too large, the curl tends to form its own diameter.
Working:

- In the figure a drawn shell is to be curled.
- The shell is placed in the curling die where it rests on knockout pad.
- The downward movement of the curling punch causes the knockout pad to be pushed down until it bottoms on the die holder.
- Further descent causes curling punch to curl the edge of the shell.
- Near the bottom of the stroke, the lip of the material contacts an angular surface in curling ring to complete the curl.
- When the punch goes up, the knockout ejects the component.

Applications: Tumblers and cups, tea shop trays

(ii) EMBossing DIE:

Definition:

Embossing is a shallow forming operation. The work piece material is displaced between a male and female surface. The finished product will have depressed form on one side and a raised form on the other.

Purpose:

- Embossing is used to stiffen and strengthen a sheet metal part or to impart a raised or depressed design on the surface of the part.

Construction:

- The embossing die consists of top plate, bottom plate, embossing punch, embossing die, blank locator, ejector, pressure pad.
- The embossing die is fixed in the bottom plate.
- The embossing punch is fixed in the top plate.
- The punch assembly is fixed to the ram of the press.
- The die assembly is fixed to the press table.
- Care should be taken to provide radii on surfaces over which the metal must flow.
• Pressure pads or ejector pins are provided to remove the embossed parts from the die.

Working:

• The blank is placed in the die surface.
• When the ram descends, the pressure pad holds the component first.
• When the ram further descends, the punch presses the component into the die.
• The embossing is formed over the component.
• At the end of the stroke, the ram moves upwards leaving part.
• An ejector pin is used to eject the part.

Limitations:

• Embossing dies are limited to shallow forming.

Applications:

The circular grooves on the bottom of a sheet metal container.

20a) explain the following (i) conventional draw die (ii) reverse redrawing die

CONVENTIONAL DRAW DIE

Single action dies:

Single action die is the one which involves only one slide movement. Draw dies consisting of only a punch and dies are known as single action dies.

In this die a precut blank is placed in a nest on top of the die. The downward movement of the punch pushes the cup through the die. During the upward movement of the punch the cup is stripped from the punch by the counter bore in the bottom of the die. The top edge of the shell expands slightly to make this possible. The punch has an air vent to eliminate vacuum, which would hold the cup on the punch and damage the cup when it is stripped from the punch. A rigid flat blank holder is used to control the metal flow and prevent wrinkling.

REVERSE REDRAWING DIE
In reverse redrawing, the intermediate part is flipped over before being placed on the die for the next operation. This will cause the sheet metal to now be drawn in the opposite direction as the first draw. Reverse redrawing of a cup is shown in figure. The cup is placed on the die steel upside down. The outside diameter of the die steel acts as a locator, which holds the cup centrally with the punch steel. When reverse redrawing, the cup is turned inside out as it is reduced in diameter.

20(b) Explain any five defects in cup drawing

**DEFECTS IN DRAWING:**

*Wrinkling:* Wrinkling in the flange occurs due to compressive buckling in the circumferential direction (blank holding force should be sufficient to prevent buckling from occurring).

(b) Wrinkling in the wall takes place when a wrinkled flange is drawn into the cup or if the clearance is very large, resulting in a large suspended (unsupported) region.

*Tearing:* Tearing occurs because of high tensile stresses that cause thinning and failure of the metal in the cup wall. Tearing can also occur in a drawing process if the die has a sharp corner radius.

**Orange peel:** When metal is stretched, it loses the shiny surface produced by rolling. Stretching cause the surface to become dull and, in severe cases, quite rough. This dull rough surface is said to be due to orange peel effect. Such a surface will show through paint or chrome plating and harm the appearance. Expensive polishing or buffing could be used. Other alternatives would be to use metal having smaller grain size or metal cold worked to the quarter or half-hard temper. Large grain size means more orange peel effect.

*Earing:*

When sheet metal is rolled at the mill, fiber structure is formed in the direction of rolling. The fibers are actually rolled out impurities. The sheet metal is therefore stronger and has greater elongation with the

![FIG 4.34 DRAWING DEFECTS](image-url)
direction of rolling. This non-uniform strength cause ears or lobes to occur, even though a circular blank is used. Earing becomes more severe when the sheet metal is cold worked to quarter hard or harder tempers. Usually, enough extra metal is left on the cup so that trimming removes the wavy edge.

**Scratching, scoring, and galling:**

Often the drawing compound fails to keep the blank from contacting die surface. This may be because the compound cannot resist the high pressure and is squeezed out. Or heat generated by cold working may cause the lubricant to become too thin. If the sheet metal actually contacts the die surface, heat is generated by the sliding action of drawing. Small particles of sheet metal become welded to the die, usually near the radius. These welded particles then scratch the next cup made, since they are high enough to penetrate most lubricants. More metal welds to the particles and large scale galling occur on the cup cylindrical wall as more cycles are made. Better or higher-pressure compounds will prevent such marking. More water in the compound will acts as a coolant by evaporating. More frequent polishing of the die will prevent severe galling.

