GOVT. TOOL ROOM AND TRAINING CENTRE
KARNATAKA

REFERENCE NOTES

PRESS TOOL THEORY -I

FOR
: DIPLOMA IN TOOL AND DIE MAKING

INDEX

PRESS TOOL THEORY – I

Contact Hrs. /Week: 4 **Contact Hrs. / Semester: 64**

SPECIFIC INSTRUCTIONAL OBJECTIVES:

1. **INTRODUTION TO TOOLING.**
   - Introduction
   - Purpose, applications and advantages
   - Types

2. **TYPES OF PRESS TOOLS.**
   - Basic description of different types of press tools, their applications

3. **ELEMENTS OF A PRESS TOOL.**
   - Different parts of a press tool
   - Materials, functions and their importance

4. **THEORY OF SHEARING.**
   - Shearing action on metal
   - Plastic deformation
   - Penetration
   - Fracture

5. **CUTTING CLEARANCE.**
   - Necessity of clearance
   - Calculation of clearance
   - Effects of insufficient, sufficient and optimum clearance
   - Misalignment between punch and die
   - Land and angular clearance
   - Problems

6. **CUTTING FORCE.**
   - Calculation of cutting force
   - Methods of reducing the cutting force

7. **STRIP LAYOUT.**
   - Unit stock and stock strip
   - Types of strip layout

- Economic strip layout
- Problems

8. & 9PUNCH AND DIE.

- Introduction
- Basic requirement of a die
- Types of dies - solid and split type
- Types of punches
- Classification of punches
- Mounting of punches
- Materials for punches and dies
- Heat treatment methods
- Methods of manufacture of punch and die

10 STRIPPER.

- Functions
- Types and applications

11STOPPER.

- Functions
- Types and applications

12 PILOT.

- Functions
- Types and applications

13 CENTRE OF PRESSURE.

- Meaning
- Importance in design
- Calculation of COP by analytical and graphical methods

14 . DIE SETS.

- Elements of a die set
- Types of die sets
- Accuracy and manufacture
- Applications of different types

15. FITS.

- Importance of Fits in press tool.
- Fits between all the elements- Pillar/Bush, Pillar/Bottom plate, Bush/ Top Plate, punches/ plates, pilots/plates, pilots/pierced hole

16. PROGRESSIVE DIES.

- Introduction
- Pitch and pitch punch
- Advantages and disadvantages
- Classification
- Design considerations

17. COMPOUND DIES.

- Introduction
- Applications
- Construction
- Comparison with a progressive die

QUESTION BANK **143-153**

REFERANCE BOOKS:

1. Tool and die maker by Mahajan
2. Design fundamentals by Pacquin
3. Tool design by Donaldson
4. Tool engineering & design by G H Nagpal
5. Basic die design by Osterguard
6. Advanced die design by Osterguard

HISTORY

BRIEF HISTORY OF PRESS TOOLS

Sheet metal operations have been in existence since 8000 B.C. Sheet metal is simply metal formed into thin and flat pieces. It is one of the fundamental forms used in metalworking, and can be cut and bent into a variety of different shapes. Due to its long history, sheet metalworking is, unfortunately, often seen as archaic and uninteresting.

That metal sheets can be transformed with the aid of robust machines intendancy consumer products with tight tolerances is inconceivable to many. Yet, sheet metal operations are used for producing both structural components and durable consumer goods. Nowadays, sheet metal parts are widely present in different daily life products. During the past decades, scientific research in the field of sheet metal operations has been booming and international conferences on different sheet metal topics attract numerous attendants. Both industry and the academic community recognize the importance of continuing improvement in sheet metal operations. Application Sheet and plate metal parts for consumer and industrial products such as: Automobiles and trucks, Airplanes, Railway cars and locomotives, Farm and construction equipment, Small and large appliances, Office furniture & Computers and office equipment. Advantages High strength, Good dimensional accuracy, Good surface finish, relatively low cost, for large quantities, economical mass production operations are available.

The most common end uses for sheet metal have been electronic enclosures, such as personal computer housings or casings; roofing and roof drainage equipment; air conditioning ducts and stovepipes; sheet metal flooring and siding; awnings, canopies, cornices, and soffits; culverts, flumes, and irrigation pipes; and other or unspecified uses. These categories cover a myriad of products used by every industry, including aircraft manufacture (air cowls); building construction (siding, stove hoods, and gutters); heating, ventilation, and air conditioning (HVAC) applications (ducts, furnace flues); mineral processing (coal chutes); highway construction (guardrails); agriculture (irrigation pipes); business machines (computer casings); shipbuilding (ship ventilators); postal delivery (mailboxes); and food preparation (vats and bins). Market Survey According to industry statistics from Dun and Bradstreet, there were an estimated 5,917 establishments engaged in manufacturing sheet metal work for buildings (not including fabrication work done by construction contractors at the place of construction) in 2010 with revenues of more than $10.7 billion employing 115,83,800 workers. States with the highest concentration of establishments in these Sheet metal product sales are expected to account for 51.3% of industry revenue in 2012. Sheet metal products are used in virtually all phases of building construction and have many uses in improvements and repairs for existing structures. Sheet metal is used to install and maintain heating, ventilation and air-conditioning duct systems; roofs; siding; rain gutters; downspouts; and skylights. Some products manufactured in this segment include awnings, canopies, casings, chutes, ducts, furnace casings, gutters and ventilators Sheet metal demand is forecast to cross $20 billion by 2017, following annual gains of over five percent from 2011. Cost Estimation Capacity: 900 MT/ Annum Mild Steel Sheet Products: 600 MT/ Annum MS Scraps: 300 MT/Annum

Unit 1: INTRODUCTION TO PRESS TOOLS

Most of the industries products are produced in mass. The idea of producing products in mass is mainly to meet the requirement of the consumer, to maintain consistent quality and to make the product cost effective.

Press tool are one of the devices, which are going to meet the entire above mentioned requirement all most all products like television, tape recorder, radio, refrigerator, car, watch etc. consists number of components made of either plastic or sheet metal. Press tool are used to produce the sheet metal components.

PRESS TOOLS:

Press tool is a device in which the sheet metal components are produced in large volume with stipulated time, when this is used in a press these press tools are develop to increases the productivity of the components both by quality and quantity. Press tools are special tools custom built to produce a component mainly out of sheet metal. Press tool is of stampings including cutting operations (shearing, blanking, piercing, etc.) non-cutting operations (bending, drawing, etc.) & hybrid operations. (Both cutting & non-cutting)

ADVANTAGES

Sheet metal items such as automobile parts, mobile parts, components of aircrafts, computer components, parts of business machines, household appliances, sheet metal parts of electronic equipment's, even medical & surgical components etc., precision parts required for homological industry etc. are manufactured by press tools.

1. Mass production –Press tool are used to produce components in large scale
2. Components are Identical- all the components produced from a Press tools are similar.
3. Less component Cost- The components produced from a Press tools are lesser in cost.

4. Accuracy of components is high- The components produced from a Press tools will have good accuracy.

5. Less labor cost- The components can be produced from a Press tools by a semiskilled labor.

DISADVANTAGES

1.Tool design & manufacturing cost is more.

2.ToolMaintenance cost is high.

3. Raw material cost is high.

4. Highly skilled manpower is required to design & manufacturing of Tool.

The word tooling refers to the hardware necessary to produce a particular product. The most common classification of tooling is as follows:

DIFFERENT TYPES OF TOOLS

1. Sheet metal press working tools –Press tools

2. Moulds Tools for plastic molding and die-casting Tools for aluminum alloys.

3. Forging tools for hot and cold forging.

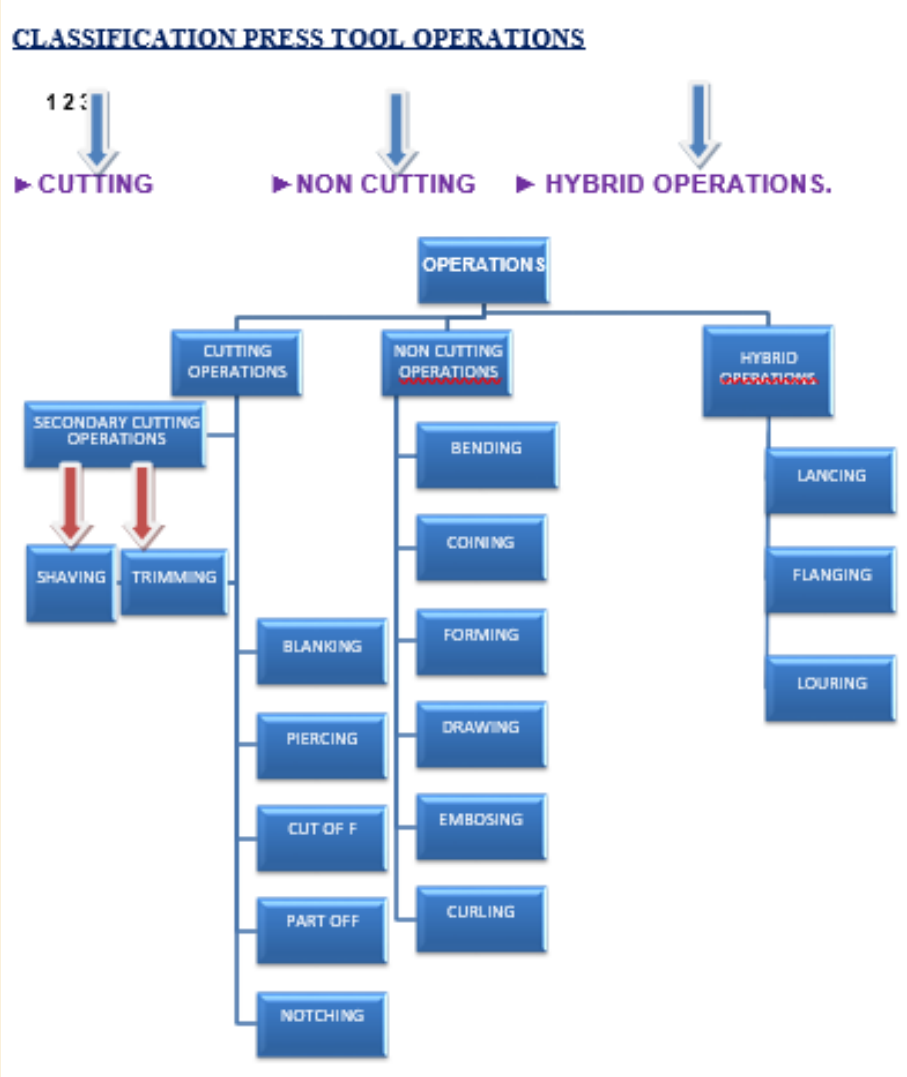
4. Jigs and fixtures for guiding the tool and holding the work piece.

5. Gauges and measuring instruments.
Cutting tools such as drills, reamers, milling cutters broaches, taps, etc.

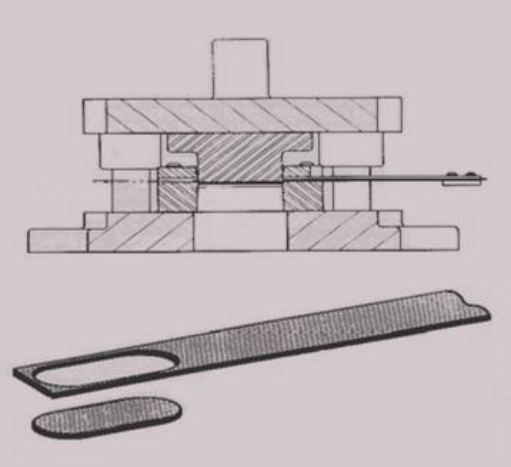
UNIT 1: PRESS TOOL OPERATIONS

PRESS TOOL OPERATIONS:

The press tool operations are classified as below depending on type of functions,



CUTTING OPERATIONS.

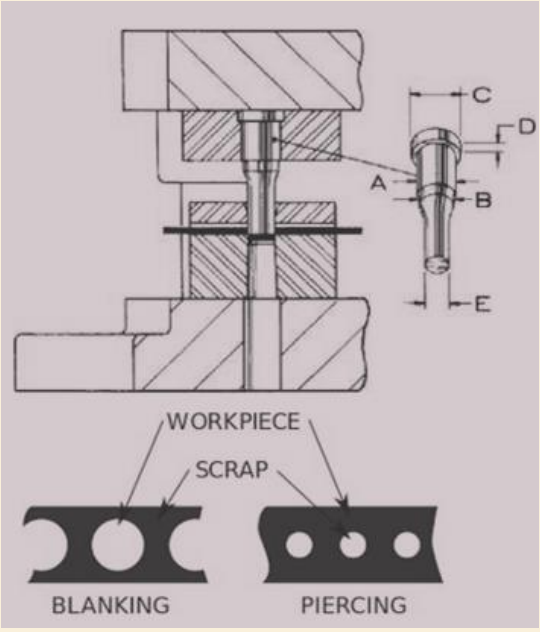


Blanking:

Blanking is a process of producing flat stampings. The entire periphery is cut and cut out piece is called the blank or a component, In blanking metal remained after cutting is called scrap or slug.

- When a component is produced with one single punch and die where the entire outer profile is cut in a single stroke the tool is called a blanking tool.
- Blanking is the operation of cutting flat shapes from sheet metal.
- The outer area of metal remaining after a blanking operation is generally discarded as waste.
- Size of blank or product is the size of the die & clearance is given on punch.
- It is a metal cutting operation.

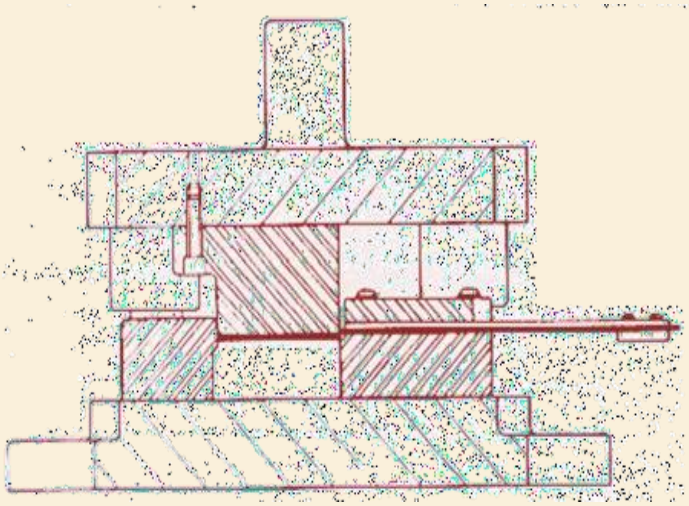
Piercing:

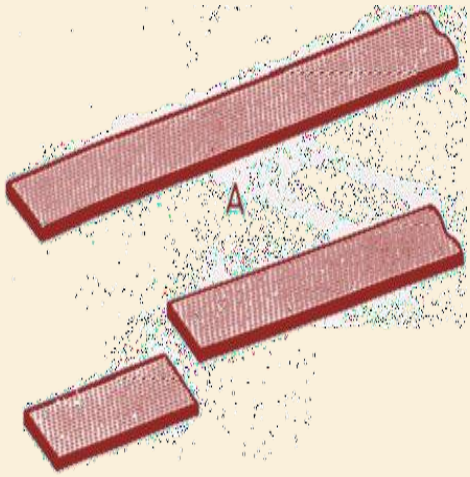


It is the operation of making hole in the stamping. Here also the entire Periphery is cut and cut piece is waste. This operation consists of simple hole punching from the components this is different from blanking here components becomes strip for piercing and the materials removed is called scarp or slug, piercing operation is most of the cases accompanied by a blanking operation either before, after are at the same time.

Cut - off:

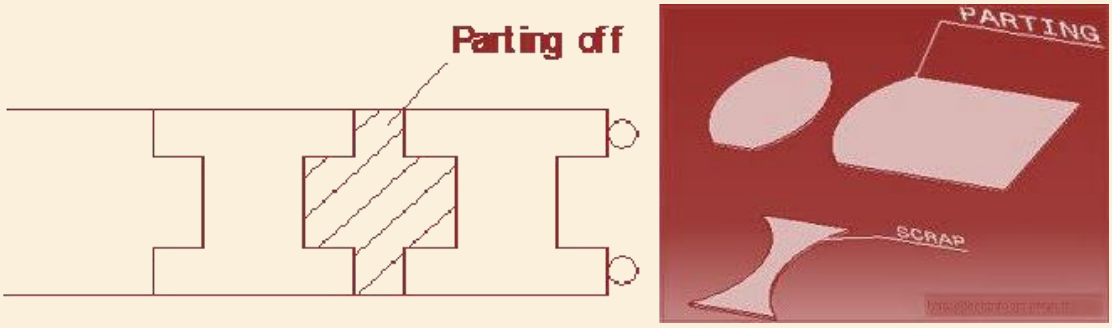
Cut off operation separates the work material along a straight line in a single cut. No scrap is produced in cutting off operation. The process of cutting off is similar to shearing in a shearing machine.cutting off or cut off operation separates the work materials from the strip along a straight axis in a single line cut in this operation utilization of strip is 100%.





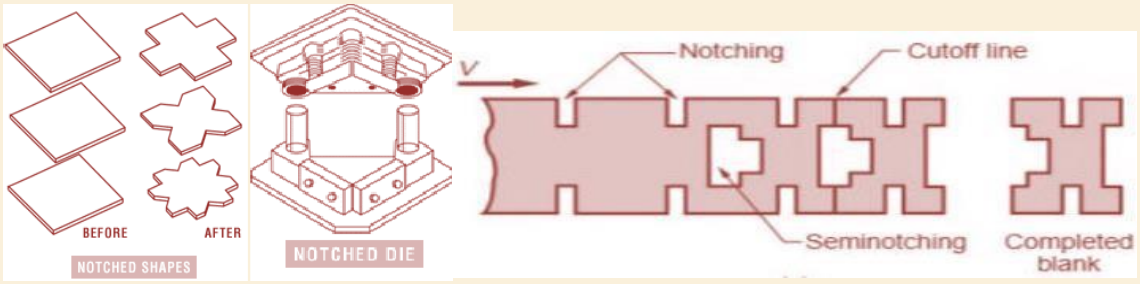
Parting - off:

The parting off operation separates the work material along a straight line in a double line cut. The piece, which is removed by the punch, is a scrap. In this operation part will be separated from the main strip by double line cutting it produces scrap also therefore, it is not economic as cutting off operation, but the accuracy of the component is more compare to cutting off some times this operation is also adopted in a progressive tool to separate the component in a final stage.



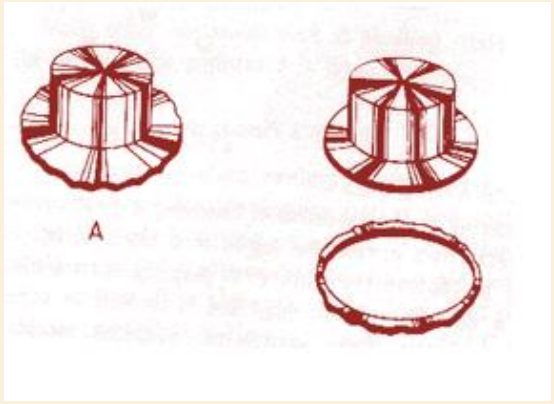
Notching:

This operation removes the metal from either one or both the edges of the strip, notching serves to shapes the out contours of the work piece in a progressive die or to remove excess metal before drawing or forming operation in a progressive die.



Trimming:

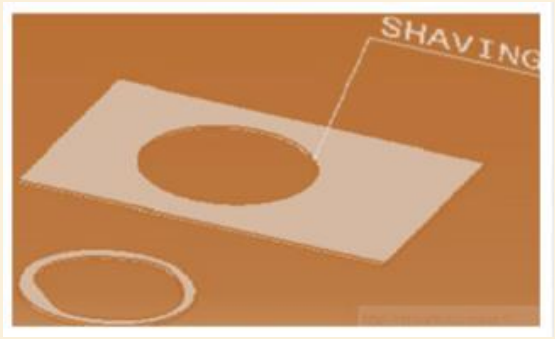
It is the operation of cutting the edges of the drawn components, which are wavy and irregular. When cups and shells are drawn from flat sheet metal the edge is left wavy and irregular, due to uneven flow of metal. Shown is flanged shell, as well as the trimmed ring removed from around the edge.



While a small amount of Material is removed from the side of a component in trimming tool.

A -- COMPONENT BEFORE TRIMMING

B -- COMPONENT AFTER TRIMMING

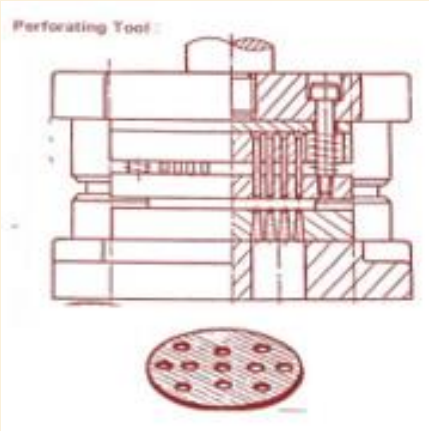


Shaving:

It is operation of removing a chip from around the edges of a previously blanked stampings to get finished edges and accurate dimensions. Shaving is a secondary operation usually done to finish the previously pierced or blanked profiles to accurate dimension, the excess metal is removed in the form of small chips of metal cutting tool, there is very less or no clearance(zero) is provided between punch and die, this operation is used to produced precession components.

Perforating:

If more number of holes are pierced, it is called perforating.

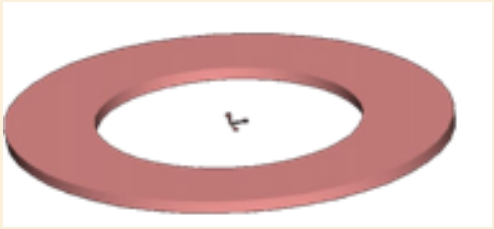


Lancing:

It is a combination of bending and cutting operation along a line in the work material. No metal is cut free during lancing operation.

Dinking:

To cut paper, leather, cloth, rubber and other soft materials a dinking tool is used. The cutting edges penetrate the material and cut (like knives).

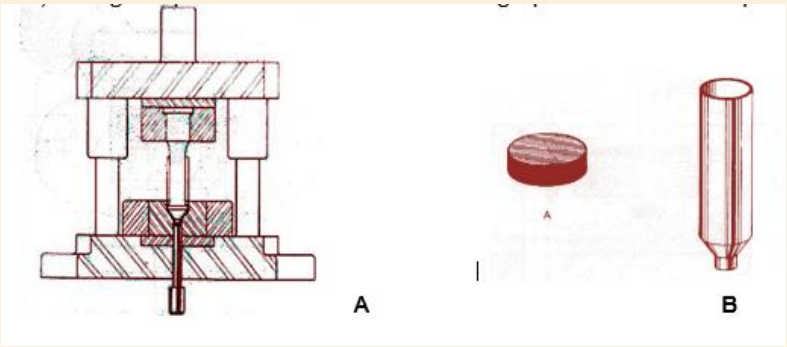


Broaching:

It is similar to shaving operation; in this a tool having a series teeth profile removes metal from the edges of the blanked component.

Extrusion:

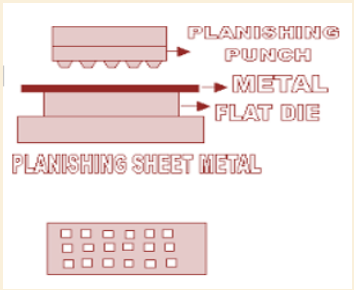
This is a special process to manufacture collapsible tubes, shells etc. The blank, which is loaded in the die, is forged upward or downward under high pressure between punch and die.



A-COMPONENT BEFORE EXTRUSION **B- COMPONENT AFTER EXTRUSION**

Planishing:

Planishing tool is used to straighten, blanked components. Very fine serration points penetrate all around the surface of the component.



Embossing:

The embossing tool is used to press letters and numbers into a sheet metal or on pre drawn piece part or stampings. Usually the punch will have the raised form and the die will have the corresponding cavity.

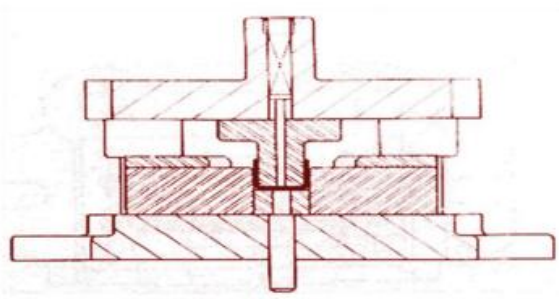
Coining:

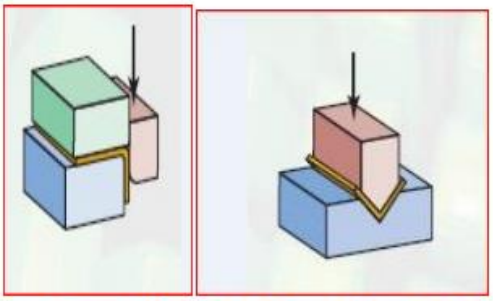
It is the process of pressing cold material in a tool so that it flows into the engraved profiles on the die face. Coining differs from embossing such that in coining the metal flows, where as in embossing the metal does not change in thickness to a great extent.

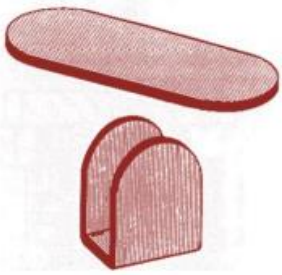
- Similar to embossing with the difference that similar or different impressions are obtained on both the sides of the sheet metal.

Bending:

It is the shaping the material around a straight axis, which extends completely across the material. The result is a plane surface at an angle to the original plane of the flat blanked component.



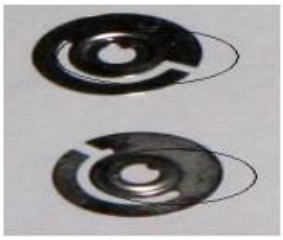


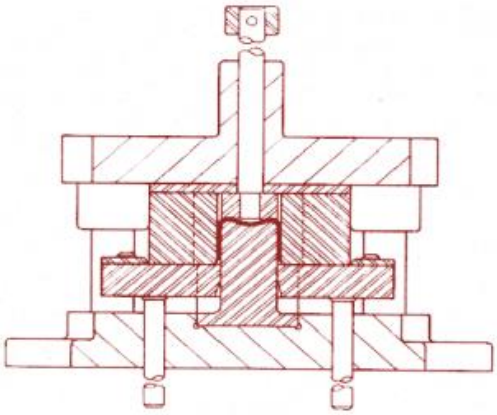


L-BendingV-BendingU-Bending

Forming:

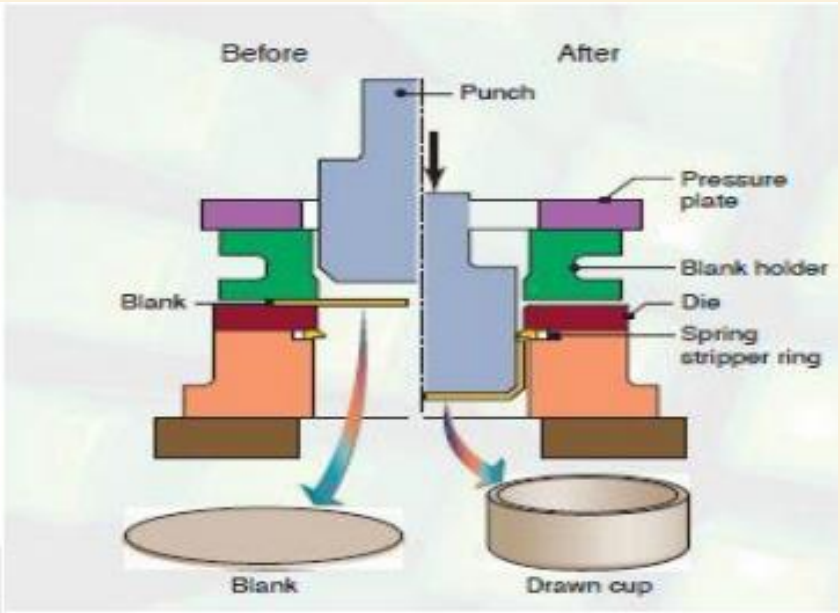
It is similar to bending except that the line of bend is along a curved axis instead of a straight one. Metal flow is not uniform. It will be localized depending upon the shape of the work piece.

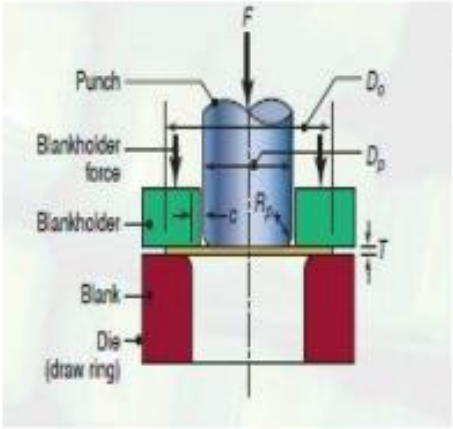




Drawing:

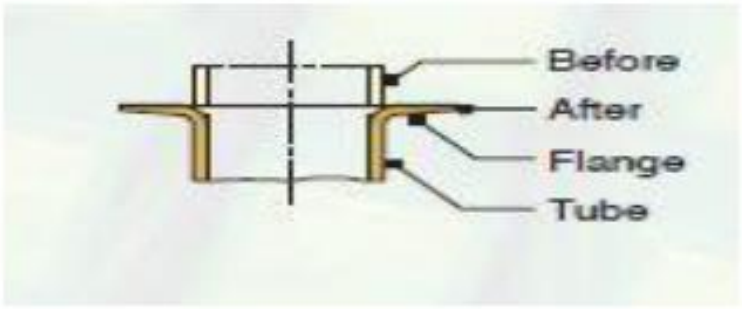
In drawing a flat blank is transformed into a cup or shell. The parent metal is subjected to severe plastic deformation. Shell forms produced may be cylindrical or rectangular with straight or tapered sides.





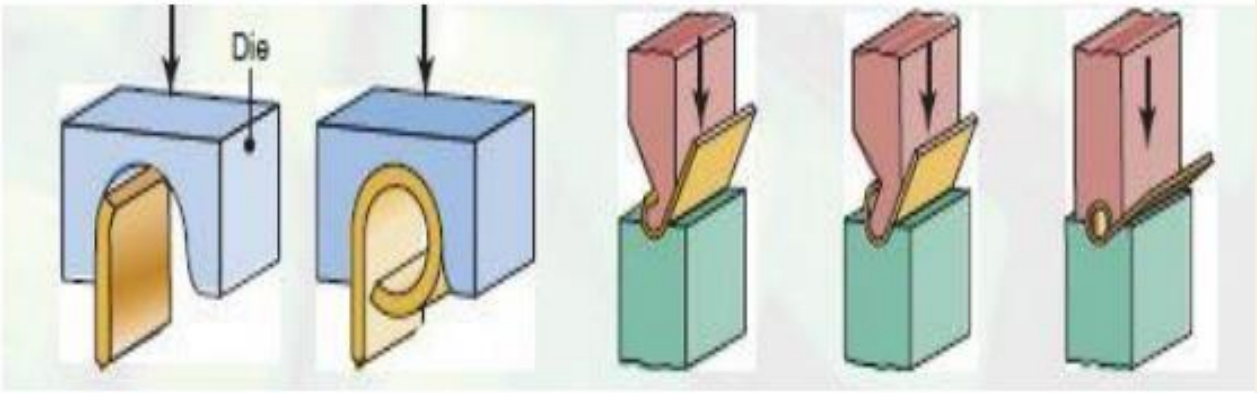
Flanging or Flaring or lugging:

The process of forming an outward flange on parts is called flaring operation. This provides toform the threads or locking option for component assembly



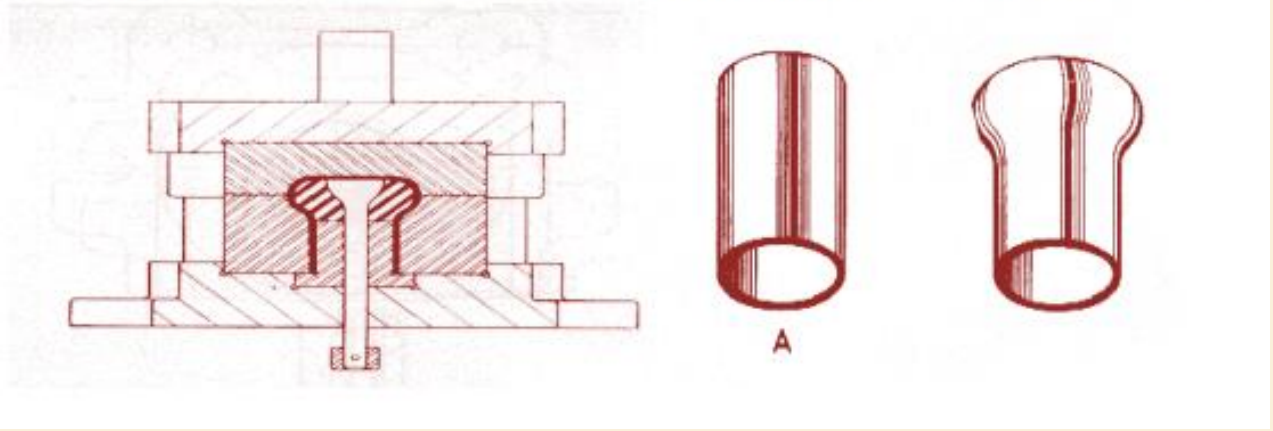
Curling

It is an operation of rolling the edges of a sheet metal into a curl or roll. It improves the appearance of the piece part. It is also increase strength of the component edges.



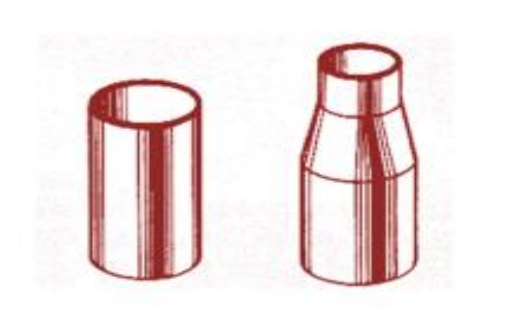
Bulging:

It is an internal forming operation used to expand portions of a drawn shell or tube. The forming force is applied from inside the work piece and is transmitted through a medium that will flow but will not get compressed. The more common media are rubber, urethane, oil, or water.



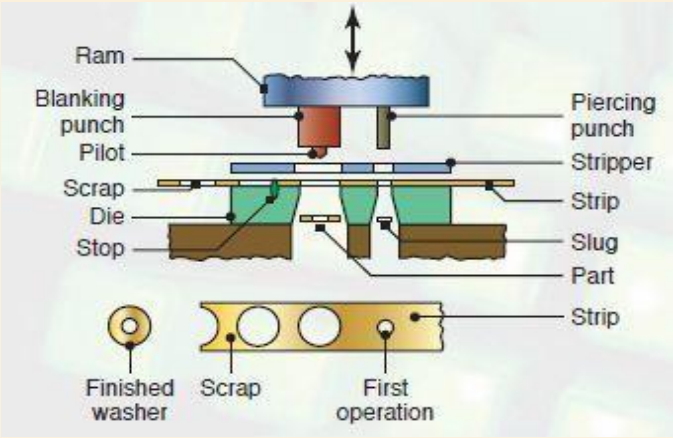
Swaging:

The operation of swaging sometimes called necking is exactly the opposite of bulging. When a work piece is swaged a portion is reduced in size and this causes the part to become longer than it was before swaging.



PROGRESSIVE TOOL:

In a progressive tool strip is moved in stages from station to station, different operations both cutting & non-cutting like piercing, notching, coining, lancing, blanking, bending etc. are performed on it at each station except idle stage. A complete strip is removed to the final stage for getting a finished Component.

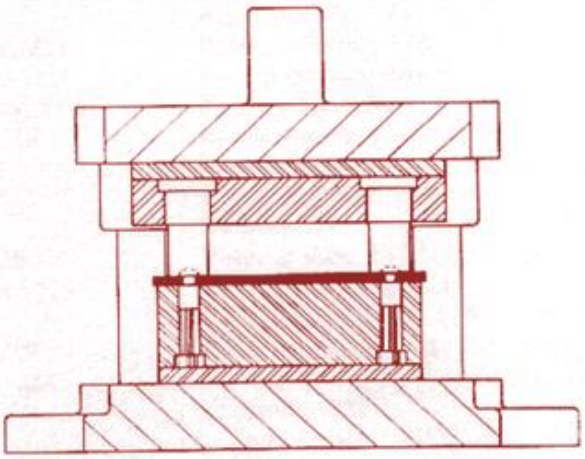


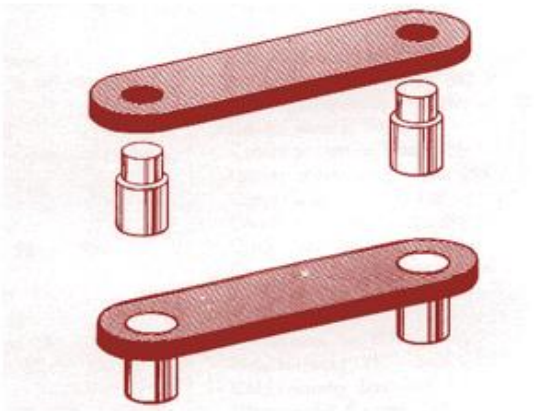
Compound Tool

A common characteristic of compound dies is the inverted construction. The blanking die is on the upper die shoe and blanking punching on the lower half. The pierced slugs pass through the lower die shoe. In the Compound Tool only cutting operations are done, in this tool **2 or more cutting operations** are done in a **SINGLE STAGE (Station)**for getting a finished Component. A strip will not be moved to stage by stage for getting a finished Component as the component produced in single stage.

Assembly tool:

Assembly tool assemble two or more parts together by press fittings, riveting or other means. Components are assembled in very short time and the relationship between parts can be maintained closely.





Side cam tool: Side cam transforms vertical motion from the press ram into horizontal or angular motion in the tool

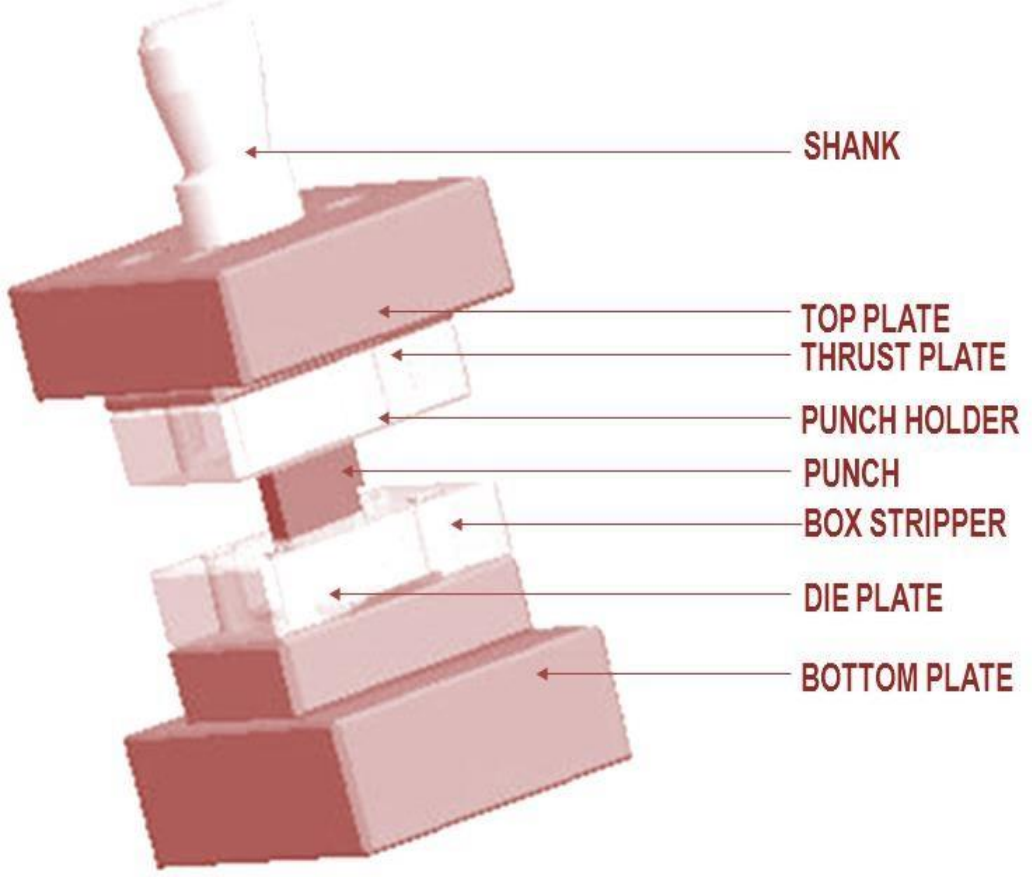
Horning: Horn tools are provided with an arbor or horn over which parts are placed for secondary operations.

Combination tool: In combination tool two or more operations such as forming, drawing, extruding, embossing may be combined on the component with various cutting operations like blanking, piercing, broaching and cut off in the single stage (STATION)

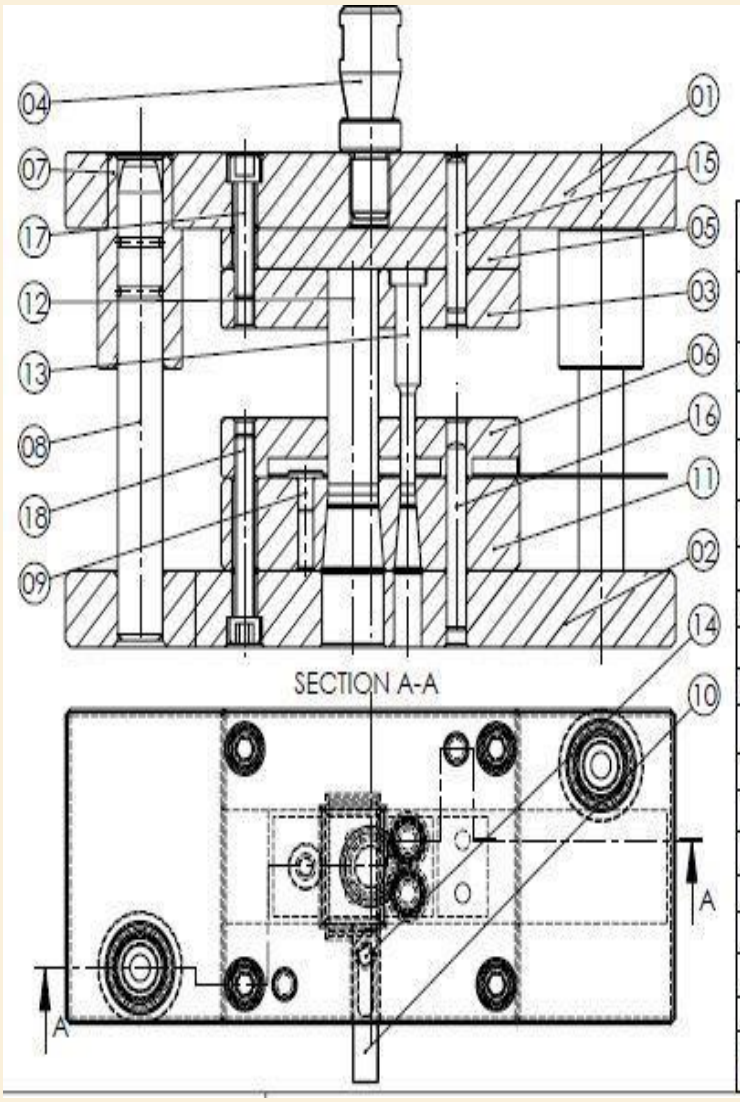
UNIT 3: ELEMENTS OF PRESS TOOL

ELEMENTS OF PRESS TOOL

Press tool is an assembly of different parts to produce sheets metal components rapidly or in mass, different elements (parts) of press tool are mentioned below.



ELEMENTS OF PRESS TOOL



PART NO	DESCRIPTION	MATERIAL	RAW.MAT.SIZE	QTY.	REMARKS
18	ALLEN SCREW	STD	M8X1.25 55 MM Lenght	4	
17	ALLEN SCREW	STD	M8X1.25 35 MM Lenght	4	
16	DOWEL PIN	STD	⌀8h7X55 MM	2	
15	DOWEL PIN	STD	⌀8h7X45 MM	2	
14	DOWEL PIN	STD	⌀6h7X12 MM	1	
13	PIERCING PUNCH	HCHCR	⌀20X70	2	60-62 HRC
12	BLANKING PUNCH	HCHCR	25X50X70	1	60-62 HRC
11	DIE	HCHCR	30X100X125	1	60-62 HRC
10	FINGER STOPER	OHNS	10X15X50	1	50-54 HRC
09	END STOPER	OHNS	⌀20X16	1	50-54 HRC
08	GUIDE PILLER	CHS	⌀25X150	2	54-56 HRC
07	GUIDE BUSH	OHNS	⌀40X70	2	56-58 HRC
06	STRIPPER PLATE	OHNS	20X100X125	1	50-54 HRC
05	PUNCH BACK PLATE	OHNS	16X100X125	1	50-54 HRC
04	SHANK	ST-42	⌀30X70	1	
03	PUNCH HOLDER	ST-42	20X100X125	1	
02	BOTTOM PLATE	ST-42	25X100X250	1	
01	TOP PLATE	ST-42	25X100X250	1	

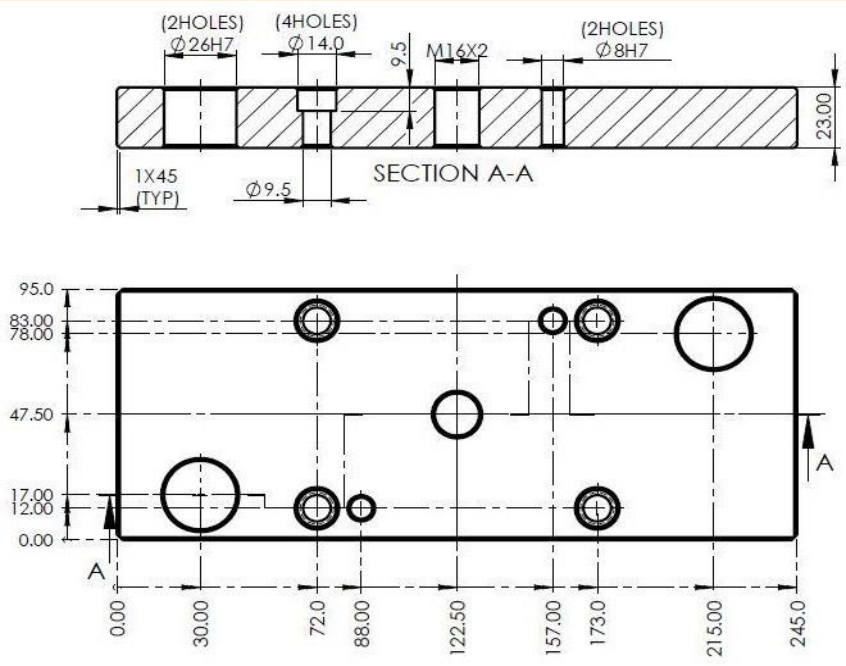
ASSEMBLY OF A PROGRESSIVE PRESS TOOL

MATERIALS USED IN PRESS TOOLS

MATERIALS USED IN PRESS TOOLS

SL NO	MATERIAL	IS CODE	COMPOSITION in %						APPLICATIONS	REMARKS
			C	Cr	Mn	W	Mo	V		
01	MILD STEEL— (MS)	St 42	TENSILE STRENGTH 42 Kg/mm2						SHANK, TOP PLATE, BOTTOM PLATE, FIXED STRIPPER PLATE, STRIP SUPPORT PLATE	
02	HIGH CARBON HIGH CHROMIUM STEEL---(HCHCr)	T215Cr12W90	2.15	12	-	0.9	1	1	CUTTING PUNCHS & DIES	60—62 HRC
03	OIL HARDEND NON SHRINKING STEEL-----(OHNS)	T110W2Cr1	1.1	1	-	2	-	-	NON CUTTING PUNCHES & DIES, ALL BACK PLATES, STOPPERS, SHEDDERS, PILOTS, EJECTORS, GUIDE PLATES	50-54 HRC
04	HIGH SPEED STEEL – (HSS)	T70 W18Cr4 V1	0.7	4	-	18	-	1	CUTTING PUNCHS & DIES FOR HIGH SPEED PRESS	60-64 HRC
05	CASE HARDEND STEEL— (CHS)	17Mn1Cr95	0.17	0.9	1	-	-	-	BACK PLATES, STRIP GUIDES STOPPERS, EJECTORS	CASE HARDEND UP TO 40--45 HRC
									GUIDE BUSHES& GUIDE PILLARS	CASE HARDEND UP TO 56--60 HRC

TOP PLATE

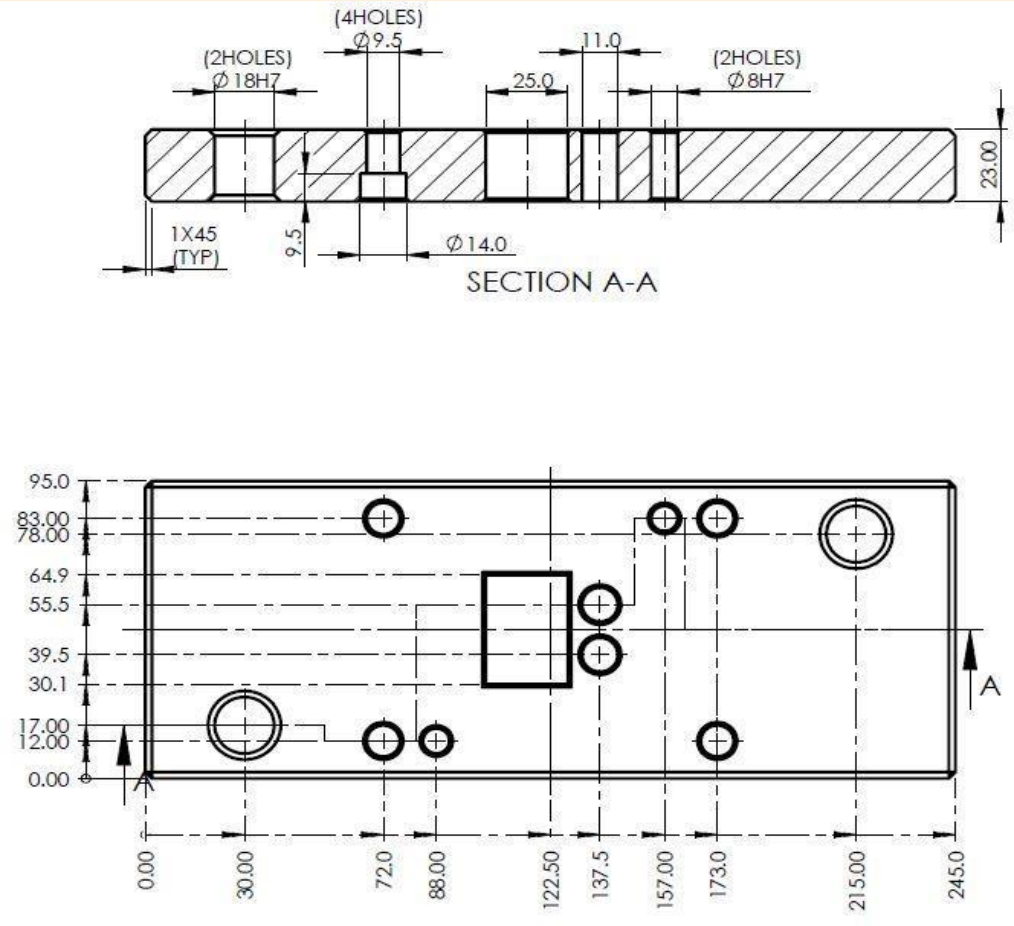


The assembly including the punch holder plate, punch back plate and punches are mounted on the **top plate**, the shank which locates the tool in the center of press ram is also screwed in the top plate. The top plate is made up of mild steel or cast iron. This plate should be thick enough to prevent bending. Top plate is a top most plate of a press tool used to hold the top of a punch unit contains punches, punch plate punch back plate etc., all these units are held together with the help of dowels and Allen screws, the main purpose of using dowels pins are for alignment of different parts, minimum two dowels are used for the alignment purpose both dowels are heavier different in diameter for fool proofing , Allen screws are used for the Purpose of clamping the parts, usually four Allen screws of same size are used number may be increased.

If the tool size is large, Allen screws is will be free in the top plate, punch back plate and in a punch plate with threads, counter bores are made in the top plate to positioned the

counter head of Allen screws. The size of the top plate is (L x B) depending upon number of operation or number of stages. In a particular press tool the material is soft (St42), no hardening is required. Top plate provides accommodation for guide bushes also, the bushes generally fitted by H7/h6 fit in the top plates.

BOTTOM PLATE



Bottom plate is a bottom part of press tool it is fixed to the die unit it is also called as base plate it holds the entire die elements like die, stripper plate, guide plates etc. generally two dowels pins of different sizes located diagonally opposite in the plate and four Allen screws are used to hold the die, Allen screws increases for the larger die unit in bottom plate profiles are made free to freely fall up slugs and components it has 2or4 holes to fix guide pillars by H7/g6 fit.

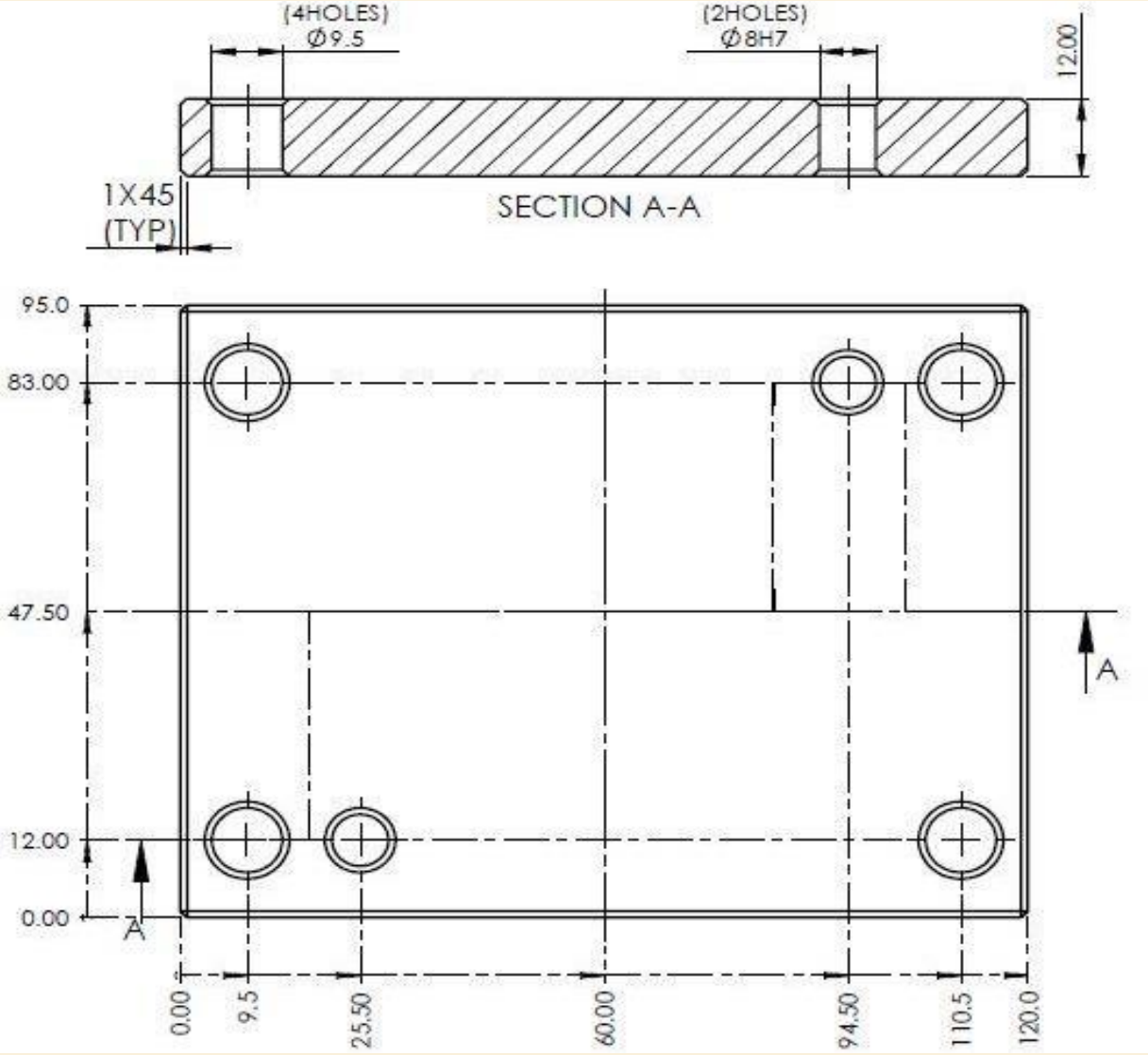
This gives a constraining effect to the die as well as provide enough room for the tool to be clamped to the press bed. The opening in the base plate allows the blank or slug to fall free off the tool, they

should meet the following requirements

- The opening should not weaken the support of the die.
- The blank should fall clear off the die without any abstraction.
- The contour of the opening should be made as simple as possible.