**Stretcher strains:**

After drawing the surface may have a patchwork of lines called stretcher strains or luder’s lines. If this lines crisscross, they may be called alligator skin. Such lines are caused by non-uniform yielding of the metal due to trapped gases within the metal. Stretcher strains at the start of the cup drawing are clearly visible in the flange area. Rim steels are responsible for this defect. The lines will disappear as drawing continues. Stretcher strains remain only in a metal where very slight deformation has occurred. Rim steel may be flex rolled to prevent the occurrence of stretcher strains. The effect returns after a day or so, and close scheduling is needed. The metal displaying stretcher strain is said to be age hardened.

**Burnish marks:** When the top the cylindrical cup wall is highly polished, the metal has been burnished or ignored. Larger clearance would eliminate this condition.

**Spring back:** When a cup is removed from the draw die, it springs open, making the inside diameter larger at the flange end. The cylindrical wall is slightly tapered. The characteristics are due to elastic spring back of the metal. This cause the cup to normally stick in the die steel, thus requiring a knock or ejection plate.

Many other marks or scratches may occur or cups due to handling. Some lubricant will leave strains. In any event, surface marks may cause more cup ejections in a production plant than tears or wrinkles.
### 21a)(i) Compare blanking with fine blanking

<table>
<thead>
<tr>
<th>S.NO</th>
<th>BLANKING</th>
<th>FINE BLANKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No V-ring is present</td>
<td>V ring is used to grip the blank firmly.</td>
</tr>
<tr>
<td>2</td>
<td>Clearance between punch and die is comparatively more</td>
<td>Clearance between punch and die is very less and is in microns</td>
</tr>
<tr>
<td>3</td>
<td>Normal blanked parts feature a smooth and a fractured cut surface.</td>
<td>Fine blanked parts features smooth cut surface only</td>
</tr>
<tr>
<td>4</td>
<td>The smooth area features the die-roll, while on the opposite side is the blanking burr.</td>
<td>Since the clearance is very less, there is no die roll</td>
</tr>
<tr>
<td>5</td>
<td>The flatness and dimensional tolerances of the standard blanked part are inferior.</td>
<td>Superior.</td>
</tr>
<tr>
<td>6</td>
<td>The die design is simple</td>
<td>Difficult</td>
</tr>
<tr>
<td>7</td>
<td>Margin and strip width are comparatively less</td>
<td>Due to the presence of V ring, Margin and strip width are comparatively more</td>
</tr>
<tr>
<td>8</td>
<td>Cost of the die is cheaper.</td>
<td>Higher.</td>
</tr>
<tr>
<td>9</td>
<td>Less accurate</td>
<td>Accuracy is more</td>
</tr>
<tr>
<td>10</td>
<td>Production rate is less.</td>
<td>Production rate is more</td>
</tr>
</tbody>
</table>
21a) (ii) give the advantages and applications of advanced multistage tooling

Advantages
Time saving
Productivity increases.
Tooling cost reduces.
Lead time is reduced.

Applications
Modern high speed, multi-ram, multi station presses accommodates sophisticated progressive tools, which combine cutting, forming, and drawing operation in a single multistage versatile progressive tool.

21b) discuss the factors affecting the tool service life.

ELEMENTS OF TOOL PERFORMANCE:
The determining factors may be classified broadly into four groups, depending on:

1) The stamping
2) The tool
3) The press
4) The operation

Press selection:
- Every C-Frame press at the instant of cutting impact, deflects somewhat, misaligning the punch a little.
- If the press capacity is very high with respect to the force required by the cutting action of the die then the press deflections is very small, almost insignificant, and no harm is done.
- On the other hand if the deflections is too pronounced, then the misalignment becomes too great so that uneven wear is produced, and in extreme cases even damage to the cutting edges occurs.
- Wherever feasible, a much larger press must be selected than necessary in order to prevent undue press frame deflections.
- If there is a possibility of choosing an OBI press and a straight side press, take the later one. It ensures longer tool life.

Cutting speed:
- The temperatures reached during high speed cutting processes do not impair the hardness of the cutting edges.
- High speed improves the conditions that prevent premature burr formation.

Die setting:

The craftsmanship, skill and care with which the die setter performs his job play an important role in tool performance. The proper setting of the tool in the press is of
utmost importance. If the alignment is not correct, excessive friction and lateral stresses are produced which cause premature wear of the tool member.

**Operation with the tool:**

The press shop contributes in several ways to tool performance. One of the first requirements consists of the periodic cleaning of the tool in order to avoid accumulation of dirt, chips, or foreign matter, which mix with the lubricant, act as abrasive and considerably increase tool wear.

The press operator is supposed to co-operative in the prolongation of the useful life of the tool by,

1. Avoiding any irregularities
2. Informing the Forman immediately when burr starts to become excessive.
3. Properly lubricating and cooling the metal to be stamped. The friction between the work piece and cutting member of the die is greatly reduced. Also the moving member of the tool must be properly lubricated.
4. Greasing the bushings and leader pins of the die sets, in order to avoiding galling.

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