The opening should not weaken the die plate.

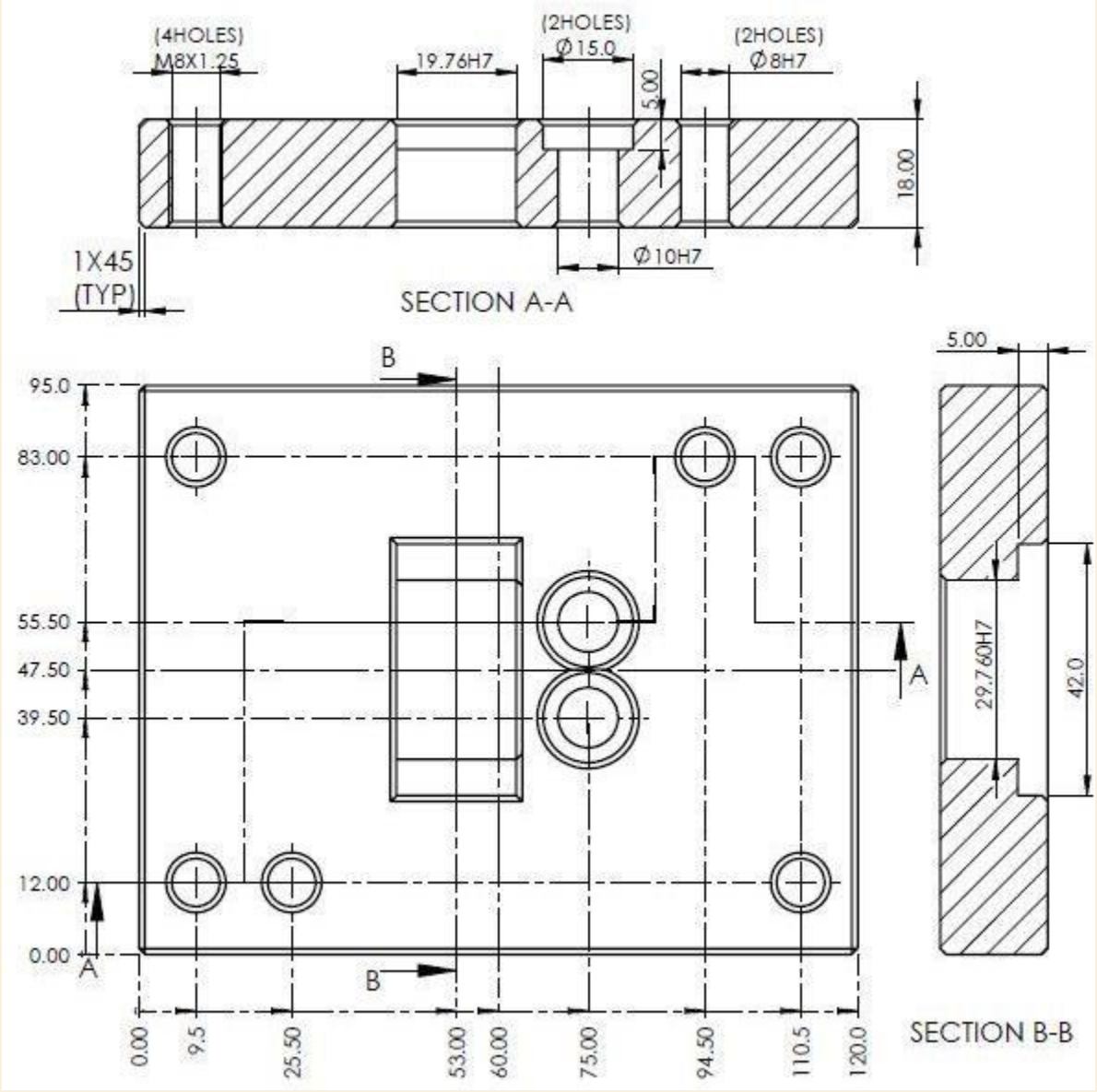
PUNCH BACK PLATE



Punch back plate is provided at the top of the punch plate (Back plate) to avoid the impression of the punches on the top plate it is a hardened plate having thickness of 8to12mm, the punch while performing

the cutting operation the punches will exert upper thrust, so the punches should be backed up by hardened plate to prevent it from digging in the soft top plate. Punch back plate is made up of case hardened steel IS Code 17Mn1Cr95 hardness up to 40-45HRC or it is made up of OHNSIS CodeT110W2Cr1 hardness up to 50-52HRC

PUNCH HOLDER PLATE

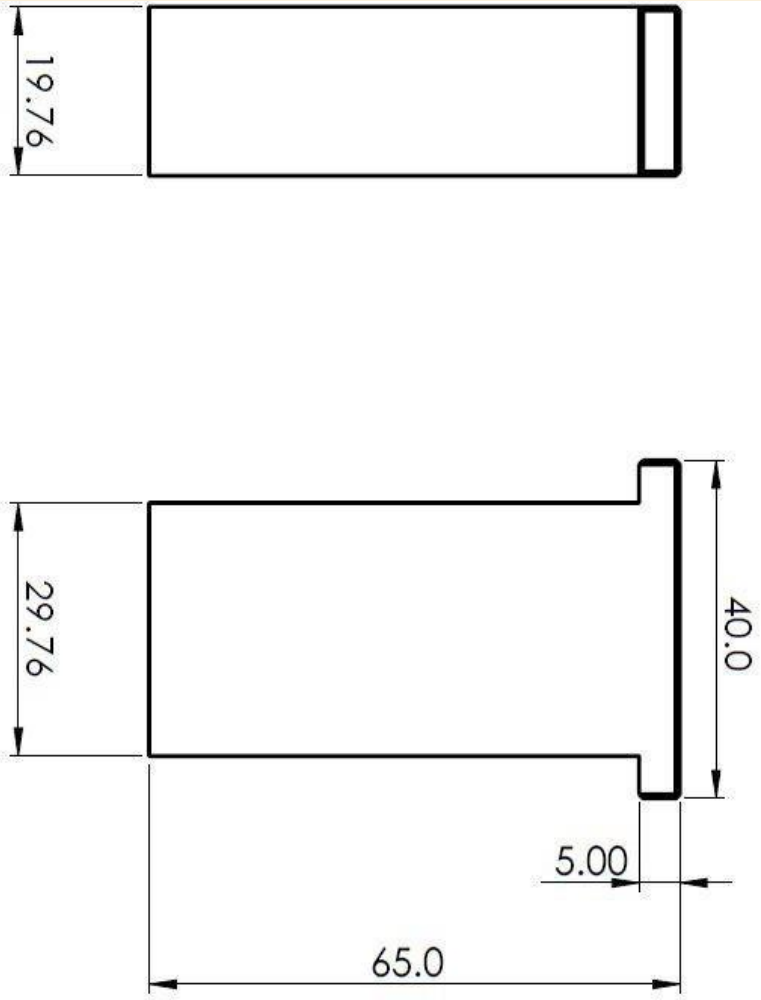


Punch plates are to hold punches to the right position to have a proper relation of a die the

profiles are made in the punch plate to fix the punches according to the design of the different punches. the material of a punch plate is Mild steel IS Code St42.

The punches are usually fixed by light press fit in the punch holder H7/k6 some means to prevent the profile punches should be provided in the punch holder plate hence it is made up of st-42 material.

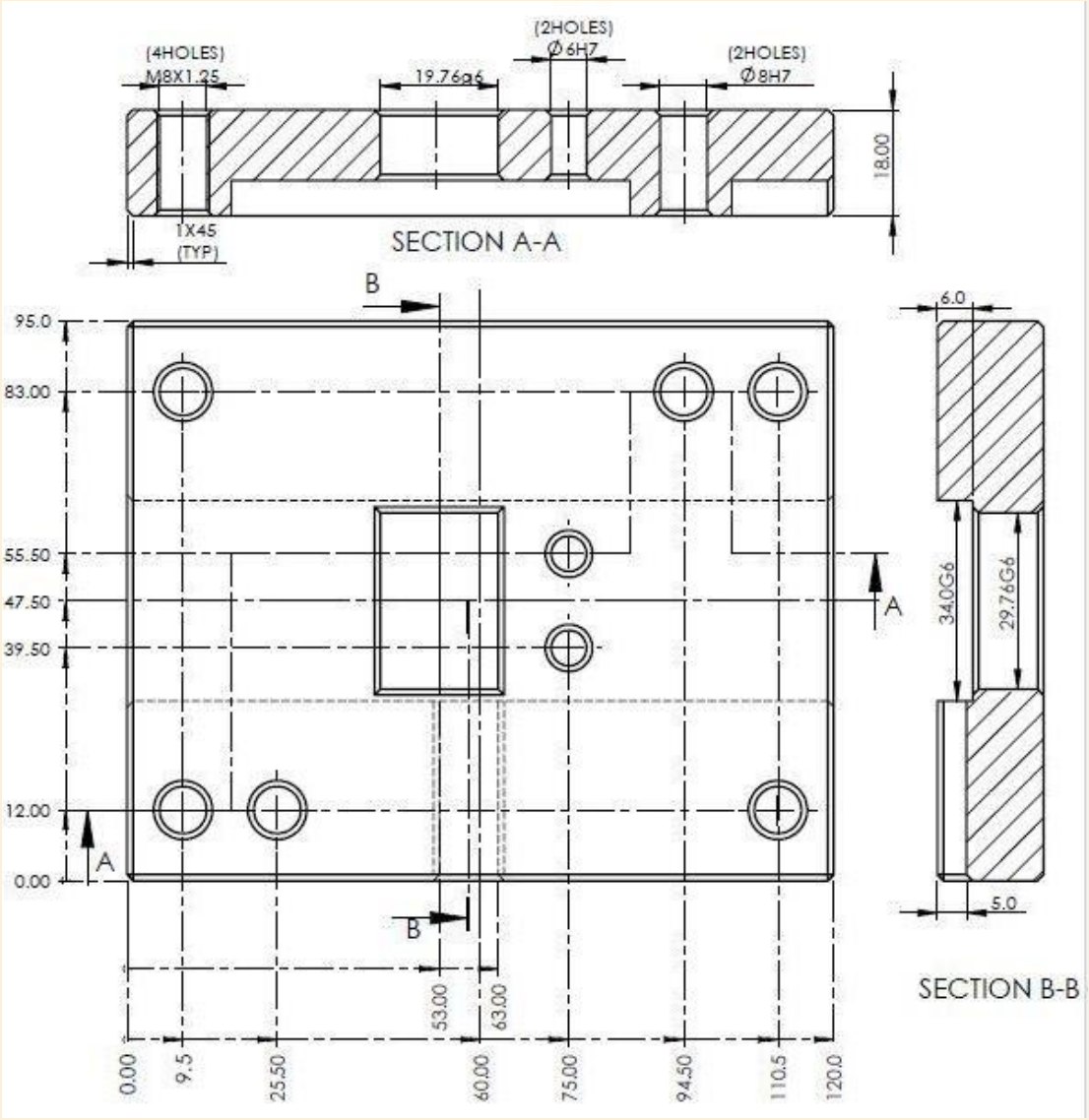
PUNCH



The basic elements of press tool are punch they are made up of good quality of alloy steel or HCHCr.IS Code T215Cr12, punches are hardened up to 60-62 HRC. The punch is generally termed as male element

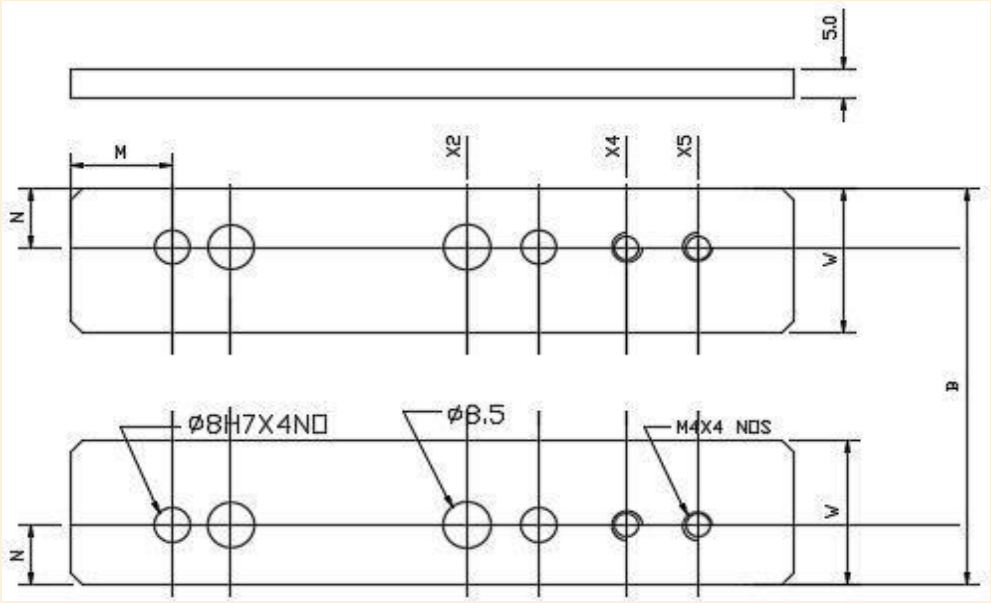
of the press tool and clamped at the top half of the tool, punch is a important element of the press tool. On cutting punches are made up of OHNS, IS Code T110W2Cr95 and hardened up to 50-56 HRC.

STRIPPER PLATE



While performing the cutting operations the punch penetrating the stock material and enters into the die before it should be guided by means of stripper, as a result of this blank or slug is punched into the die on completion with draws from the die but the stock material sticks tightly around the punch the strip cannot be moved forward unless the punch to facilitate the removal of the strip from the punch another plate is mounted on the top of the die with the help of screws and dowels this plate does not allow the strip to move with punch. this strips out or removes the stock material which sticks tightly around the punch and so it is called stripper plate. Stripper plate is made up of St42 material and kept soft for fixed strippers, and OHNS for floating stripper and hardened up to 50-52 HRC.

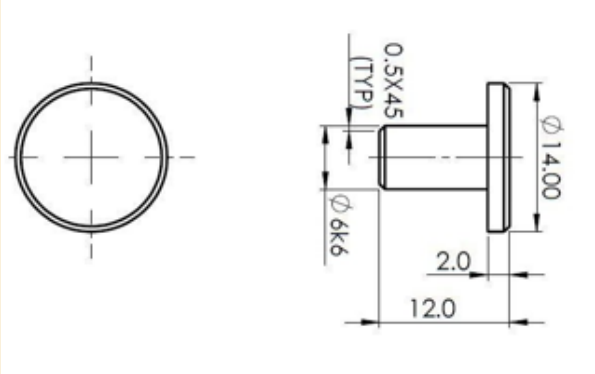
STRIP GUIDE PLATE.



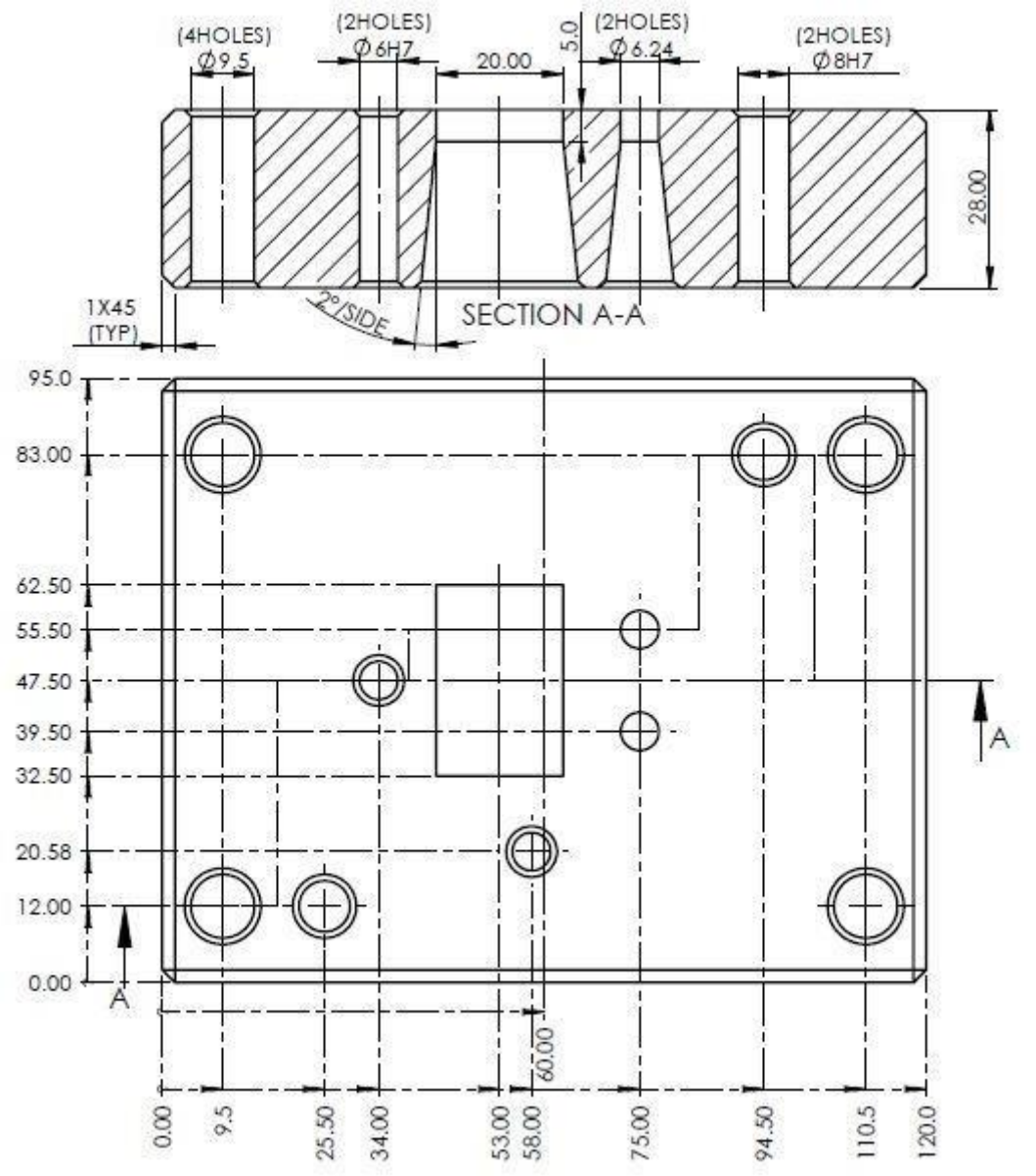
Strip guide are used to guide the strip for different operations for different stages in a tool, strip guides are fitted in between the stripper plate above the die plate it is fitted in bottom half of the press tool. Strip guides make a way to strip movement. Strip guides are made up of case hardening steel and hardened up to 40-45HRC.

End Stopper:

End Stoppers are stopping agents for the strips in press tools, they are fitted on the die plate to stop the strip feeding at required position for the operations to perform on the strip. They are mounted on holes provided for the end stopper away from the opening. The end stoppers are made up of OHNS hardened up to 50-54HRC

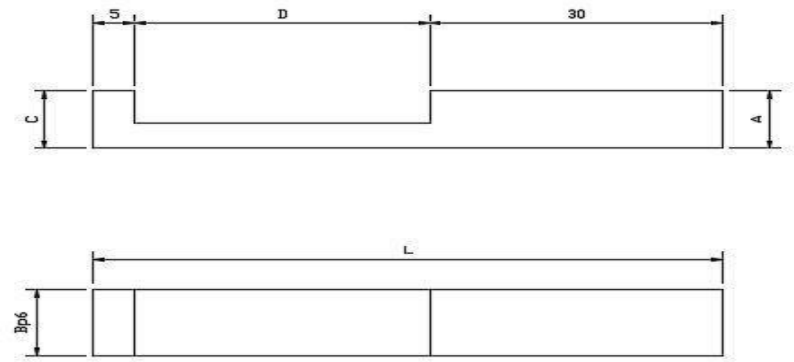


DIE PLATE



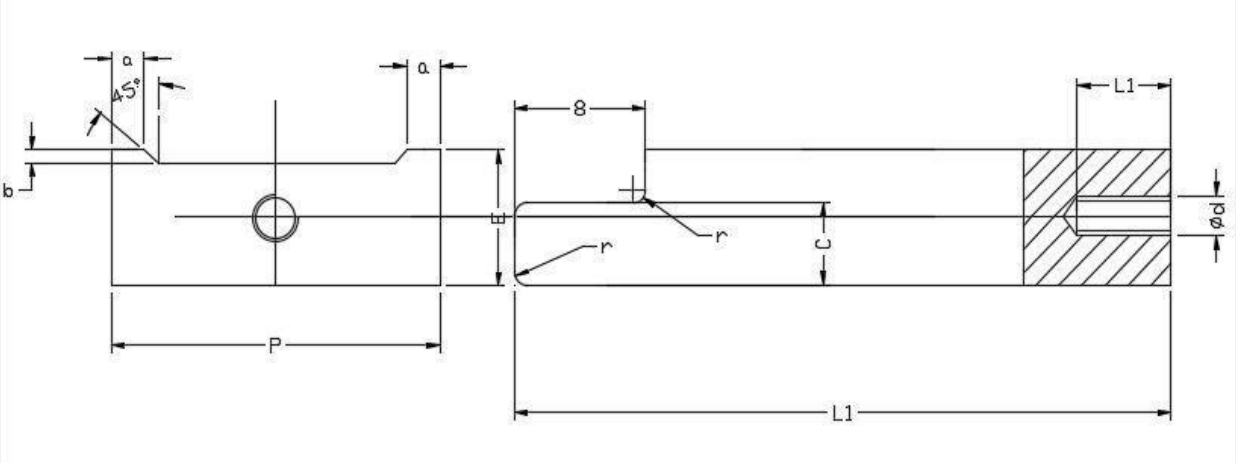
The basic element of the press tool is die plate; they are made up of good quality alloy steel or HCHCr. they are hardened to 60-62 HRC. The die is generally termed as female elements of the press tool and clamped at the bottom half of press tool using screws and dowels. The profile required for the components are machined on the Die, the accuracy of the component depends on the manufacturing of die. The die plate plays important role in press tool for getting/manufacturing the required component

STAGE STOPPER



STAGE STOPPER is also called as finger stopper in progressive tools for manual feeding finger stops locate the strip for each station except for final station. It is made up of OHNS (IS CODE-) T110 W2 Cr1 material with 50-54HRC.

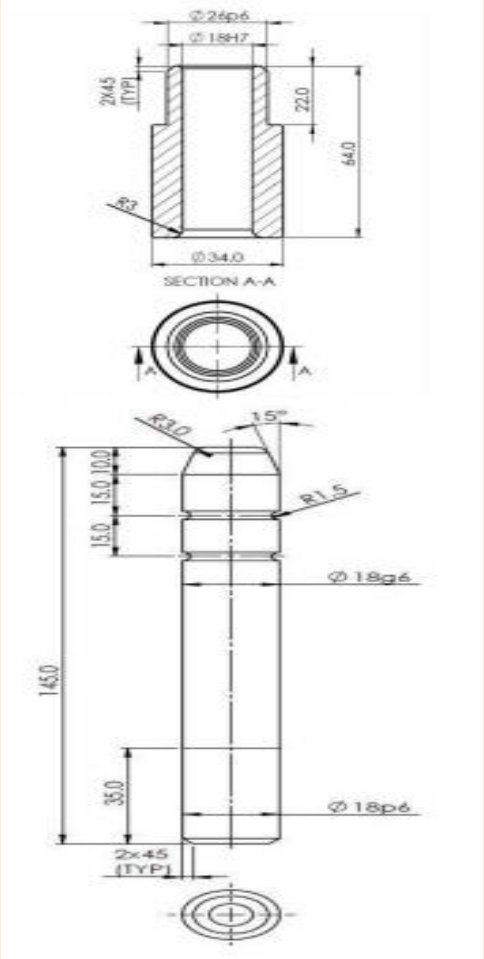
PITCH PUNCH (END NOTCHING PUNCH)



Pitch punches wear against cut off strip edges these are also known as notching stops. At a pitch punch cuts the strip to the exact width desired and to a length equal to the ONE feed distance or pitch punch

length is slightly greater than the feed advance so that no scrap can remain. These are made up of HCHCr with hardness up to 60-62HRC.

GUIDE BUSH & GUIDE PILLAR.



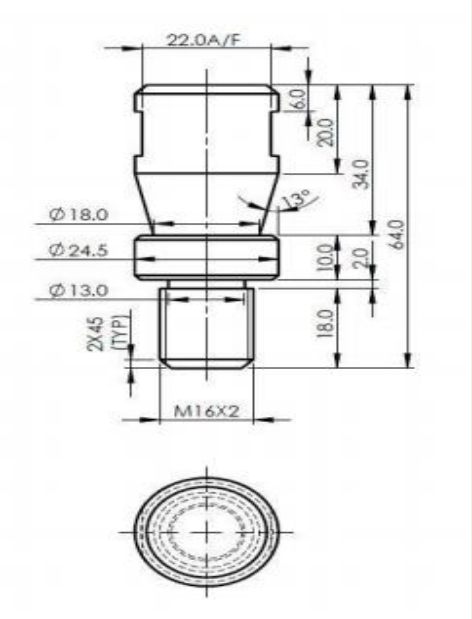
GUIDE BUSH

These are mounted on the top plate which provides smooth sliding contacts between pillars and top half. They are made up of 17mn1Cr95 material with 56-58 HRC. The containing surface of pillars and guide bushes have H7/h6 precession sliding fit whereas the fitted portion of the bush with top plate have H7/h6 tolerance.

GUIDE PILLAR

These are cylindrical pins known as Guide pins or Guide pillars these provides **0 means** of alignment to die sets they are made up of 17mn1Cr95 material with 58-60 HRC and are ground one end of the pillar is press fitted in bottom plate with H7/p6fit. The other portion which is sufficient long provides guide for top half and having precision sliding fit H7/h6 with the guide bush at top plate for easy sliding & alignment.

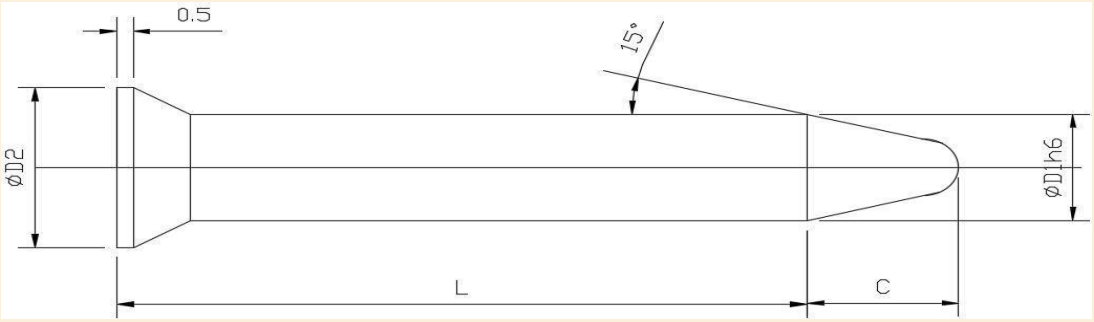
SHANK



It is element which connects between the press tool and press ram the shank is screwed in top plate and clamped to the press ram .it is made out of mild steel the diameter and length of shank depends on the force required for the press tool. the major function of shank is to locate the press tool on the press ram. Shank is made up of St42 material and kept soft.

PILOTS

These are also called as true gauges. the functions of pilots are to position the stock strip accurately and bring the strip to proper registry for successive stations when the strip stop allows a slight amount of over feeding, they bring strip to the registry position, a pilots than blocks the strip in to registry position in a direction away from the strip stop. It is made up of OHNS (IS CODE-) T110 W2 Cr1 material with 50-54HRC.



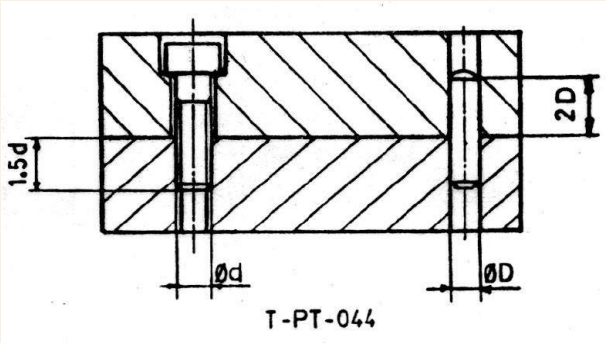
SCREWS

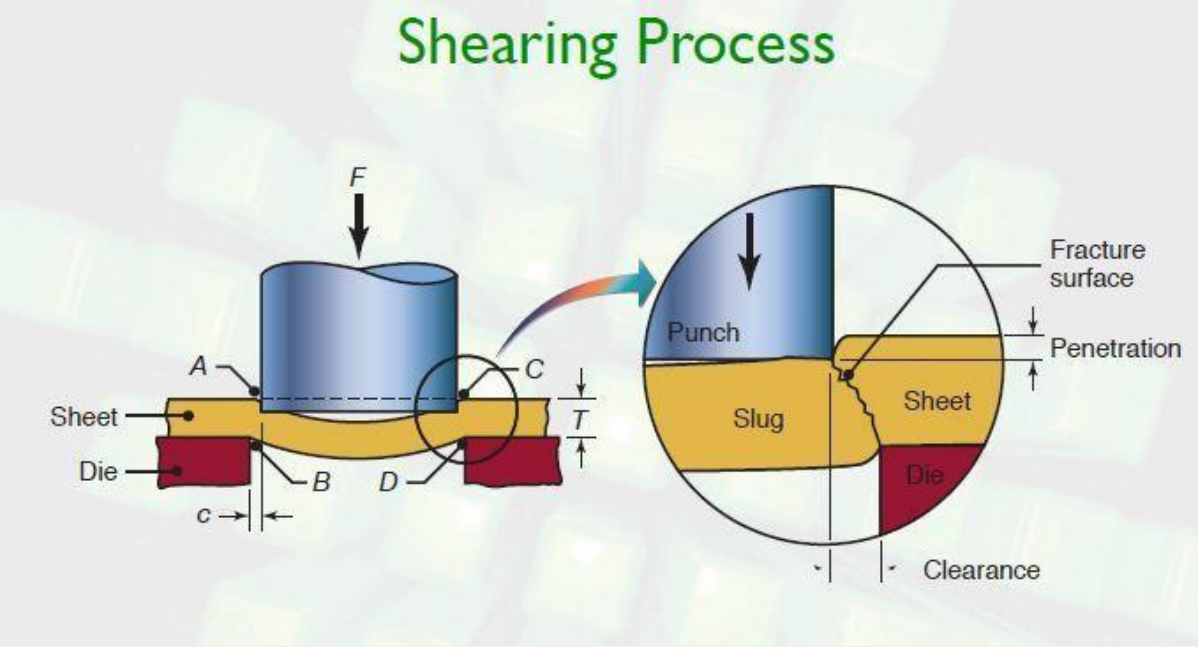
Screws are the clamping elements which are used to clamps the plates of top half and bottom half and also some punches. screws used in blanking and piercing dies should be located diagonally across from each other and as far apart as possible to increase location accuracy.

UNIT 4: THEORY OF SHEARING

DOWELS

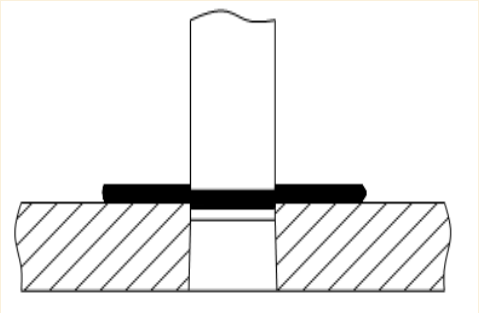
Dowels are the aligning elements where the plates are aligned and clamped dowels are cylindrical pins which are hardened and ground accurately to fit into the holes by means of H7/m6 fits. all dowels should be located at a distance ranging from 1.5 to 2 times.





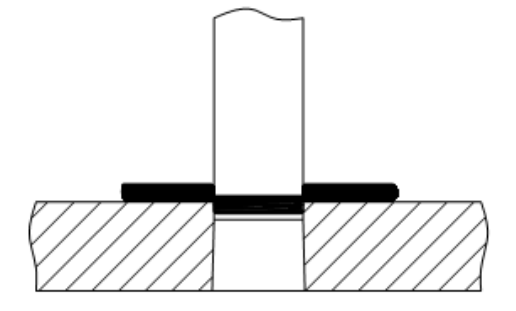
The result of the force imposed on the stock material by the working of the blanking or piercing dies is a shearing action. This shearing action may be considered in three stages, which are very important to the die maker because of their direct relationship to the dimensional qualities and appearance of the piece parts. They are also related to the effective working and life of the die.

1. Plastic deformation:



The pressure applied by the punch on the stock material tends to deform it into the die opening when the elastic limit is exceeded by further loading, a portion of the material will be forced into the die opening in the form of an embossed on the lower face of the material and will result in a corresponding depression on its upper face. This stage imparts a radius on the upper edge of the punched out material. This is called the stage of "plastic deformation

2. Penetration stage:



As the load is further increased, the punch will penetrate the material to a certain depth and force an equally thick portion of metal into the die. This stage imparts a bright polished finish or burnished surface (cut band or burnished land) on both the strip and the blank or slug. On optimum cutting conditions the cut band will be 1/3rd of the sheet thickness.

This is "penetration stage".

3. Fracture stage:

In this stage, fracture will start from both upper and lower cutting edges. As the punch travels further, these fractures will extend towards each other and eventually meet, causing complete separation. This stage imparts a dull fractured edge. This is the "fracture stage". There will be a small burr as a result of fracture, known as TENSILE BURR, the amount of burr depends on the quality or sharpness of cutting edges of punch & die

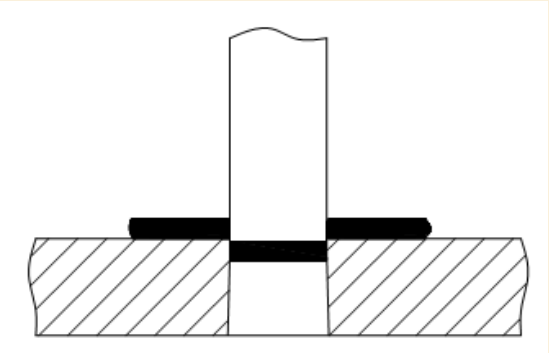
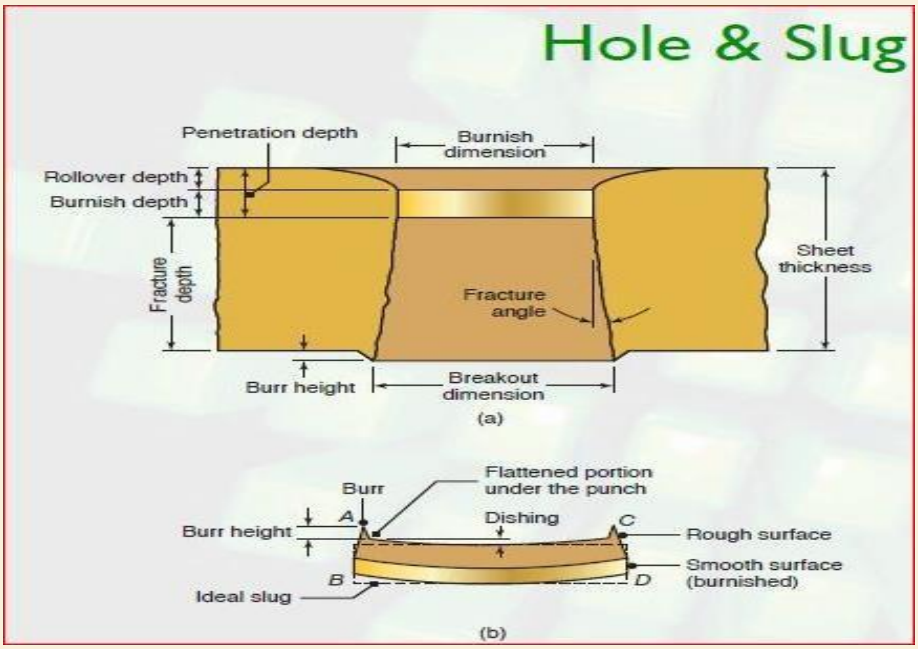


Figure shows the characteristic appearance of the edges of the produced by blanking and piercing operations in details. The edge radius appears more when using soft materials.

The highly **Burnished Land** or **Cut Band** is the result of the material being forced against the walls of the punch and die and rubbing during the final stages of **plastic deformation**. The sum of the **edge radius depth**, and the **burnished depth** is referred to as **penetration,** i.e. the distance the punch penetrates into the stock material before fracture occurs. Penetration decreases. For this reason, harder materials have less deformation and burnished area or cut band.

The remaining portion of the cut is the fractured area, or break. The angle of the fractured area is the breakout angle or slug is towards the punch, and the burr side of the work material is toward the die opening.

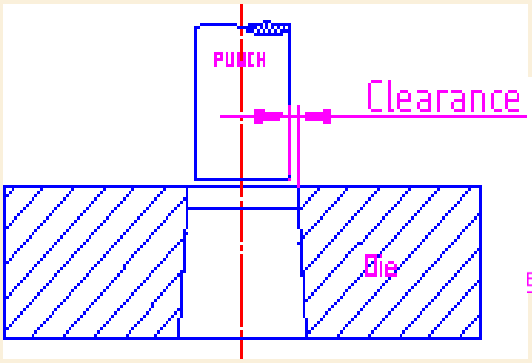


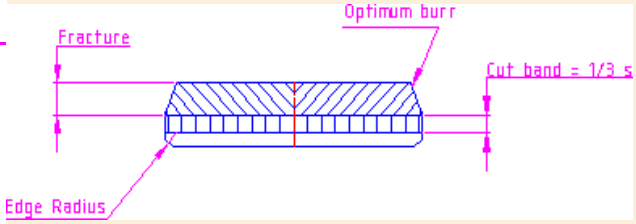
Note- Cut edge characteristic features of Punched Hole (a) & scrap (b-slug)

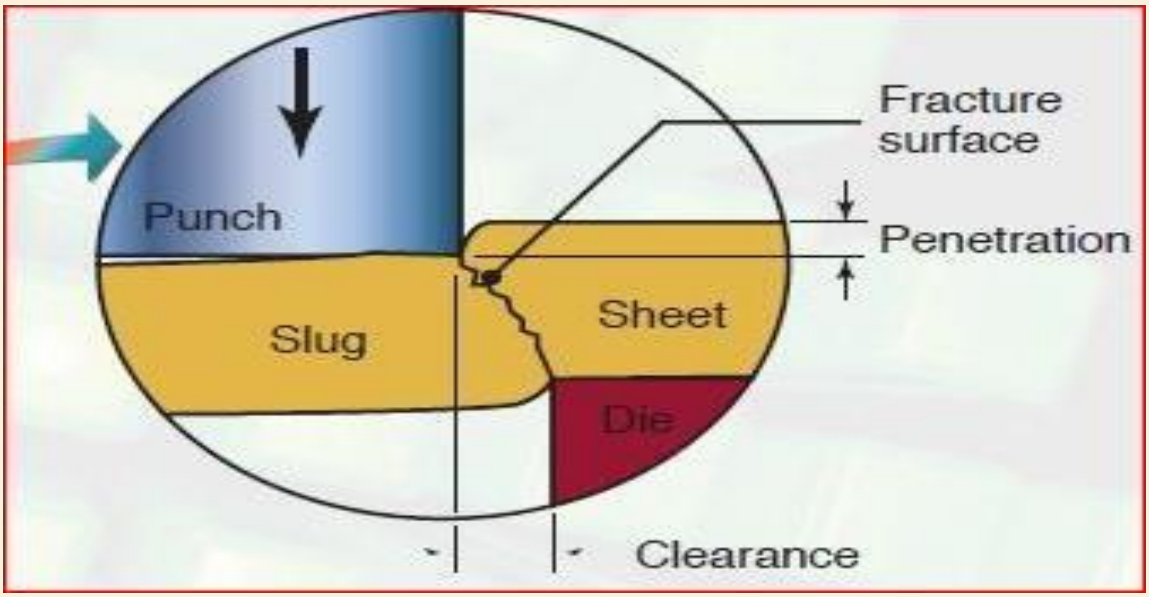
UNIT 5: CUTTING CLEARANCE

Cutting clearance:

Cutting clearance is the gap between the side of the punch and the corresponding side of the die opening on one side of the edge, when the punch is entered into the die opening. It is expressed in the amount of clearance per side.







Importance Of Cutting Clearance:

Proper cutting clearance is necessary to:

1. Improves &Increases the life of the die.
2. Increase the quality of the component.
3. Improve the cut edge characteristics of the component.
4. Reduces the undue stress and wear on the cutting edges of the tool.

Optimum Cutting Clearance:

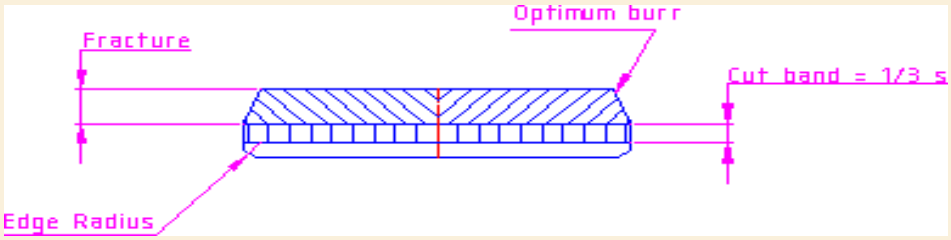
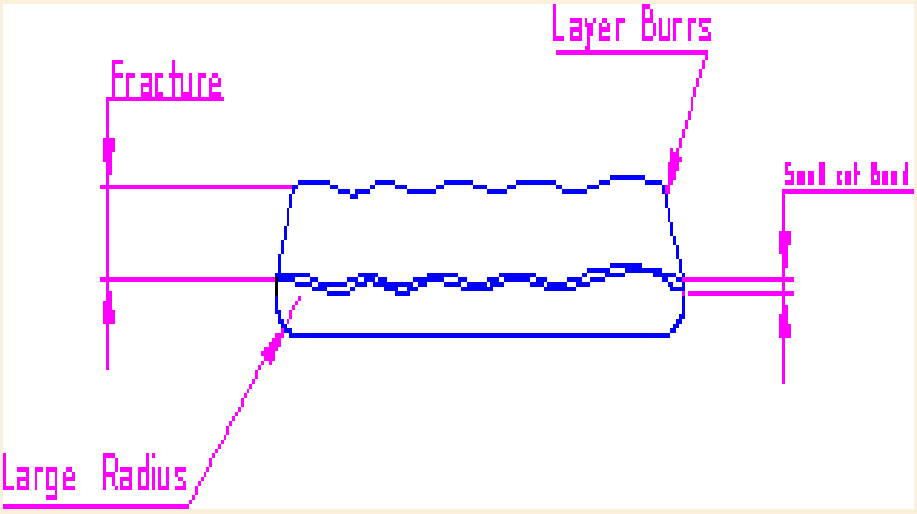


Fig shows the blank or slug made under optimum cutting conditions. The edge radius (die roll-roll over) is the result of initial plastic deformation, which occurred during the first stage of **plastic deformation** action.

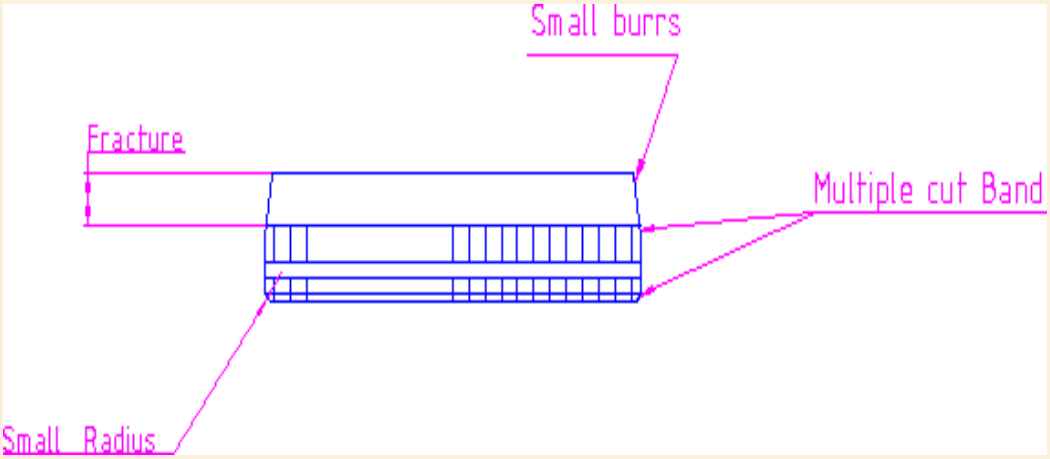
Highly burnished cut band results from the second stage (penetration) of shear action. The width of the cut band is approximately 1/3$^{rd.}$ of the thickness of stock material. The balance of the cut is the break, which results from the third stage (fracture) of the shearing action.

Excessive Cutting Clearance:



In this the large gap between the punch and die cutting edges allows the stock material to react to the initial pressure on a manner approaching that of forming rather than cutting. Therefore, the edge radius becomes larger and the cut band becomes smaller

Insufficient Cutting Clearance:



When the cutting clearance is slightly less the condition can be identified by greater width of the cut band. Because of steeper angle between the punch and die cut edges the resistance of the stock material to fracture is increased. In case of excessive clearance, the burr results from dragging of the material. While insufficient clearance compressive forces cause the burr.

MIS ALINGMENT OF PUNCH & DIE

When the cutting clearance is uneven the condition can be identified by uneven width of the cut

band by the sides, the edge radius becomes uneven at the sides, Because of lesser and more angle between the punch and die cut edges the resistance of the stock material to fracture is increased. In case of the misalignment of punch & die excessive burr & lesser burr results from dragging & shearing of the material. While insufficient clearance compressive forces cause the burr.

Burr Side:

The burr side is the adjacent to the break. The burr side is also called because of a noticeable burr condition develops it will occur in this side. Burr should be practically non- existence if the cutting clearance between the punch and die is correct and if the cutting edges are sharp.

The burr side of the blank or slug is always towards the punch (die starts shearing) the burr side of the punched opening is always towards the die opening.

Determination of punch and die size:

For Piercing:

Piercing punch = Piercing hole size.

Die = Piercing hole size + total clearance.

For Blanking:

Blanking punch = Blanking size - total clearance.

Die = Blanking size.

For finding the cutting clearance following formula to be used.

Cutting Clearance = 0.01x t x √fs, mm/side

fs= shear strength of the material t= sheet thickness

Problems:

1. Calculate the clearance for punching a 2mm sheet shear strength of the material assumed to be 30kg/mm2.

Cutting Clearance = 0.01x t x √fs, mm/side

= 0.01 X 2 X √ 30

= 0.02 X √ 30/1

= 0.12 mm/side

Therefore, clearance on one side = 0.12 mm

2. Determine the punch and die dimension for the component given below. Sheet thickness 0.5mm, stainless steel sheet, is 40 kg/mm2.

Cutting Clearance = 0.01x t x √fs, mm/side

= 0.01 X 0.5 X √40

= 0.03 mm/side

Therefore, clearance on one side = 0.03 mm.

Blanking punch:

Component Dimension	Clearance Add / Deduct	Punch / Die Dimension
50	-0.06	49.94 mm
15	-0.06	14.94 mm
R10	0.03	R10.03 mm

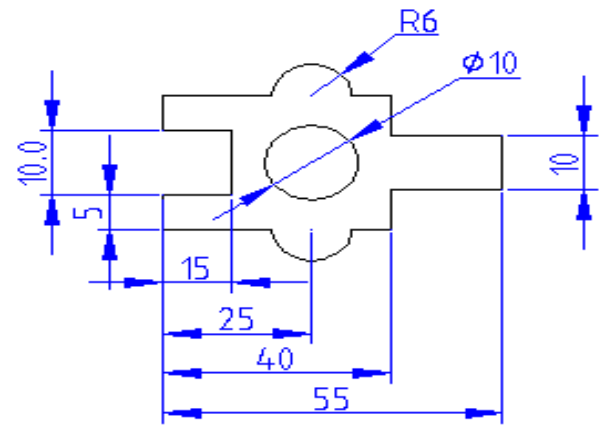
- ❖ Blanking die dimension is the same as that of component dimension.
- ❖ Piercing punch size is the same size of the pierced hole

Piercing Die:

Component Dimension	Clearance Add / Deduct	Punch / Die Dimension
R2	0.03	R2.03 mm
4	0.06	4.06 mm
18	0.03	18.03 mm

1. Determine the punch and die dimension for the component given below. Sheet thickness

2mm MS, shear strength is 40kg/mm2.



Cutting Clearance = 0.01x t x √fs, mm/side

= 0.01 X 2.0 X √ 40

= 0.126= 0.13 mm/side

= 0.13 mm/side

Component Dimensions(punch)	Clearance Add / Deduct	Punch / Die Dimension
5	-0.26	4.74
R5	-0.13	5.87
10	-0.26	9.74
10 (Slot)	0.26	10.26
15		15
20	-0.26	19.74
25	-0.13	24.87
40	-0.26	39.74
55	-0.26	54.74

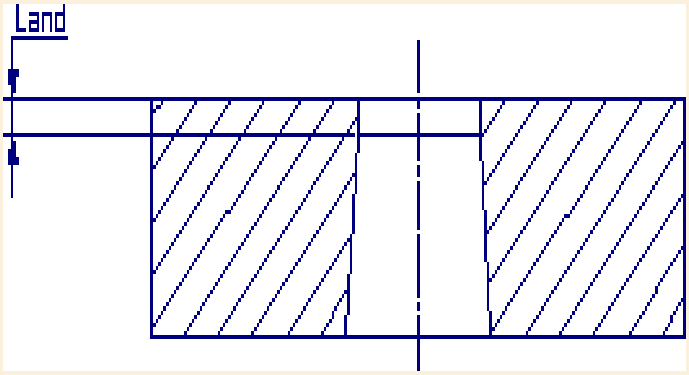
- Blanking die dimension is the same as that of component dimensions.

- Piercing punch size is same as component size.

Piercing Die size = component size + clearance

= 10.00 + 0.26 = 10.26mm

LAND:

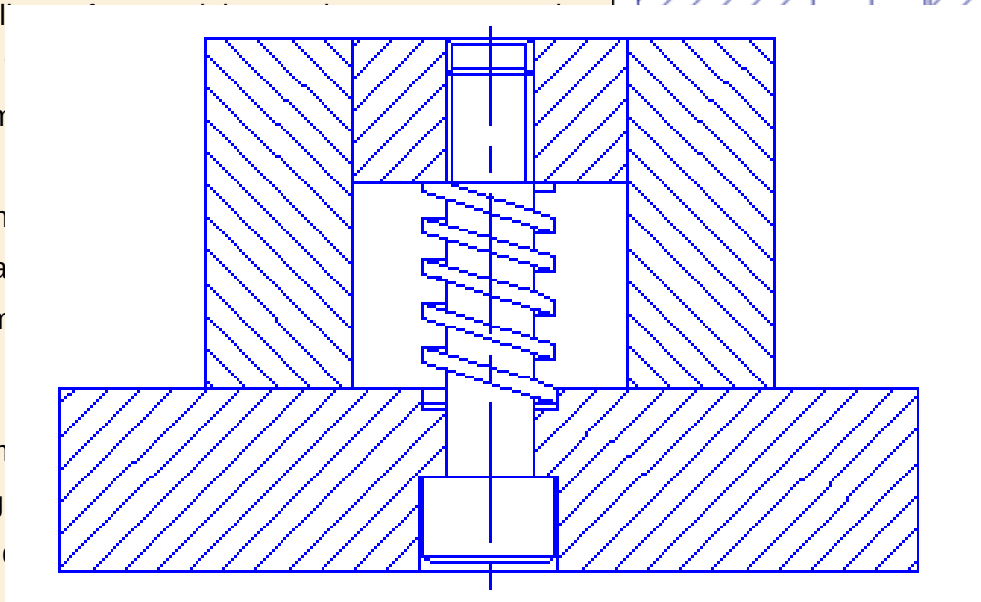


The inner walls of a die opening are not usually made straight through as the blanks or slugs tend to get jammed inside, which may result undue stress build up. This may lead to the breakage of the punch and die.

To avoid such situation, the die walls are kept straight only to a certain amount from the cutting edge. The straight wall is called ***"THE LAND".***

- An amount of 3mm land for stock thickness up to 3mm.
- For thicker materials equal to their sheet thickness.

ANGULAR CLEARANCE OR ANGULAR RELIEF:



Generall
clearance
above 3mm
Clearance
requiremen

In specia
top to bottom
land.

Dies em
have straig
the blanks

UNIT 6: CUTTING FORCE

CUTTING FORCE OR SHEAR FORCE :

"Cutting force is the force which has to on the stock material in order to cut out the blank or slug". It is expressed in tons. This determines the capacity of the press to be used for particular tool. The cutting force is also determining the cut length area for straight cuts are performed in the shearing and some cut off operations, the area to be cut is found by multiplying the length of cut by stock thickness.

Formula for calculating the cutting force:

$$\text{Cutting force} = \frac{K \times L \times fs \times t}{1000}$$

K = Constant value 1.33

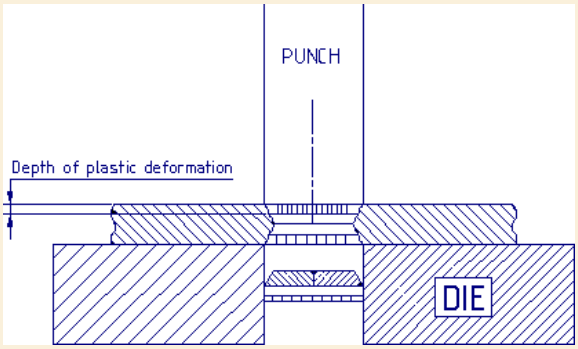
L = Total cut Length or material to be cut in 'mm'.

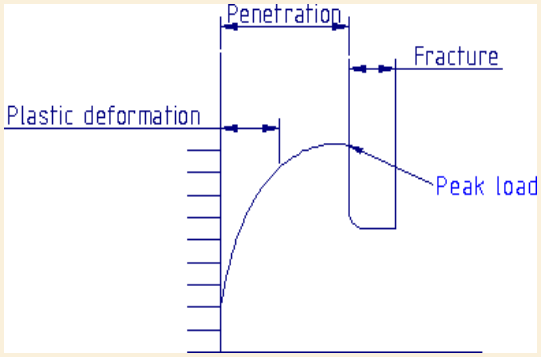
t = Sheet thickness in 'mm'

fs = Shear strength in Kg/mm2, (taken from the table)

Add 20% safety for the Cutting force

The fig. Represents the typical load curve of cutting force of blanking or piercing punch.





Formula to calculate the press force:

Press force = Cutting force + stripping force
(Stripping force = 15% - 30% of cutting force)

The following table gives the shear strength of different materials.

MATERIAL	Shear strength in Kg/mm2
Steel with 0.1% carbon	24 – 30
Steel with 0.2% carbon content (deep draw steel)	32 - 40
Steel with 0.3% carbon	36- 42
Steel with 0.4% carbon	45 - 56
Steel with 0.6% carbon	50 - 70
Steel with 0.9% carbon	70 - 90
Silicon steel	45 - 55
Stainless steel	35 – 45
Copper	20 – 40
Brass	35– 40
Bronze	36 – 45
German silver (2 - 20% Ni, 45 - 75% Cu)	30 – 32
Tin	3 – 4
Zinc	10 – 12
Lead	2 – 3

Aluminum 99% pure	2– 12
Aluminum manganese alloy	15 – 32
Aluminum silicon alloy	12 – 25
Paper & card board	2 – 5
Hard board	7 – 9

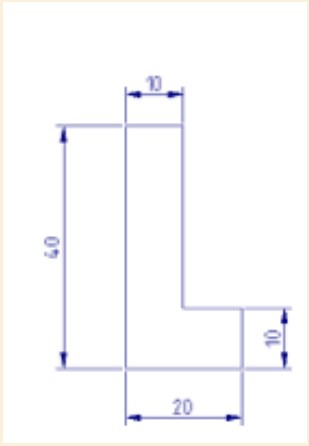
MATERIAL	Shear strength in Kg/mm2
Laminated paper or rosin impregnated paper	10 – 14
Laminated fabrics	9 – 12
Mica	5 – 2
Plywood	20 – 40
Leather	1
Soft rubber	1
Hard rubber	2 – 6
Celluloid	4 -6

CUTTING FORCE CALICULATION

Example:

Calculate the press force required t produce the following component.

Given Data-Sheet thickness 2mm. Material is brass.



Cutting force $= \frac{K \times L \times fs \times t}{1000}$

$= \frac{1.33 \times 120 \times 2 \times 40}{1000}$

$= \frac{12768}{1000}$

$= 12.76$ tons

Safety 20% $\frac{12.76 \times 20}{100} = 2.5 =$

12.76+2.5 =15.26 tons **That is equal to 16 TONS**

Note- Cutting force calculations to be done for different components……

METHODS OF REDUCING THE CUTTING FORCE:

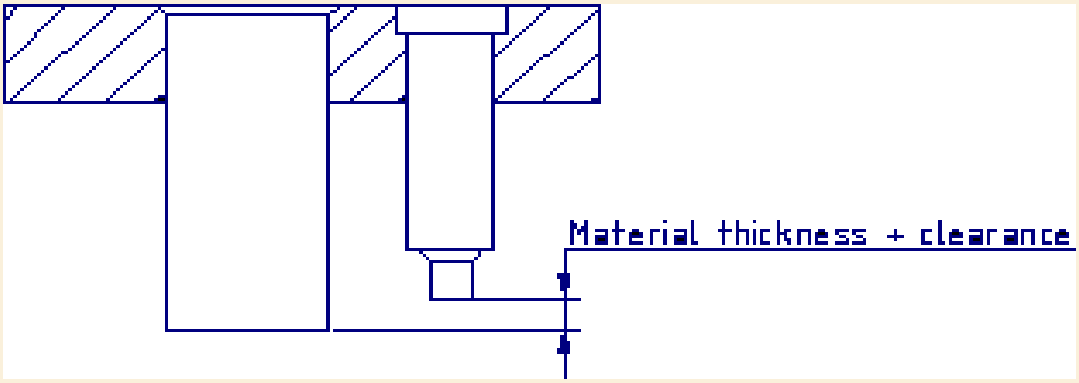
It sometimes becomes necessary to reduce the cutting force to prevent press over loading

1. The use of Stepped punches will reduce the shear force..

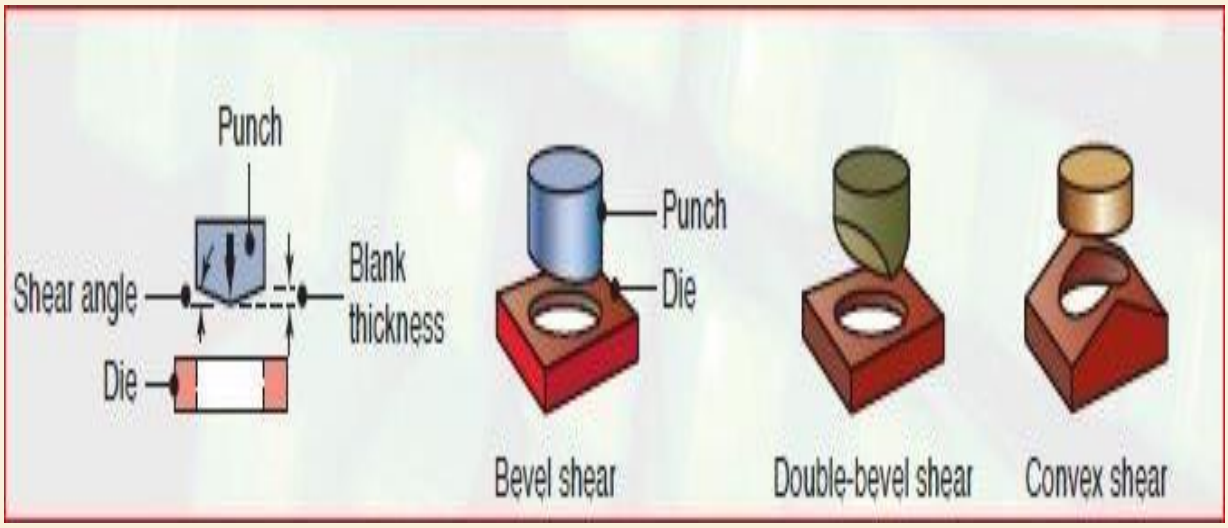
2, To grind the small shear angle on face of the punch or die will reduces the shear force 3, To grind the concave or convex surface on face of the punch or die will reduces the shear force

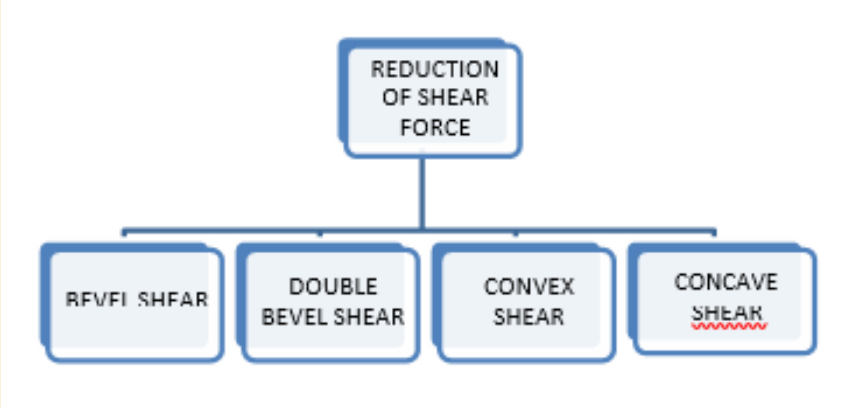
DIFFERENT METHODS TO REDUCE SHEAR FORCE

1. The use of Stepped punches.



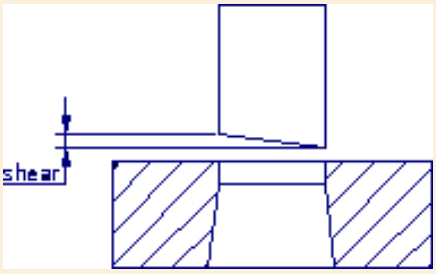
A minimum of a sheet thickness can be varied in punch length and cutting force will be applied in progressive way reducing the shear force/cutting force

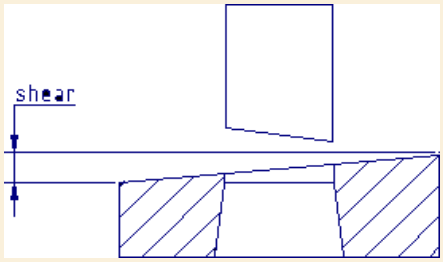




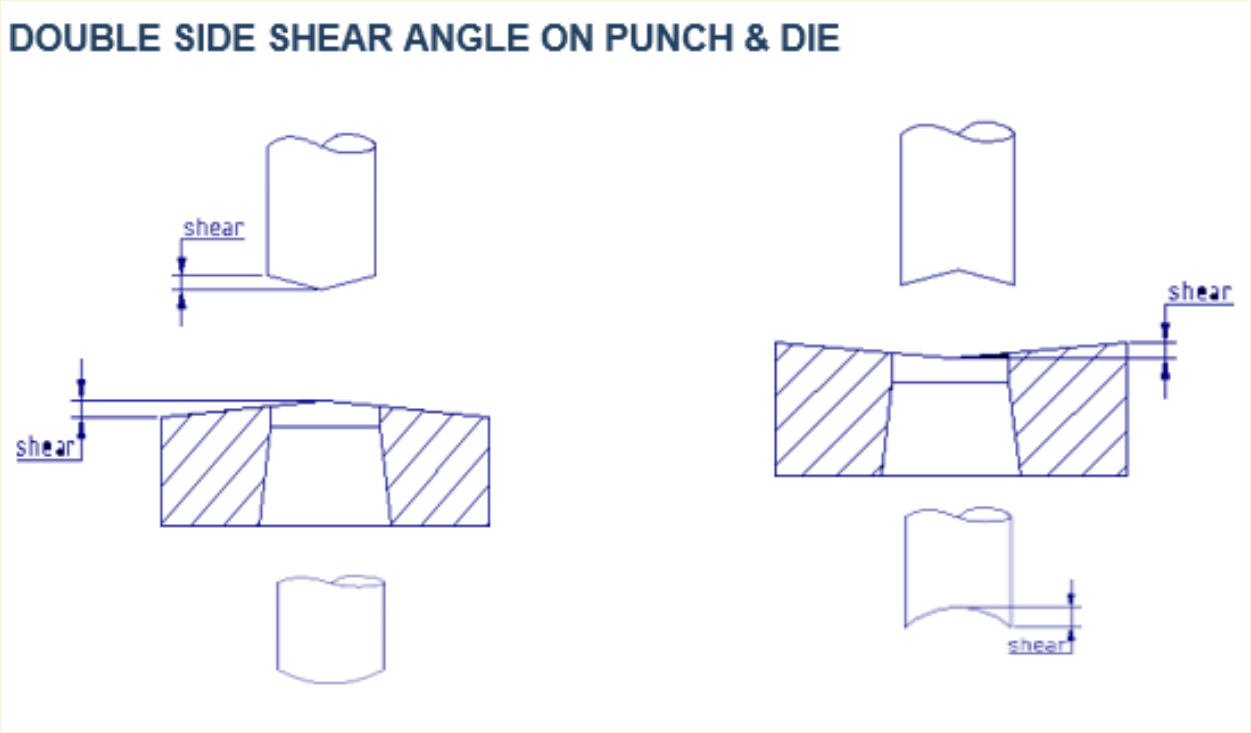
SINGLE SIDE SHEAR ANGLE ON PUNCH & DIE

A minimum of 1 degree to 3 degrees' max angle can be given and cutting force will be applied in progressive way in a same punch/die by reducing the shear force/cutting force

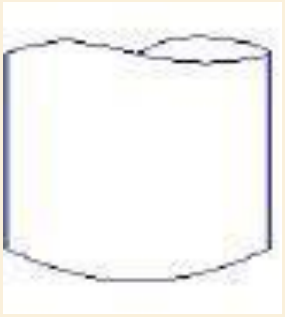


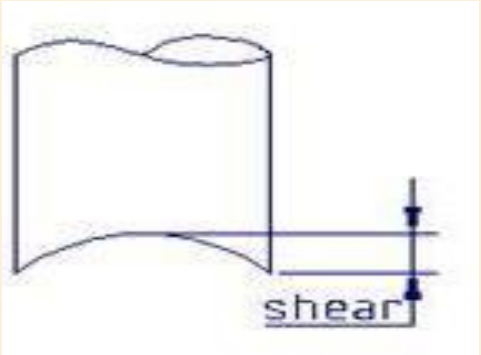


DOUBLE SIDE SHEAR ANGLE ON PUNCH & DIE



CONCAVE & CONVAX SURFACE ON PUNCH FACE



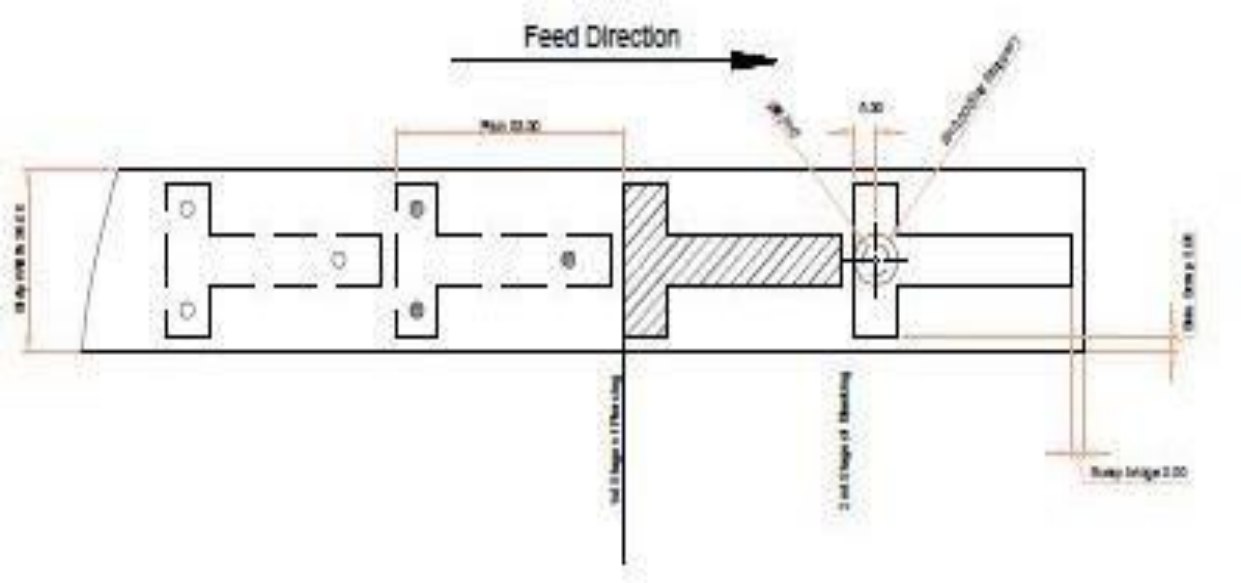


UNIT 7: STRIP LAYOUT

STRIP LAYOUT:

The strip layout is defined as an imaginary plan of producing a sheet metal component in an economical way in which all details are indicated clearly, details such as no of stages, feed directions, different operations performed, strip width, pitch, scrap value stopper position & pitch, pilots placed & sheet thickness.

A strip layout represents the sequence of the logical, workable operations, which is to say a sequence of ideas. If this sequence of operations has error, the error will be surely emerging in a tryout of the press.



Strip Layout for blanking tools:

- Blanking tools produce blanks entirely from the strip or unit stock.
- Blanking is a most efficient and popular way of producing intricate and closely tolerated blanks.

UTILIZATION FACTOR: (ECONOMY)--KW

The designer should try out every possible means to attain a good percentage of utilization strips, without sacrificing the accuracy of the piece part.

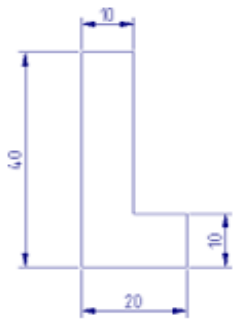
UTILIZATION FACTOR (KW)= Area of the blank x No of rows x 100

Strip Width x pitch

A minimum utilization of 60% should be aimed. The position of the blank in the strip decides the utilization factor

Problem: - Calculate percentage of utilization strip for the component scrap value 3mm sheet thickness 2mm.

COMPONENT DRAWING



Width =46mm, Pitch =23mm

That=46x23

=1058mm2

Area of the blank (COMPONENT)= (40x10)+(10x10)

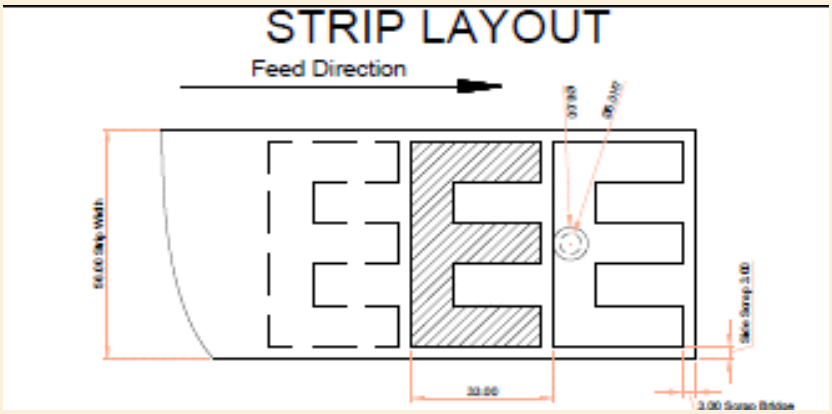
=500mm2

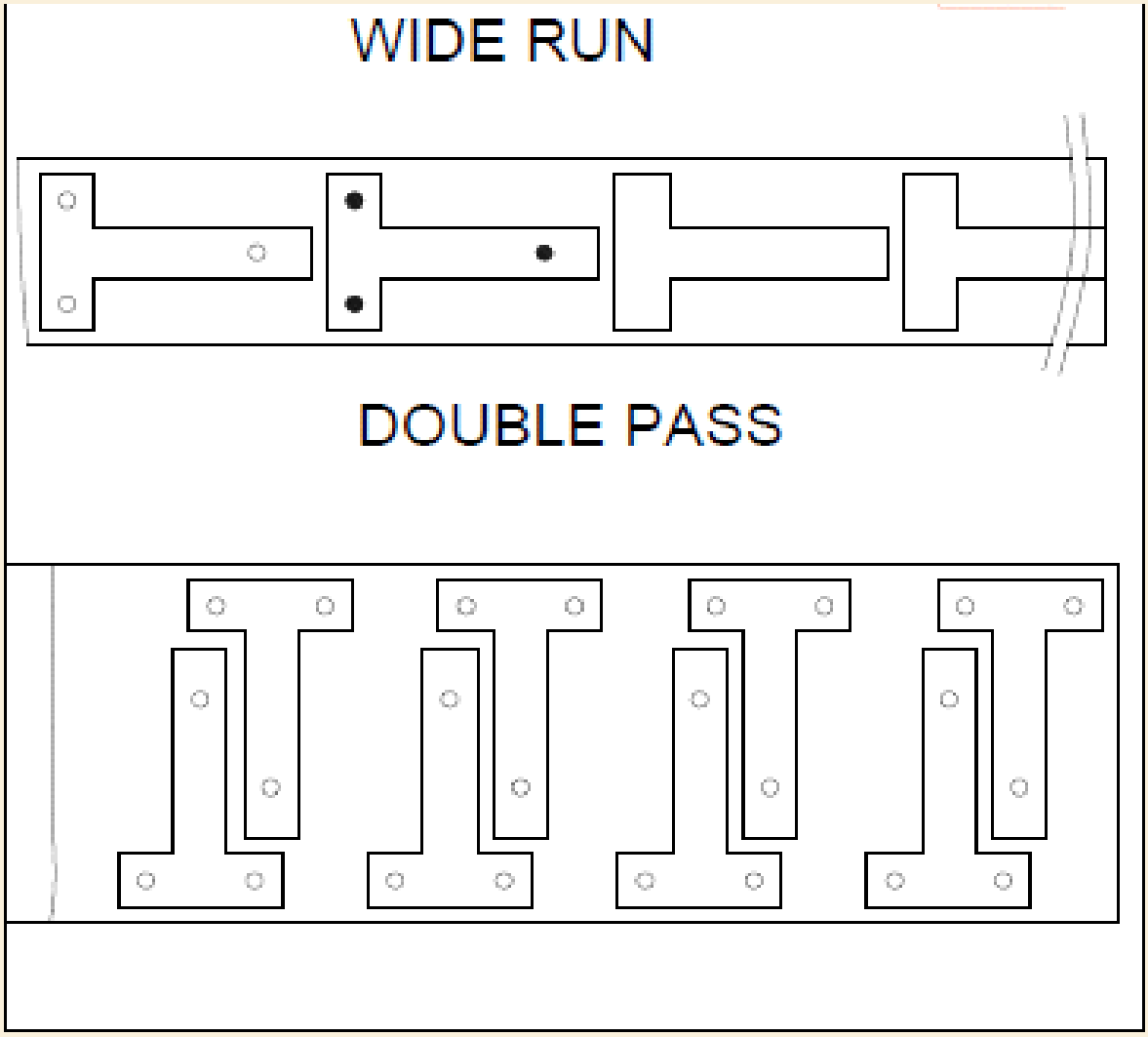
UTILIZATION FACTOR (KW)= Area of the blank x No of rowsx 100
Strip Width x pitch

$$= \frac{500x1x100}{1058}$$

$$= 47.27\%$$

UTILIZATION FACTOR (KW)= 47.27%





Factors to be considered while designing the layout are: -

1. Shape & Size of the blank.
2. Production requirement.
3. Grain direction.
4. Burr side.
5. Stock material.

Shape & Size of the blank:

- The contour of the blank, decides the position of the strip.
- Some of the blanks are laid at an angle.

Production Requirement:

If production requirement is less, then material conservation is necessary. This must not increase the tool cost. Gang die may be suitable for the mass production.

Grain Direction:

- The grains are found in the sheets when they are rolled.
- Bending the strip along the grain direction results in crack and fracture.

Burr Side:

- It is a decisive factor in laying the strip.
- In blanking, burr is found on the punch.
- In piercing, burr is found on the die.

Stock Material:

- Every means is necessary to conserve the stock material.
- A double pass layout would justify the cost of stock material conserved.

Single Row One Pass layout:

Here the blanks are arranged in a single row and the strip is passed through the tool only once to the punch and blanks from it.

Blanks having at least two Straight parallel sides:

Here the strip width should be equal to the distance between two parallel sides. The blanks are

produced by cut off or parting off operation.

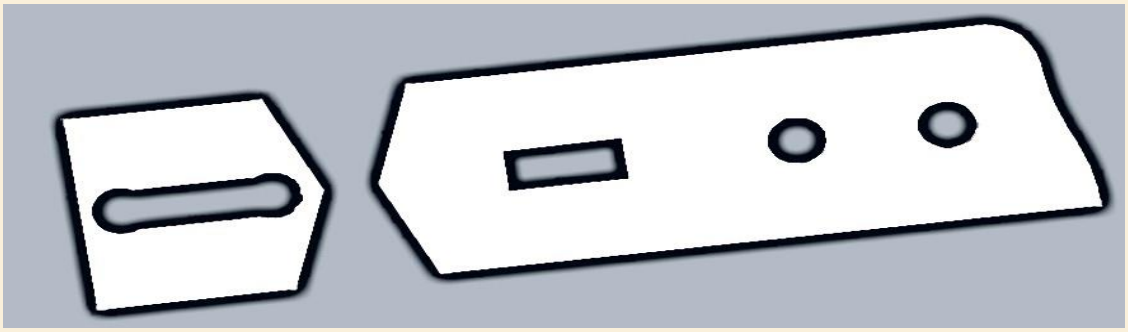
Blanks having Irregular Counters:

Factors considered for best method of positioning a blank in the strip.

1. Contour.
2. Minimum material wastage.
3. Less tool cost.
4. No scrap strips to handle, which renders the production faster.
5. Accuracy in strip width.
6. Accuracy of the blank.
7. Flatness.

Strip layout for Cut Off and Parting Off:

- Cut off and parting are the operations, which shear the strip across the entire width either, in straight or curved lines.
- The difference is cut off punch cut s only one edge producing no scrap where as parting punch cuts two opposite edges producing the scrap.



FORMULA TO CALCULATE

SCRAP BRIDGE, PITCH & STRIP WIDTH

FOR SINGLE PASS-

SCRAP BRIDGE = 1.5 x SHEET THICKNESS

PITCH = 1 x SCRAP BRIDGE + COMPONENT LENGTH STRIP WIDTH

= 2 x SCRAP BRIDGE + COMPONENT WIDTH FOR DOUBLE PASS-

STRIP WIDTH = 3 x SCRAP BRIDGE + 2 x COMPONENT WIDTH

ELEMENTS OF STRIP LAYOUT

Different layouts:

There are two ways of laying the strip, Narrow run and wide run. Wide run is generally desirable due to,

- ✓ Shorter advance distance of the strip promotes easy feeding.
- ✓ More blanks can be produced from a given length of strip.

Narrow run is used when the grain direction of the piece part is important.

Single row two pass method:

A two-pass tool requires minimum of two stops. The stops used for the first pass have to be removed. Or made to disappear from the working surface so as not to interfere with the second pass. For double pass the front and back scrap as well as the scrap bridge should be wider than those for single pass (about 50-100). Two pass layouts are justified only when the wastage is considered and the stock material is costly.

Double row layout:

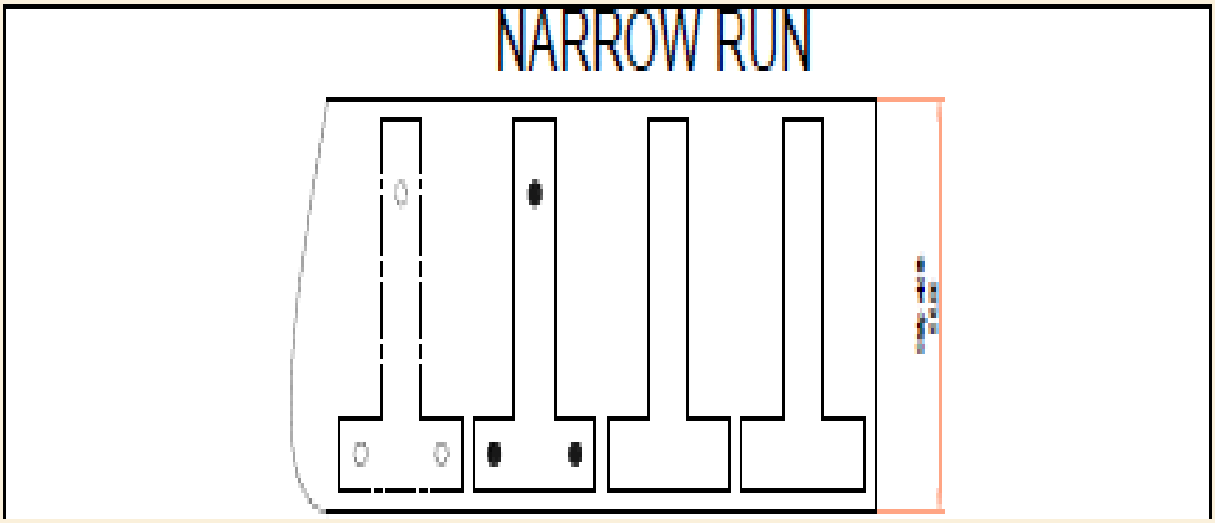
Further economy can be attained by double rows. Strips for double row layout will be wider and require the back and front scrap to be more than usual amount.

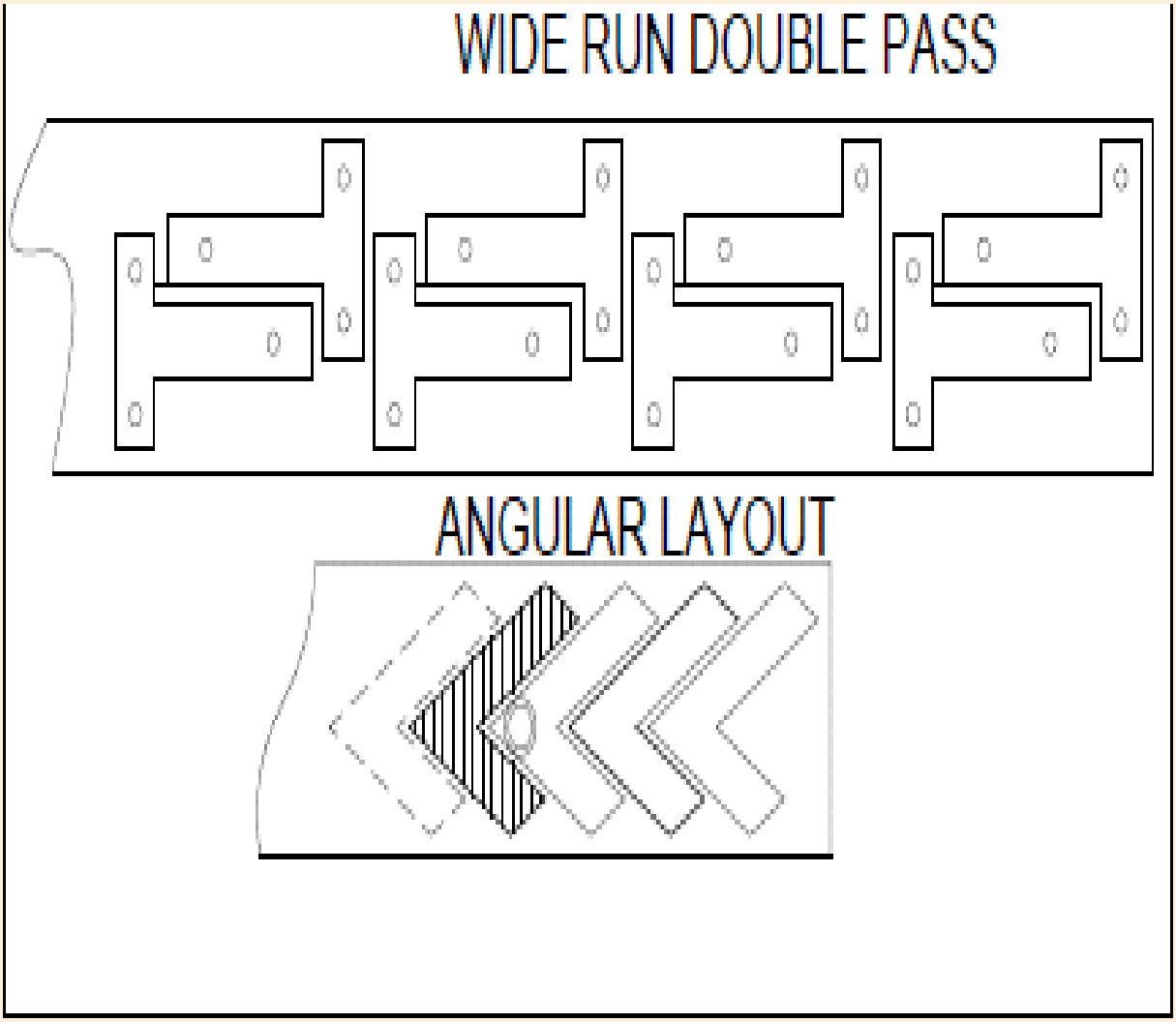
Gang die:

It consists of two or more similar sets of tool members so as to produce two or more number of components during the single stroke of press ram. Gang die is the most economical means of mass production of stampings. But still gang dies are not recommended for very complex work.

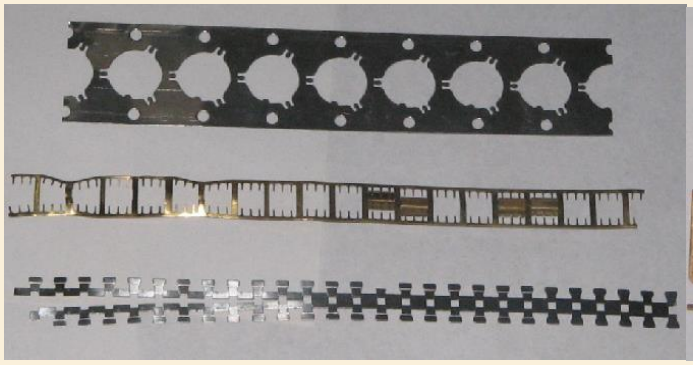
Angular layouts:

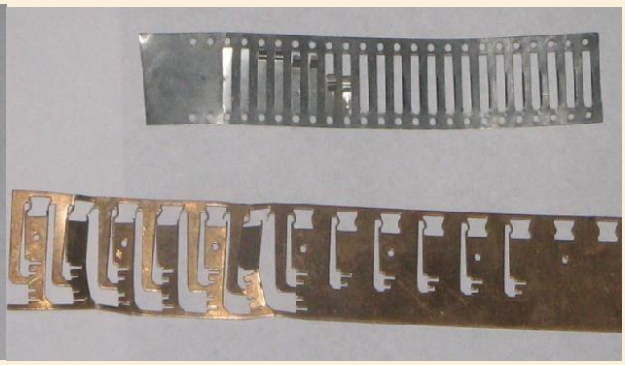
Some of the piece parts will be require to be laid out to an angular position to make the layout more economical.


NARROW RUN



Different types of strip layout: - PRODUCTS





UNIT 8 : PUNCHES

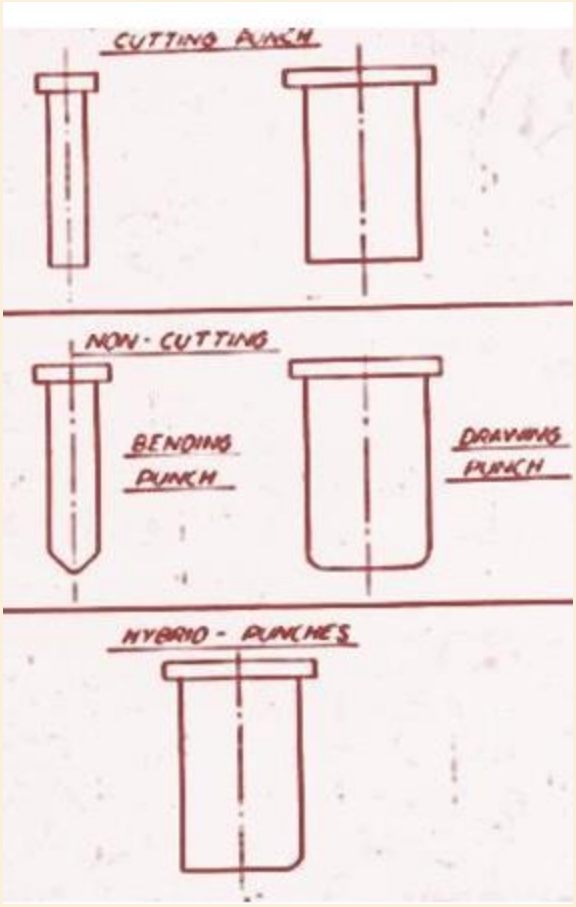
PUNCH:

Punch is the male member of a press tool There are three categories of punches:

Cutting punches. ------- Material HCHCr –T215Cr12 - HARDNESS—60-62HRC
Non – cutting punches. -- Material OHNS–T110W2Cr1 - HARDNESS—50-54HRC
Hybrid punches. ------ Material HCHCr –T215Cr12 - HARDNESS—60-62HRC

CUTTING PUNCHES:

These punches perform operations like blanking, piercing, notching, trimming etc.

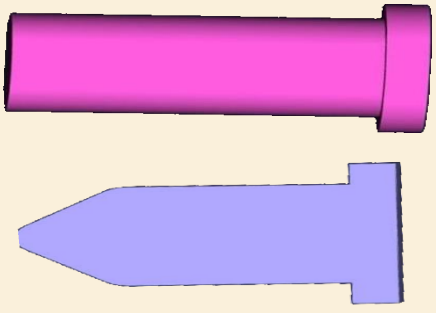


NON - CUTTING PUNCHES:

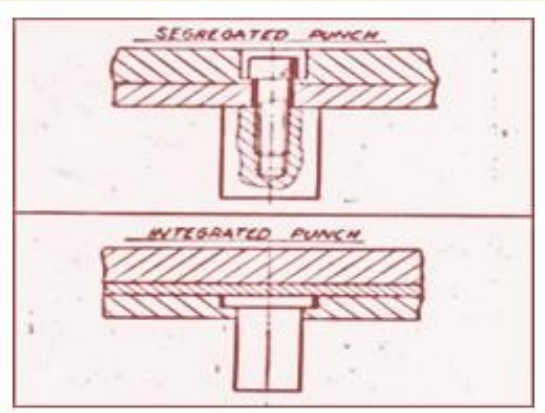
These punches perform operations like bending, forming, drawing, extruding etc.

HYBRID PUNCHES:

These punches perform both cutting and non-cutting operations, like shear and form, punch-trim etc.



PUNCH GROUPS:



There are two groups of punches:

Segregated punches.

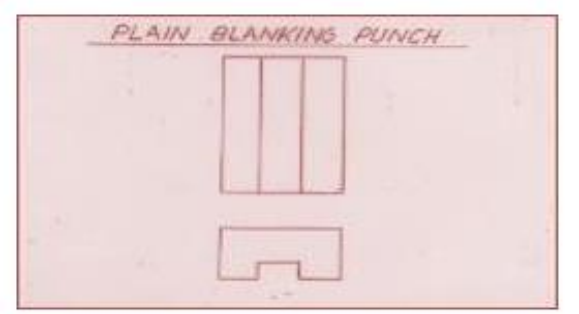
Self mounted punches, which are positioned and retained by means of self-contained screws and dowels.

Integrated punches.

Punches depend on other component such as punch plate, to locate and position them.

TYPES OF PUNCHES:

1) Plain punches

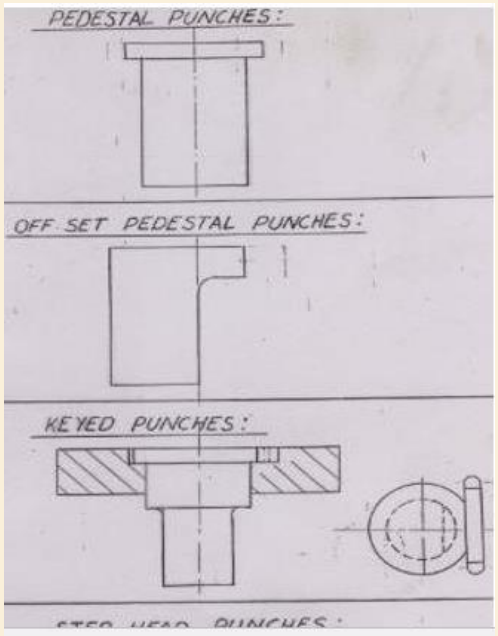


- ✓ Rectangular in cross section.
- ✓ These are self-mounting straight punches.

Advantages:

- ❖ Material saving.
- ❖ Machine time saving.

- Easy mounting.



2) Pedestal punches

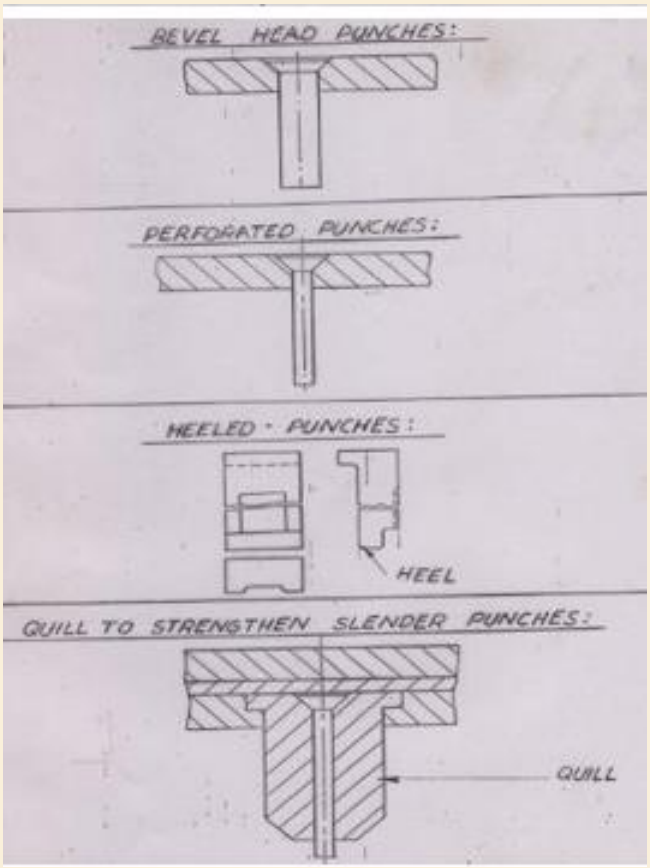
- ✓ They are also called as broad based punches.
- ✓ Load distribution qualities are excellent.
- ✓ Used for heavy-duty work.

3) Pedestal offset punches

- ✓ Base is offset.
- ✓ Reason for offsetting
- ✓ Space consideration for other components.
- ✓ Machining and grinding accessibility.

Disadvantages:

Non-uniform distribution of forces.



4) BOSSED PUNCHES

- ✓ Punches made with positioning boss.

5) FLANGED PUNCHES

- ✓ Punches having a flange with boss.
- ✓ Allows the possibility of providing clamping screws.

6) HEADLESS PUNCHES

- ✓ Plain punch, which does not contain dowels.
- ✓ Positioning is done by opening provided on the punch plate.
- ✓ Fastening is done by means of screws.

7) STEPHEAD PUNCHES (SHOULDERED PUNCHES)

- ✓ Punches fitted in punch plate without screws and dowels.

8) BEVELED HEAD PUNCHES

- ✓ Punches are made to angular sitting.
- ✓ Bevel angle is made to 30-45deg.
- ✓ Beveled portion may be machined or

pinned.

9) CLAMPED PUNCHES

- ✓ A headless punch except the manner in which it clamped.

10) FLOATING PUNCHES

- ✓ Punches made loose in the punch plate.
- ✓ Well guided in the stripper plate.
- ✓ Alignment of the stripper to the die plate is maintained precisely.

PERFORATORS:

- ❖ Punches of dia 2.5mm or below.
- ❖ Punches whose working contour are other than round.

Commonly used perforators:

Step head perforator:

Consists of stepped head shank and point diameter.

Step head shank less:

Similar to step head perforator. Shank dia is more than point diameter.

Pyramid perforator:

It is used when there is a disparity between point dia and shank.

Bevel head perforator:

Consists of bevel seating

Headless perforator:

Does not have a shoulder. A whistle notch is milled on the shank for fastening.

Slug ejector perforator:

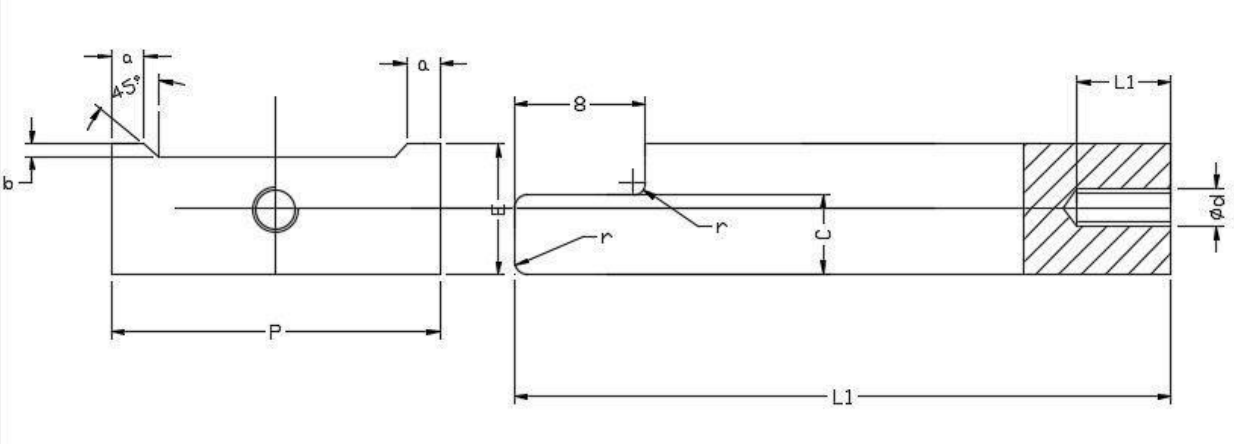
To prevent slug pulling, air pressure or spring pins are commonly used.

Quilled perforator:

Slender perforators are quilled, to prevent buckling.

Healed Punches

UNIT 9: DIE BLOCKS



These types of punches give support to the cutting edges as only one edge will cut the material the chances of punch deflection to other end will be avoided by the heel provided. The punches are called end notching punch or side cutters

This is also called as Side cutter; Side cutters an accurate method of stopping arrangement used mainly for thinner strips where it is difficult to accommodate the other type of stoppers.

FACTORS INFLUENCE THE DESIGN OF A DIE BLOCK:

1. Piece part size
2. Stock thickness
3. Type of tool
4. Profile of the piece part contour
5. Accuracy
6. Production requirement
7. Machinery available for manufacturing the tool

SOLID DIES:

1. Made up of Alloy Tool Steel (HCHCr) or non-shrinking tool steels
2. Hardened & tempered to 54-62hrc

CONSIDERATIONS OF SOLID DIES:

1. Critical nature of the Dimensions involved
2. Extreme Pressures & Wear conditions while Shearing
3. Sheet thickness
4. Press force
5. Strength & Life of the Die:
6. Sufficient wall thickness at the weakest points
7. Sufficient Die thickness according to the Severity of the specific operations.

DIES THICKNESS:

STOCK MATERIAL THICKNESS IN mm	FOR DIE BLOCK LENGTH		
	upto125mm	125-200mm	200-400mm
upto 1	16	20	24
1 to 2	20	24	28
2 to 3	24	28	32
3 to 4	28	32	36
4 to 6	32	36	50
6 & above	36	40	60

DIES THICKNESS:

The thickness of the die is calculated by the formula: -

3√Shear force in kg. (Cube root of CUTTING FORCE IN Kg)

Expressed in tons

Example If the Cutting force is 16 Tons

16 Tons converted to Kgs= 16x1000 3√16000Kg = 25.2MM

Note +25% safety

SOLID DIES

SOLID YOKED DIES (DIE BUSHES):

1. Made up of Alloy Tool Steel (HCHCr) or non-shrinking tool steels

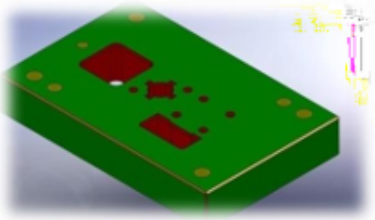
2. Hardened& tempered to 54-62hrc

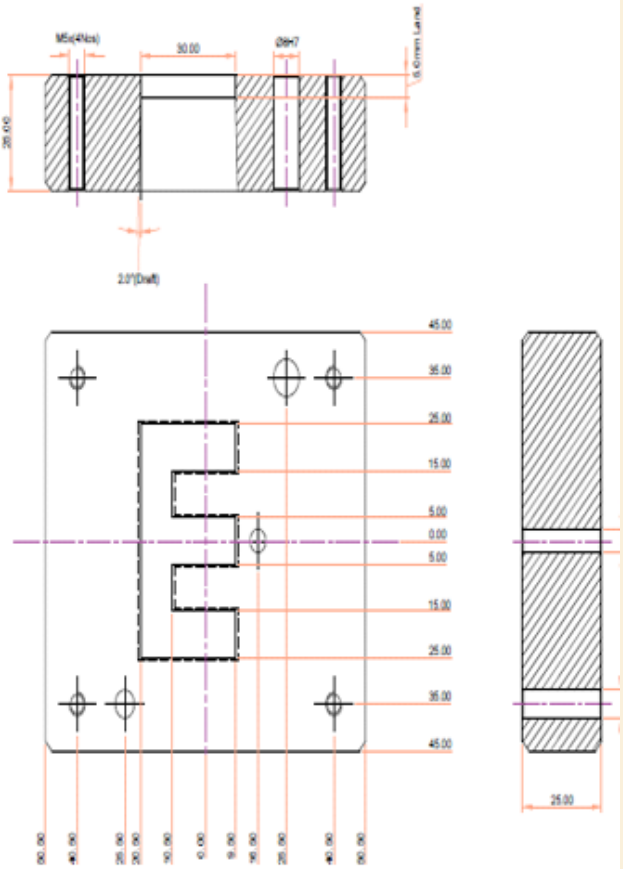
Advantages:

- Easily replaceable.
- Reduces cost of the die manufacturing.

Application:

- In large piercing dies.



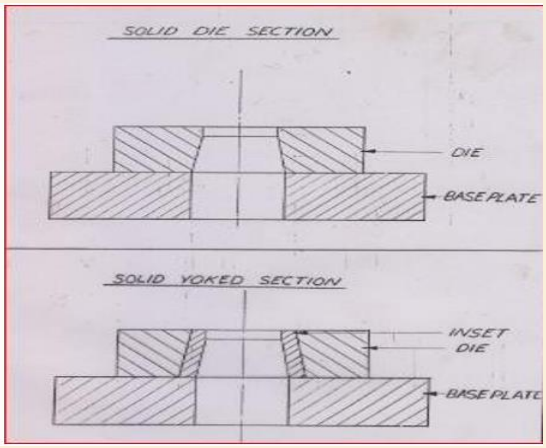


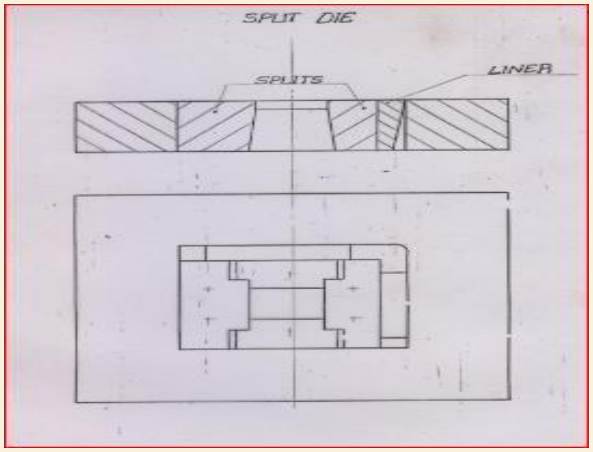
SPLIT or SECTIONAL DIE BLOCKS:

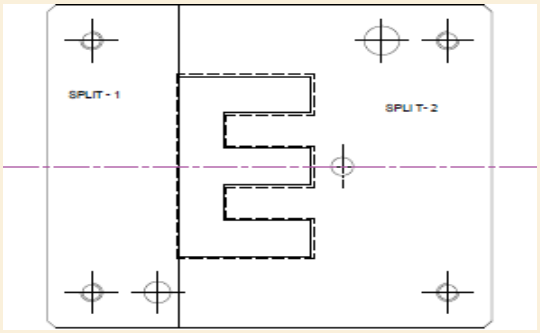
These are the dies having more than One Section.

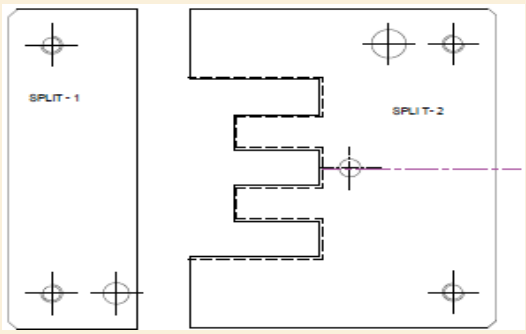
1. Made up of Alloy Tool Steel (HCHCr) or non-shrinking tool steels

2. Hardened & tempered to 54-62hrc



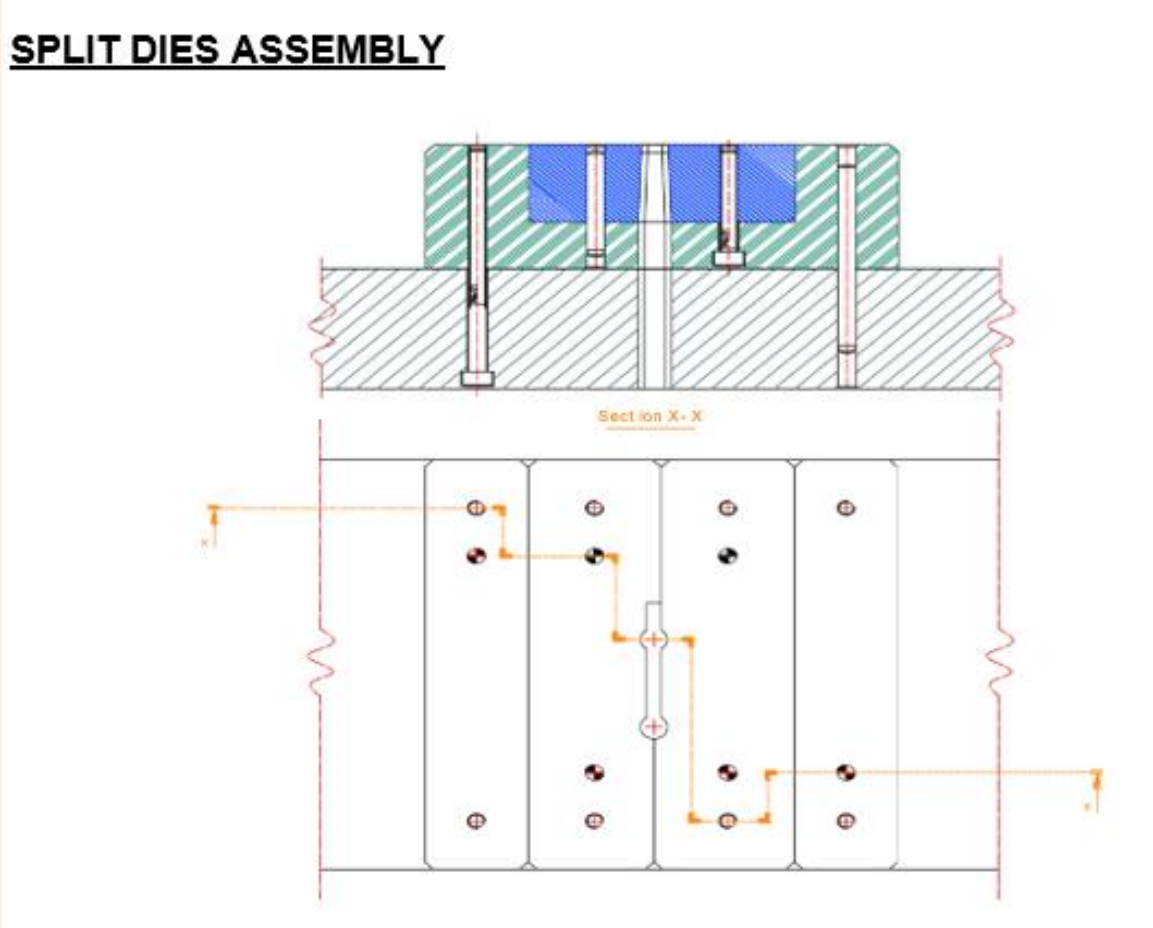






SPLIT DIES ASSEMBLY

SPLIT DIES ASSEMBLY



Locating & Clamping of Die Sections:

Considerations:

- Tilting Due to Downward Thrust.
- Lateral Displacement due to Lateral Thrust created by the Punching Action.

Methods:

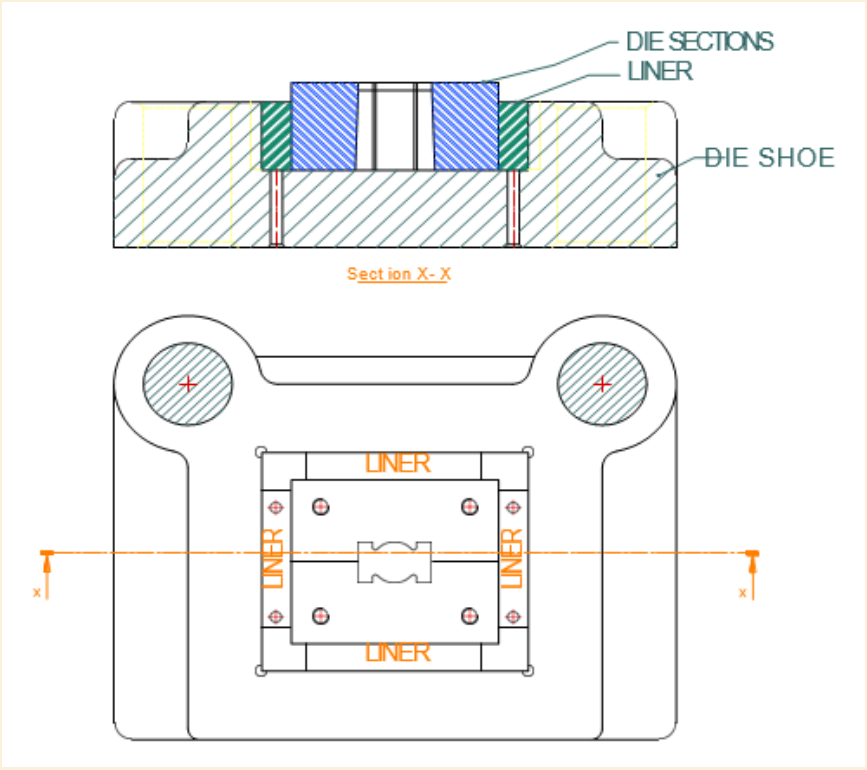
- For Thin Stock materials, Dowels and Screws.
- As the Stock material thickness increases, Need of Nesting arises.

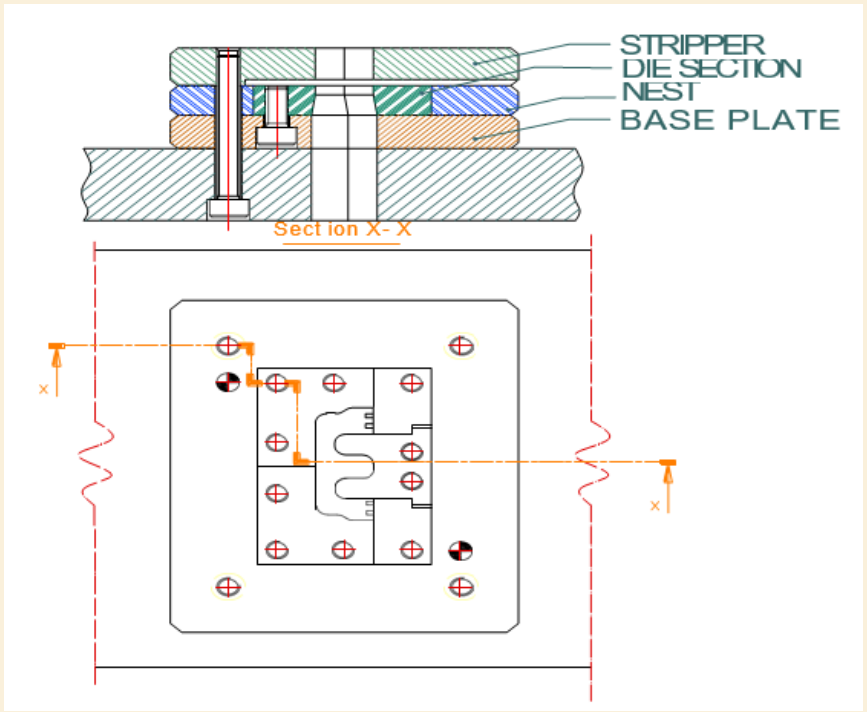
NESTING:

METHODS OF NESTING:

- Nesting in Die set pockets.
- Nesting in Retainer Plate, which is of Mild steel.

- Nesting in the above methods incorporating Liners.





NESTING IN DIE SET with LINERS:

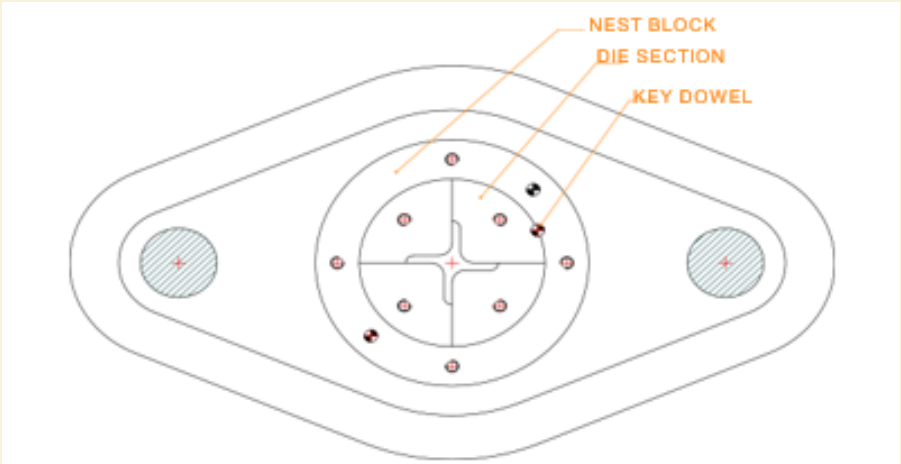
NEST BLOCKS

Advantages:

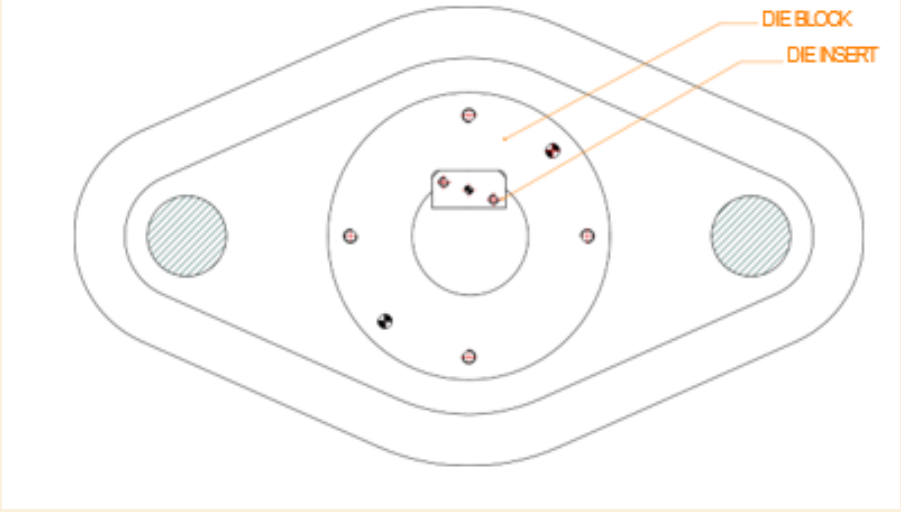
- They do not weaken the die set.
- Can be easily hardened for heavy work.
- Can be easily ground, when Die needs to regrind. As the Whole assembly of Die Sections are ground together.

Disadvantage:

Costly compared to pocket milled Die set type nesting, as the separate nest block has to be machined & clamped to the die set.



Locating & Keying of Circular Sections:



DIE INSERT:

CARBIDE DIES:

Die Material: Tungsten Carbide.

Applications:

- Blanking, Piercing, Trimming, Forming, Drawing, and swaging operation.
- Where production rates are high.
- Parts having Close tolerances.

DESIGN PRINCIPLE:

- Draw radii or approach angles.
- Punch & die clearance.
- Relief

All remains the same as that of the steel dies.

Supporting of Carbide Dies inserts:

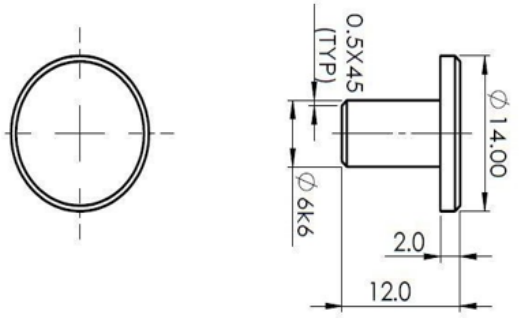
Inserts must be supported externally by pressing or shrinking them into a Hardened steel case.

UNIT 10: STOPPERS

STOPPERS

After each and every stroke of the press, the strip has to be fed forward for one pitch length. This can be accomplished by means of stopper.

The function of the stopper is to arrest the movement of the strip when it is fed forward to one pitch length



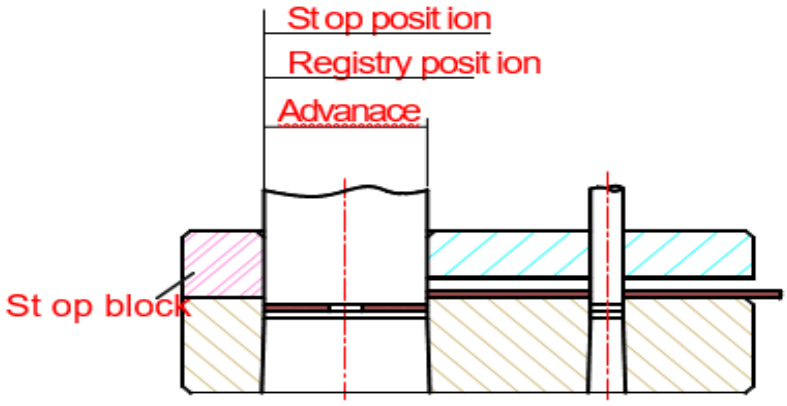
Basic stop principles:

It is essential that two basic definitions be associated with the fundamental principles of stops,

- Stop position.
- Registry position.

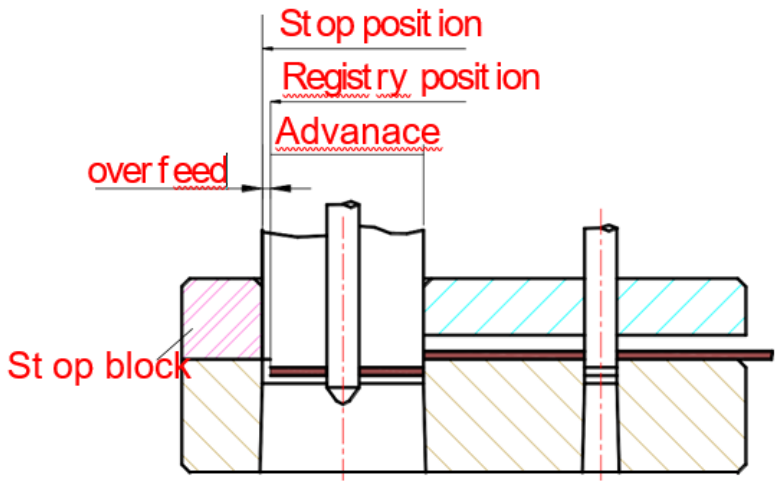
Stop position:

This is the location of the actual stopper position surface against which the stock strip is halted.



Registry position:

This is the exact location in which the stock strip must be established in order that the work will be dimensionally correct. The registry position may or may not be the same as the stop position.



Relationship between stop position & registry position:

- The work is located by the stop and is registered by the pilots.
- The Relationship between stop position & registry position depends upon the function of the stop. if a stop acts a true gauge, stop position & registry position are one end the same. If stop function as an approximation gauge, the stop position doesn't coincide with the registry position. It can be said generally that if the stock strip is piloted, it is necessary for the stop to act only as an approximation gauge, allowing the strip to be overfed. If a stock strip is not piloted the stop then function as a true gauge.

Stopper Categories:

Primary:

Primary stop is the first stop in the die, which act as true gauges, registering the stock strip.

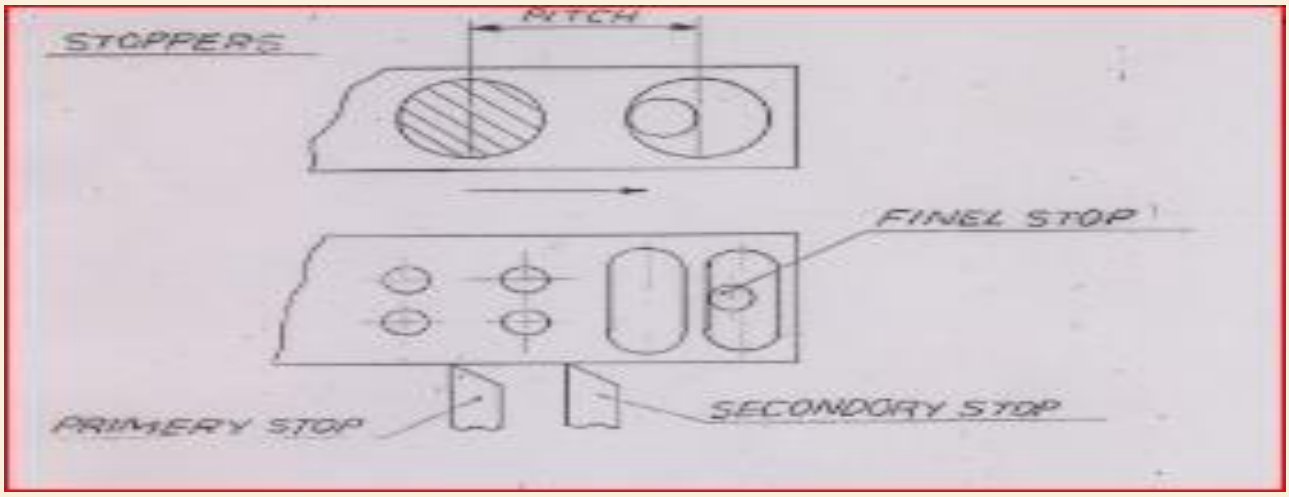
This locates stock position to coincide with the registry position.

Secondary:

The stops in between are secondary stops. The secondary stop acts as an approximation gauge, therefore allows the overfeed when installed.

Final:

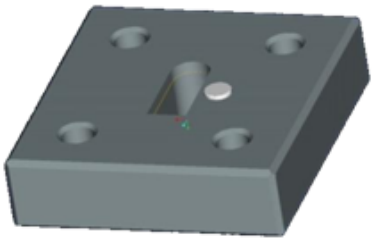
The final stop is the last stop in the die. It may or may not register the stock strip, when mounting them locate the stopping position as required.



Stop types:

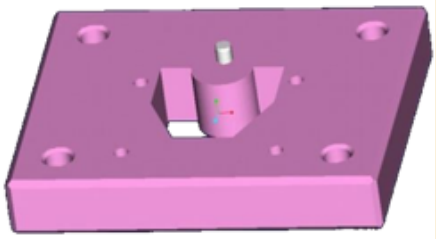
Solid stop:

It is simply a hardened steel pin mounted at required location.



Plain pin stop:

The stop is the plain cylindrical pin. The stop pin is mounted in a die Block. The pin is a light drive fit on the mounted hole. The mounted hole is generally made to suit standard pin size.

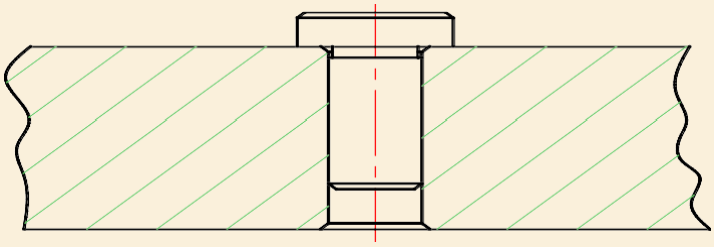


A clearance hole for the pin should be provided in the die shoe for three reasons:

- To permit adjusting the height of the stop pin without removing the die block from the die shoe.
- To allow the stop pin to be removed in order to sharpen the die with the die block fastened to the die shoe.
- To allow the pin to be driven down in the event of a miss-feed, thus reducing the chance of damage to the die

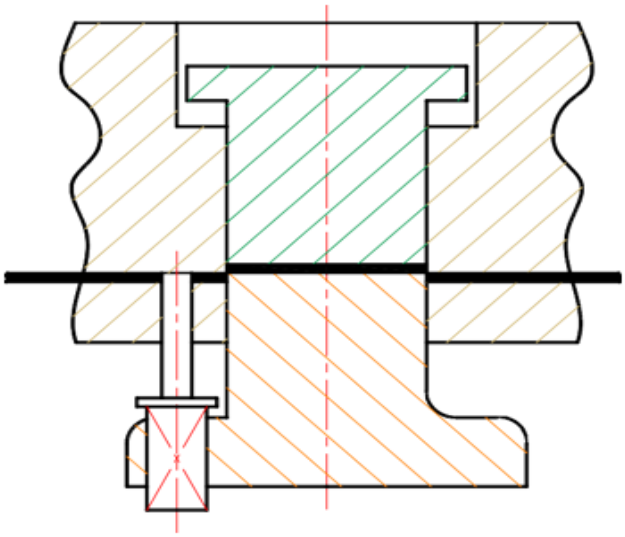
Headed pin stop:

It frequently occurs that a stop must be located close to the die opening. In such cases the use of plain pin stop is prohibited because the proximity of the mounting hole to the die opening will make the die weak. For such an application a headed pin stop may be employed. The mounting hole can be located at the safe distance from the die opening.



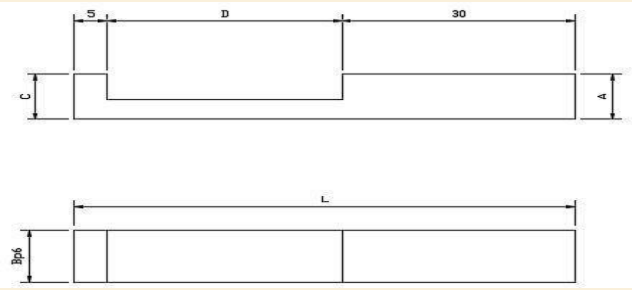
Disappearing stopper:

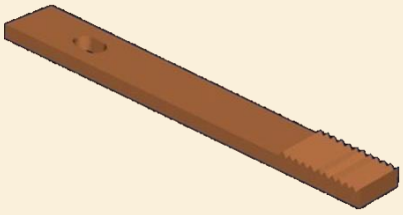
It is a spring pin located at the required stopping position disappearing stops offer one important advantages over other pin stops is that they do not require clearance in opposing die members



Finger stopper (STAGE STOPPER)

The stop is actuated manually. It is pushed inward until the stop shoulder contacts the front edge of the stripper. When the stop is in close position, the nose of the stop extends into the stock channel, obstructing the stock strip. The stop is held in closed position and the leading end of the stock strip is fed against the stop. Then operator trips the press and releases the stop. The spring returns the stop to its open position where its remains until a new stock strip are fed into the die.





Pusher Stops:

UNIT 11: STRIPPERS

These stops are special types of finger stop. They serve a dual purpose as both stops and pushers–the spring forces inward where it obstructs the stock strip channel. In operation the leading end of the stock strip is fed against the pusher stop. After the press cycle, the stop is manually pulled outward, permitting the strip to advance the next stop. When released, the stop in effect becomes a pusher.

Trigger stoppers:

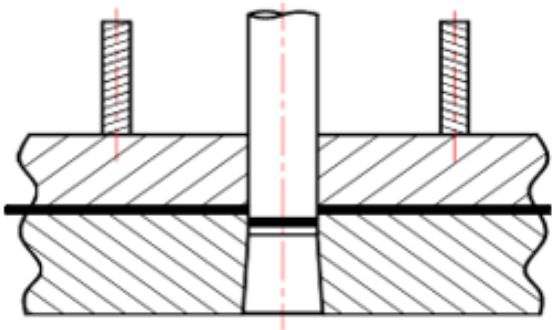
For the fast productions mostly trigger stopper are used. They are also called as automatic stoppers. They are of two types

1. Front acting &
2. Side acting.

In general, the working mechanism is same in both but one is mounted in the front end of the tool & other one at the side of the tool. The lever shaped trigger stop fits freely in the slot milled in the guide plate. One sidewall of the slot is provided with the taper angle, which gives the necessary movement to the trigger. An inclined set spring set at the other end of the trigger.

STRIPPERS:

The main function of the stripper is to strip the stock material off the punches after each stroke. In addition, the stripper may act as a guide for the punches, as well as hold the strip flat and tight, while the strip is being worked on.



STRIPPER CATEGORIES AND TYPES:

Stripper can be classified into 2 groups,

- Fixed stripper, (BOX STRIPPER)
- Traveling stripper. (FLOATING STRIPPER)

Fixed stripper is easier to make than the traveling strippers. Fewer components are required in the construction of fixed strippers when compared to the equivalent traveling stripper. Therefore, the fixed strippers are economically desirable as far as the die construction cost is concerned, mechanically, fixed stripper are solid in performance. This is an advantage where the stripping force is necessary. But, in some situations a fixed stripper may be impracticable. i.e.

1. When it is necessary to clamp the strip in addition to its stripping function.
2. When it is necessary to keep the punches engaged in the stripper during the entire press cycle.
3. A traveling stripper permits the operator to observe the work while the tool is operating.

Box Stripper:

A typical box stripper is shown below made up of mild steel St42, this is always kept soft. The tunnel dimensions are as fallows tunnel is the space (way) to strip movement

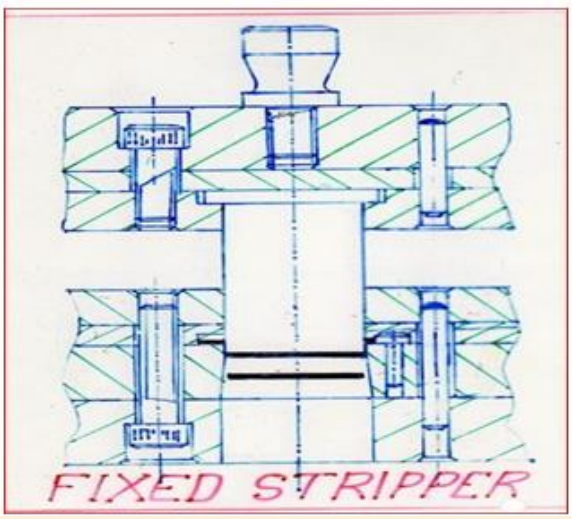
The tunnel width “X” can be determined as

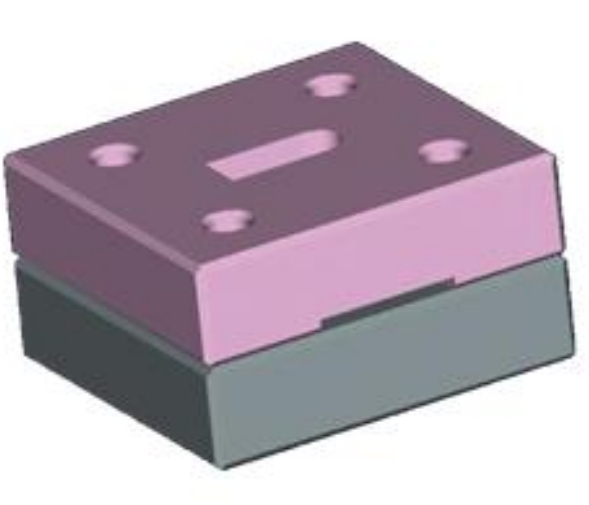
X=W+F W = Stock strip width at maximum tolerance.

F= Desired horizontal feeding distance.

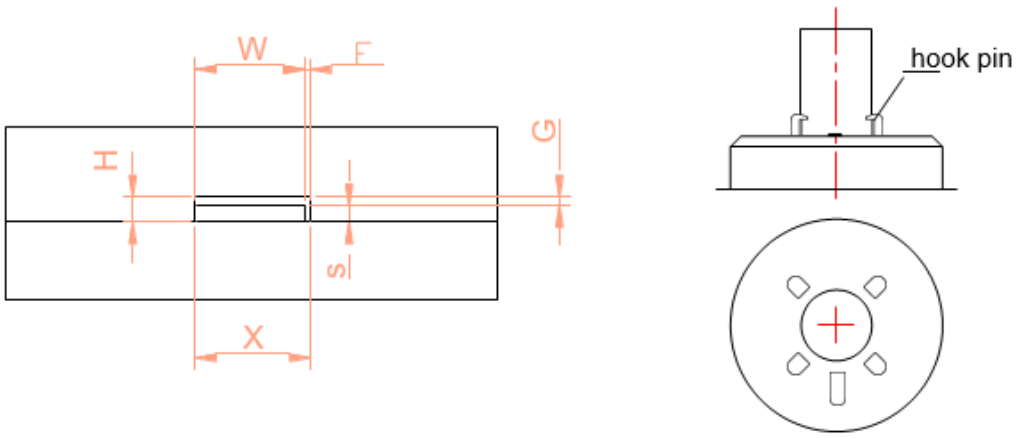
For the average progressive die, assuming there are no other specific requirement, Clearance F may be 0.3 per 100mm tunnel length.

Tunnel height H=S+G, G is the required vertical feeding clearance, G may be= 0.5s for flat work cutting dies with short tunnel length. Or it may be several times larger than the ‘S’





HOOK STRIPPER



Hook pins are made from cold drawn steel. The function is as shown in figure.

PRESSURE PAD STRIPPERS:

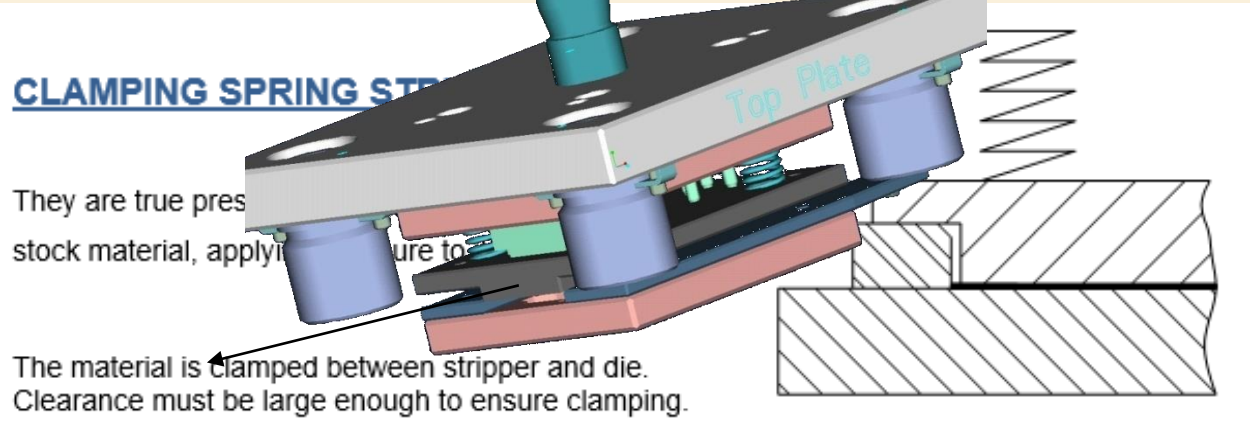
Pressure pad strippers hold the material during cutting and strips it from the punch in the upward stroke. They may be actuated by the spring, rubber or hydraulically.

SPRING STRIPPERS:

Spring stripper is a pressure pad stripper. They are used when it is necessary or desirable to hold the stock material flat (or very nearly flat), or to provide better visibility and access when the tool is mounted on the press. Inverted dies have stationary punches & therefore

require traveling pressure pad strippers. Pressure pad strippers are also used for push back applications.

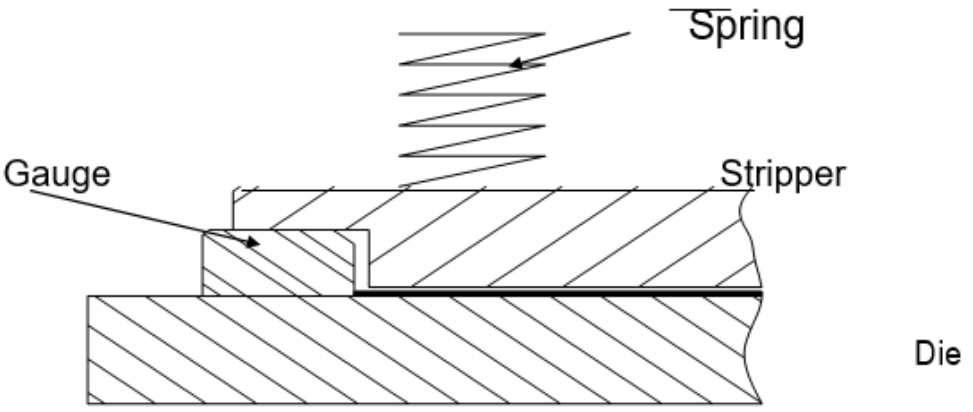
Stripper Plate



NON CLAMPING SPRING STRIPPER:

These kinds of strippers are used when the material is not to be clamped. There will be clearance between the stock strip and the strip for obtaining good flatness, clearance within 0.05 to 0.4mm is recommended. The pilot registers the stock strip. In most cases, spring strippers are an effective device for producing good flat piece parts.

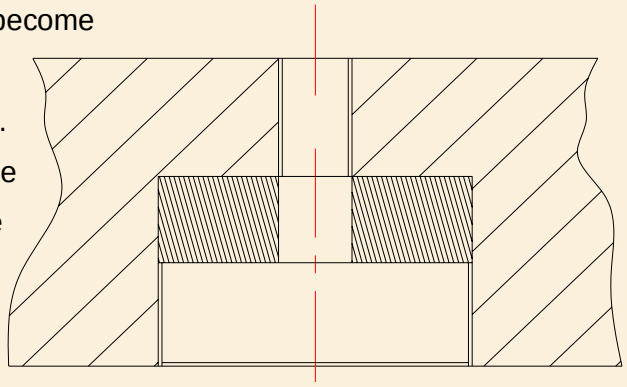
PILOTING THROUGH SPRING STRIPPERS:



It is often necessary to employ pilots in conjunction with spring stripper. If the stripper is the clamping stripper, it cannot be used to strip the pilot completely, this is because the pilot should register the stock strip before the strip contact the material. To strip the material from the pilot, the guide rails are used. If the pilots however are too far away from the hooking action of the guide rail legs, the stock material may pull up, bowing the strip even if the stock material doesn't pull out of the rail confinement, there will be bowing action. It can cause the excessive pilot wear, seriously deteriorate the quality of the pierced opening and adversely affect the ultimate flatness of the piece part. When the pilot position too far away, then non-clamping strippers are applied, so that the stripper strips the stock strip also from the pilot.

COMPENSATING WASHER:

When cutting punches are sharpened they become shorter. In many applications, the springs are compressed a little more and are not always desirable. A practical method to eliminate this is to install the cylindrical washer as shown in the figure. Each time the punches are sharpened the washer is reduced for the amount



SPRING AROUND THE STRIPPER BOLTS:

Such a construction is shown figure. This construction has desirable features and undesirable features

Desirable features are

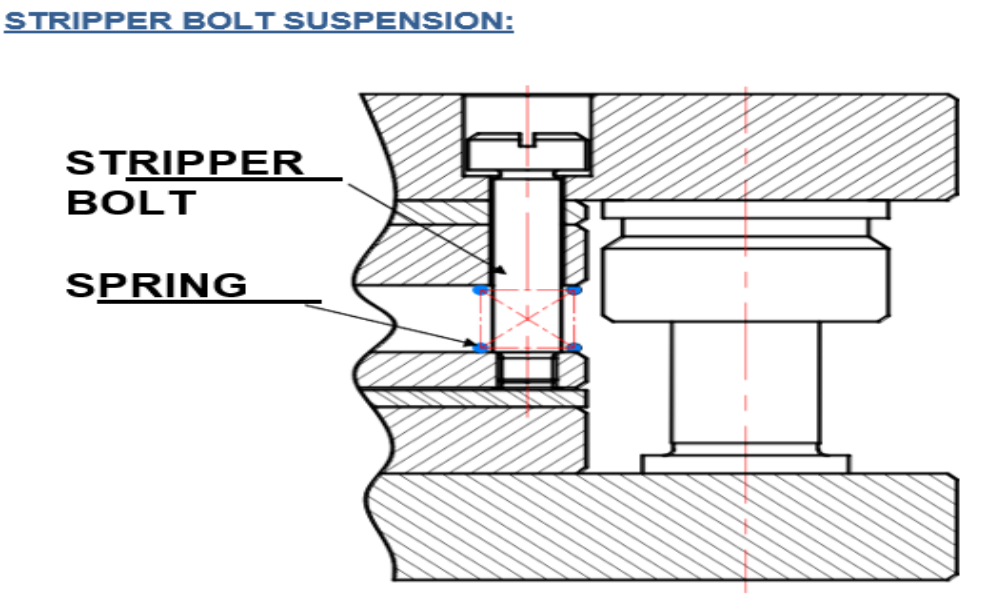
- The bolt retains the stripper at center of spring pressure
- The bolt acts to confine the spring in location so that the double spring pocket can be eliminated

STRIPPER BOLT SUSPENSION:

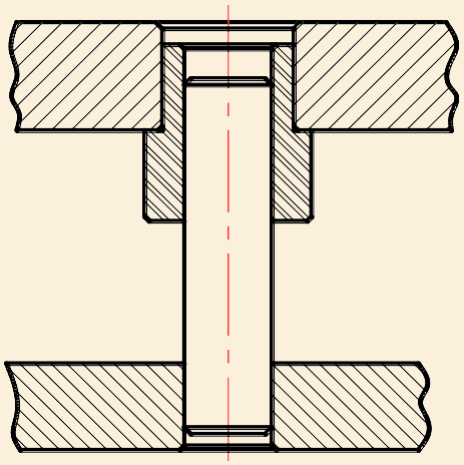
Bolt hole is drilled larger than shoulder diameter A. (clearance hole is provided). When the die fully closed and the stripper bolt is at its maximum travel position E must be sufficient to assure adequate punch grinding life (E is about 6mm).

Normally, a space G Should exists between the end of the stripper bolt and the stripper (G = 0.5mm).

To ensure stripping a spring stripper should over travel a distance S, when the stripper is at its extended position. The over travel is between 0.1 for every light work to 1.5 for heavy work. In any case each time the punch is sharpened, the over travel increases. This should be corrected from time to time by inserting the compensator under striper bolt head as shown.



GUIDE STRIPPERS:



Two typical stripper guide pins arrangements are shown in figure. The drawings are self-explanatory.

STRIPPING FORCE:

Stripping force for most operations range from 10 to 20% of the cutting force. If the die has more than one punch the stripping force for that die is the sum of stripping force required for each punch.

Stripping Force for the Blanking and Piercing:

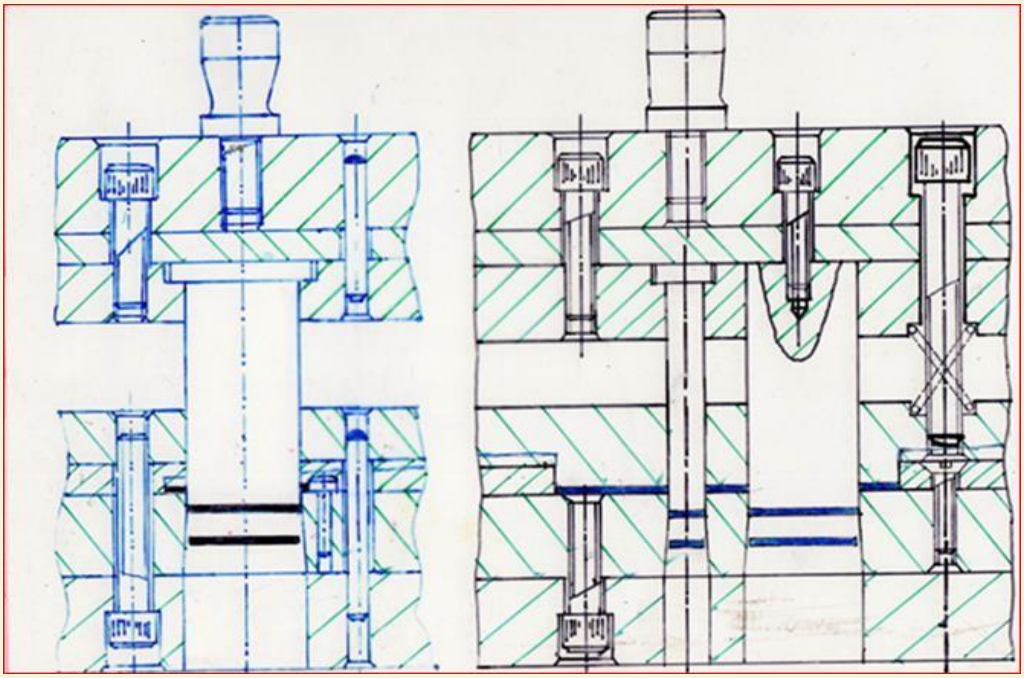
The following factor affects stripping force,

1. **Stock material:** Material, which has high friction, value and material, which tend to cling, are more difficult to strip.
2. **Surface condition of sidewalls:** A punch, which has smooth finish on its side, wall strip more easily than punch, which is not as smooth.
3. **Area of the stock material to be stripped:** Figure shows two-piece parts one larger than other. The thickness and the type of stock material. The pierced opening is the same size in both parts. The cutting is the same for both the parts. But the larger piece part requires the greater stripping effort.

The larger area of the stock material surrounding the punch is stronger and causes the material to

cling more tightly to the punches.

THE TYPICAL VIEW OF FIXED STRIPPER & FLOATING STRIPPER



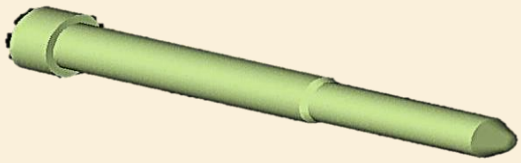
FIXED STRIPPER	FLOATING STRIPPER
1, Stripper plate is clamped to bottom half, & It is constant.	1, Stripper plate is at top half, & It has movement.
2, Guides the punches & removes (strips out sheet metal)the sheet after cutting operation	2, Guides the punches & removes (strips out sheet metal)the sheet after cutting operation and also holds the sheet material while cutting operation.
3,Components produced not perfectly flat	3,Hence components produced perfectly flat
4, Tool design & manufacturing cost is more	4,Tool design & manufacturing cost is too high.

UNIT 12: PILOTS

PILOTS:

Pilots play a vital role in the operation on multiple-station dies, and many press lines troubles can be traced to their faulty design. In applying pilots, the following factors should always be considered:

1. They must be strong enough so repeated shock will not cause fracture.
2. Slender pilots must be sufficiently guided and supported to prevent bending, which can cause faulty strip positioning.
3. Provision should be made for quick and easy removal of the pilots for punch sharpening.



PILOTS

- The function of the pilot is to position the work piece or stock strip accurately
- In progressive dies to locate the work strip so that the relationships between stations may be maintained.
- Advantage is taken of these holes so that the blank formed is exactly concentric to the pierced hole
- This piloting is obtained with the help of pilots secured to the blanking punches

PURPOSE OF PILOT:

The pilot positions the stock strip relation with die opening. This is termed as registering the stock strip in the required position. Usually the stock strip is over fed than the actual pitch length. The

max over feeding of the strip is about 0.1mm.

When the press is tripped the pilot comes down and engages the pierced hole thus dragging the strip back into the registry position stock strip is fed by mechanical means pilot action is the same principal. However, the direction in which the feeding is qualified is normally reversed. Instead of being over feed the stock is under fed.

PILOT SIZE:

The accuracy with which the work can be registered depends upon the proper location and the diameter of pilot, the pilot should be close sliding fit to the die opening after piercing. There will be clearance given between cutting punch & corresponding die hole but there will be only sliding fit between pilot & the corresponding die hole.

Example – Pierced hole Ø8.00 then pilot will beØ7.98 –Ø7.99 & die hole will be Ø8.02 The following will indicate the pilot diameter;

For an average work Ø of pilot = (Ø of hole to be piloted-0.03 to 0.05mm) For close work Ø of pilot = (Ø of hole to be piloted-0.02to 0.03mm) For an accurate work Ø of pilot = (Ø of hole to be piloted – 0.01to 0.02mm)

However, the thick stock materials & the stock materials like aluminum and copper need often bigger tolerances between the pilot and the pierced hole.

PILOT LENGTH:

Registering the strip must be complete before the cutting punches come and engage the strip. Therefore, the pilot must be **10mm longer than the punches**. If the pilots are too short they cannot perform their function

This creates serious consequences ranging from spoiled work to damaged pilots. Care must be taken while setting the stroke of the press so throes pilots clear the stock strip without obstructing the future feeding of the strip in any case the piloting length should be extended beyond the punch face equal to the sheet thickness.

PILOT OPENING IN THE DIE:

The opening of the pilot in the die should not be too large. If so, the stock strip may tend to draw into the opening. In case of the thin material pilot may not displace the material into registry position but may instead draw the material on one side therefore it is advisable to have the die opening Ø as pilot dia+0.02mm, Weaker pilots are guided in the stripper.

PILOT OPENING IN DIE SHOE:

Through hole is provided in the die shoe for the pilot so that slugs produced during miss feed are cleared. It also helps in clearing the accumulated burrs dislodged from the pierced hole.

- Step headed shank less
- Step head shank type
- Step head pyramid type
- Beveled head
- Headless whistle notched

PILOT NOSE PROFILE:

The main function of the pilot nose profile is to allow smooth riding of the pilot into the stock strip. The most commonly used nose profiles are described below:

BULLET NOSE:

The most common pilot nose profile is bullet nose. The bullet shape is formed by radius 'R', which is equal to piloting diameter. For piloting in holes less than 6mm the length of radius R can be increased to reduce the lateral force during piloting. Bullet nose is strong simple to make and smooth in action.

The other three commonly used pilot nose profiles are:

1.45º conical stub nose

2.30º conical stub nose

3.16º angular long nose

45º CONICAL STUB NOSE PILOT:

The profile is used when a shorter nose profile is desired. 45º cone increased the relative lateral forces hence not recommended for delicate pilots used for piloting thin soft material.

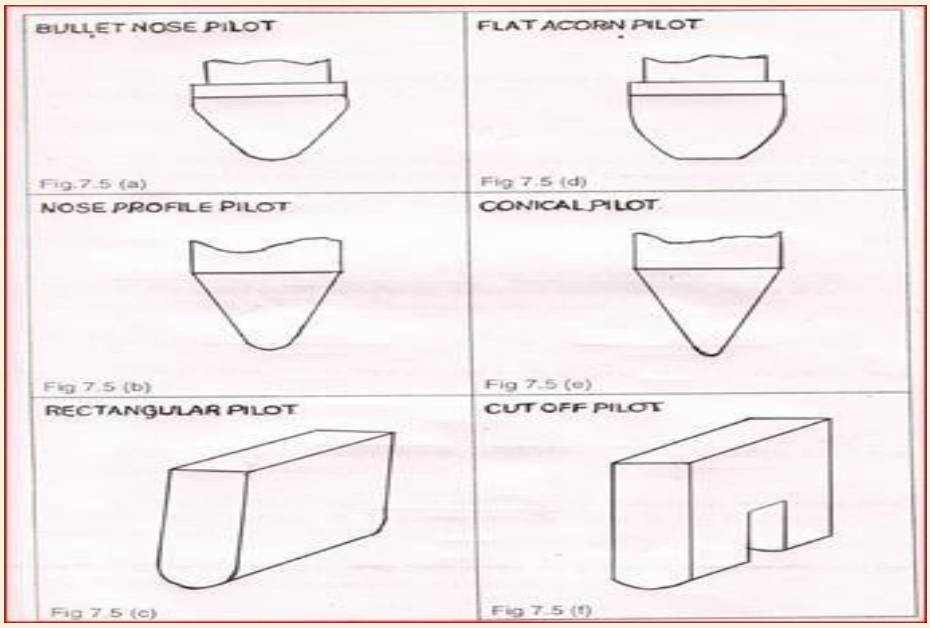
30º CONICAL STUB NOSE PROFILE:

This is same as the above pilot except the nose angle is30º this is a compromise between the 45º stub nose pilot and the conventional bullet nose

15º ANGULAR NOSE:

This small angle provides good mechanical advantages. they are used for small pilots and for thin materials.

PILOT NOSE PROFILE

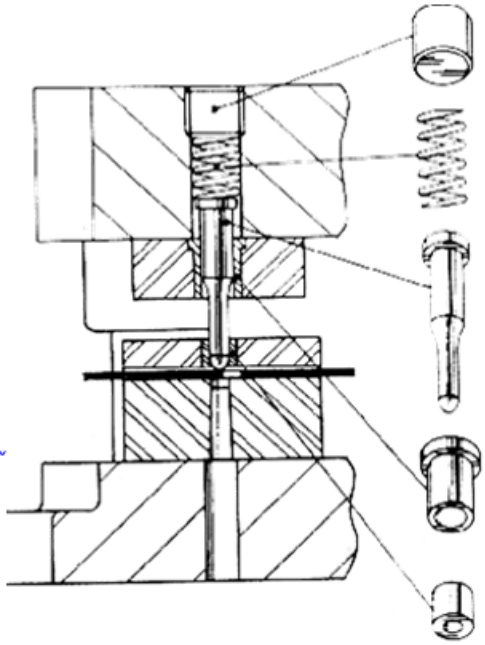


TYPES OF PILOTS:

RETRACTABLE PILOTS:

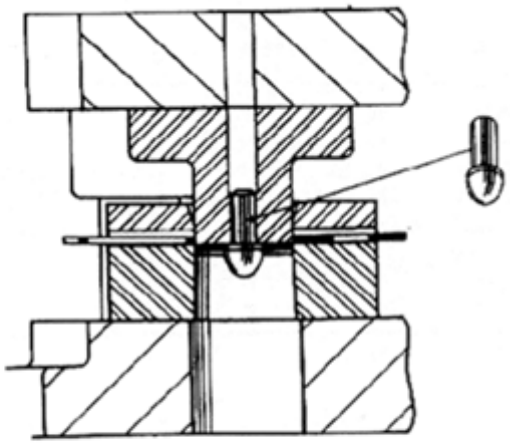
In many occasions especially during hand feeding misfeeding occurs due to over shooting of the stock strip over the stoppers. This creates the problem when a tool is having pilot s in it. Pilots may break or buckle obstructing smooth function of the tool.

Generally retractable pilots are spring loaded in such away that they will be lifted upwards when they come in contact with the un pierced area during press descends. Care should be taken while selecting spring so that springs allow more telescopic movement of the pilot.



REMOVABLE TYPE PILOTS:

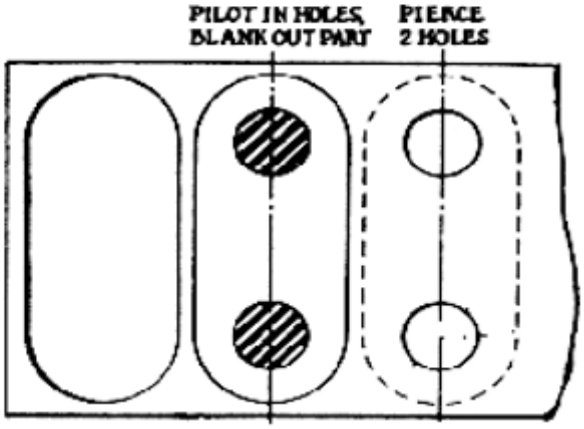
Pilots break very often due to misreading of the stock strip. Much consideration must be given for changing quickly the broken pilots, preventing greater time loss during production. Removable type of pilots can overcome this difficulty. These pilot inserted through top bolster into the punch holder and fastened with a backup screw as shown in fig:



METHODS OF PILOTING:

Direct piloting:

It consists of piloting in holes pierced in that area of the strip, which will become the blank. All pilots decided so for have been direct pilot which are retained in the blanking punch.

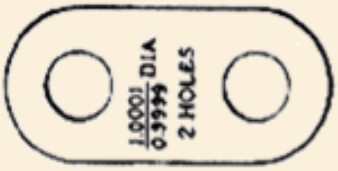


INDIRECT PILOTING:

Indirect piloting consists of piercing hole in the scrap area of the strip and locating in these holes at subsequent operations direct piloting is the preferred method but certain blank condition require indirect piloting, as will be explained.

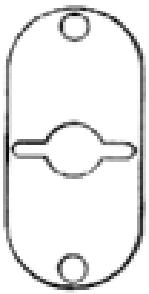
IN DIRECT PILOTING PART CONDITION:

There are seven conditions that required in indirect piloting. Close tolerance on hole: Pilots can enlarge holes in pulling a heavy strip to position.

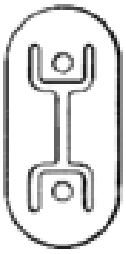


Holes too small: Frail pilots can break or deflect in operation.

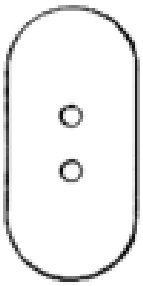
Holes too close to edge of the blank: Distortion can occur in blank because of enlargement of holes



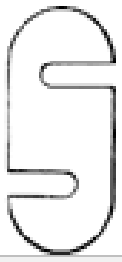
Holes in weak area: Piloting in projecting tabs is impractical because they may deflect before the strip is pulled to position.



Holes placed too closely: Piloting in closely placed hole does not provide an accurate relation between two holes and edge of the blank.

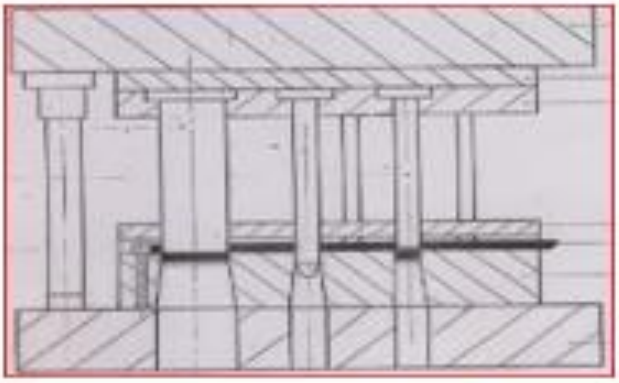


Blank without holes: Piloting is done in the scrap area wherever the blank does not contain holes.



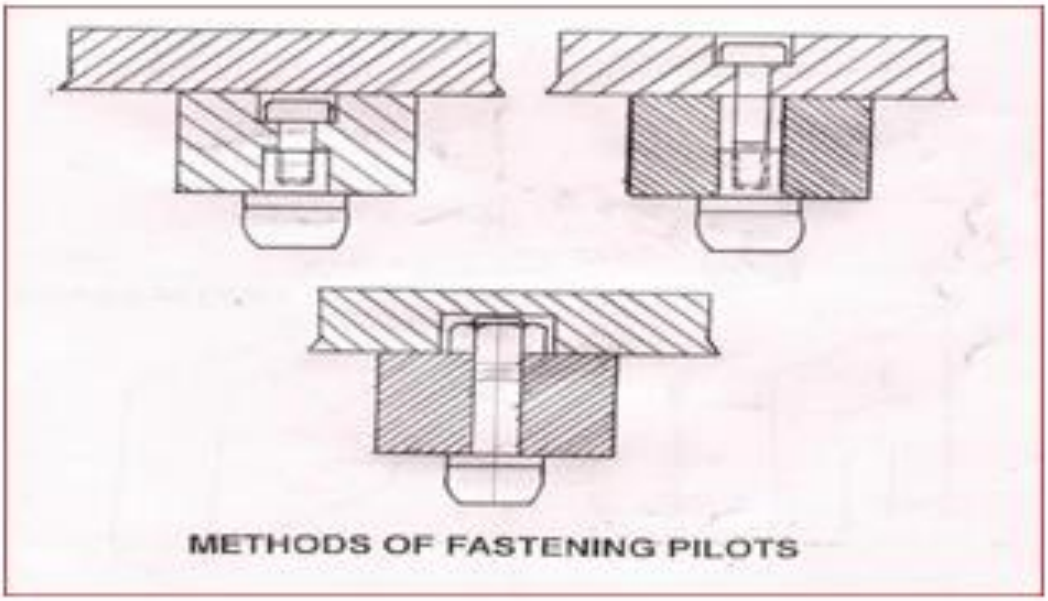
Projection in hole: Whenever the hole in the blank contains weak projection, which could be bent down by the pilot, indirect piloting should be selected.

PILOTS PLACED IN A PROGRESSIVE TOOL



MOUNTING METHODS OF PILOTS

Pilots can be mounted some method of positive retention should be used to prevent the pilot from dropping out of the punch. Press fit pilots should be avoided for this reason.



METHODS OF FASTENING PILOTS

UNIT 13: CENTRE OF PRESSURE

Centre of pressure (Location of a Shank on a Tool):

The point of pressure where at which the all the forces acts, it is the resultant position at which all the applied forces meet. In the press tool different operations are done with different profiles of components, thus the forces of different pressure will be applied by a various types of punches hence center of pressure is most important for considering the die life of the tool. The shank is clamped at the point where Centre of pressure meets, so this is also called as Location of a Shank

IMPORTANCE OF CENTRE OF PRESSURE

- Balancing of the punches is the most important aspect during punching operation.
- Un balanced force on the tool may lead to undue wear on punch and die as well as pillars.
- The resultant forces of all cutting forces acting on many punches should pass through the shank center.
- This is called as **center of pressure or COP**

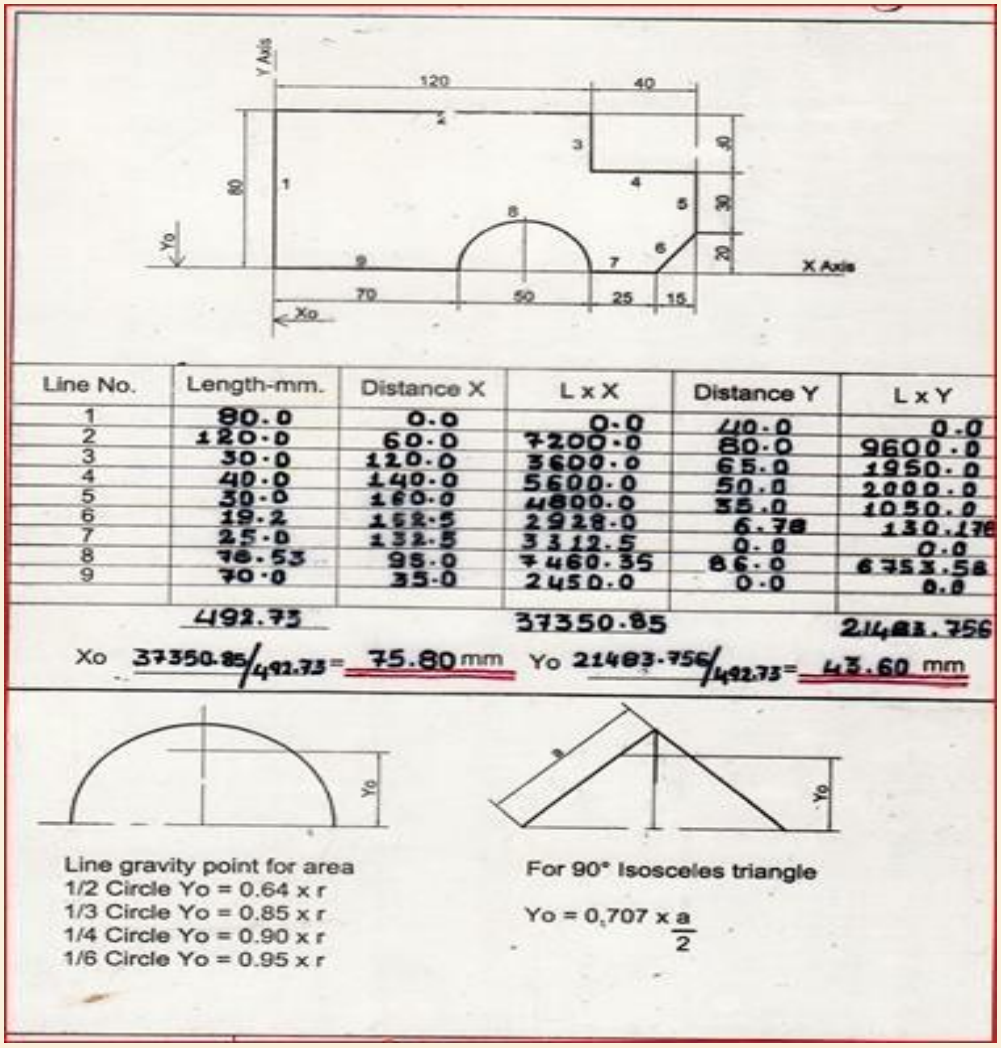
The position of the resultant forces of all partially cutting forces can be found by the following methods

- By calculation.
- By polygon system (graphical)

By Calculation:

1) No all the lines in component.
2) Length of each lines in mm
3) Distance from X axis.
4) Distance from Y axis.
5) Line length multiplied by Distance from X axis.
6) Line length multiplied by Distance from Y axis.
7) Total of L x X & L x Y
8) L x X & L x Y = COP IN X AXIS & COP IN Y AXIS
9) Total of L

By Calculation:



Line No.	Length-mm.	Distance X	L x X	Distance Y	L x Y
1	80.0	0.0	0.0	40.0	0.0
2	120.0	60.0	7200.0	80.0	9600.0
3	30.0	120.0	3600.0	65.0	1950.0
4	40.0	140.0	5600.0	50.0	2000.0
5	30.0	160.0	4800.0	35.0	1050.0
6	19.2	152.5	2928.0	6.78	130.176
7	25.0	132.5	3312.5	0.0	0.0
8	78.53	95.0	7460.35	86.0	6753.58
9	70.0	35.0	2450.0	0.0	0.0
	492.73		37350.85		21483.756

Xo $\frac{37350.85}{492.73}$ = 75.80 mm Yo $\frac{21483.756}{492.73}$ = 43.60 mm

Line gravity point for area
1/2 Circle Yo = 0.64 x r
1/3 Circle Yo = 0.85 x r
1/4 Circle Yo = 0.90 x r
1/6 Circle Yo = 0.95 x r

For 90° Isosceles triangle

$Yo = 0.707 \times \frac{a}{2}$

By Polygon System:

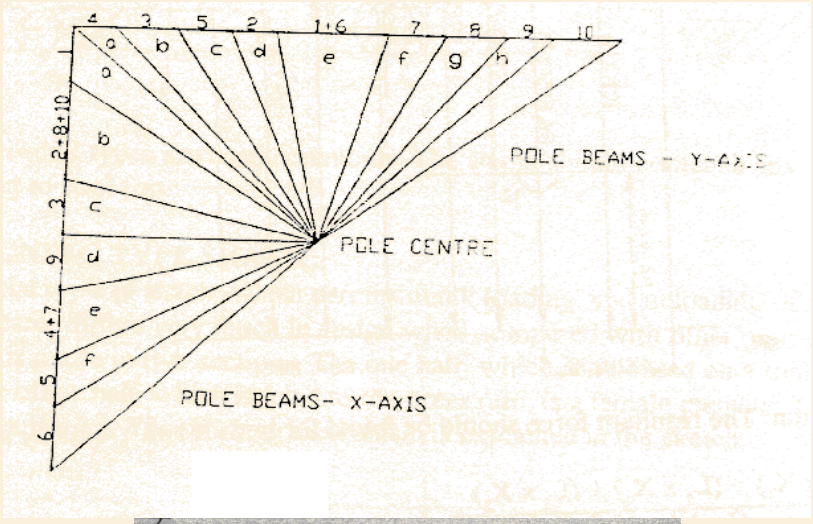
Polygon system:

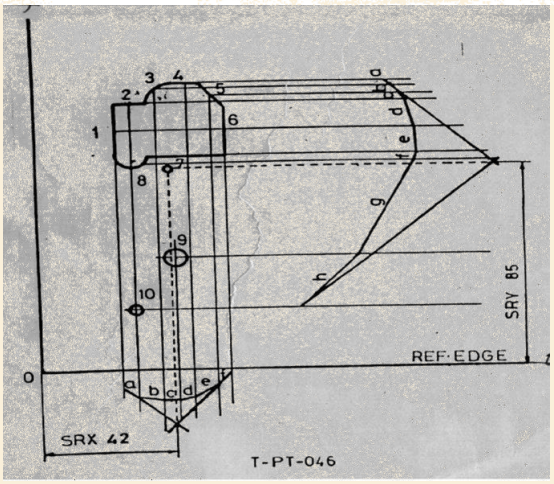
To find the line of the action of resultant then follow the reference below:

1. Draw the forces to scale in a straight line.
2. Draw the arrowheads at the ending points of each force as shown.
3. Draw two more lines at 45^0angle from the starting and finishing points of the total length of the forces so as to form an equilateral triangle and call the intersecting point as pole.
4. Draw the lines from each arrowhead joining the pole point and call them as pole beams.
5. Draw the forces to scale at the given distance.
6. Draw the lines parallel to the pole beams, cutting force line graphically.
7. The line of action of the action of the resultant goes through that point where those two-

UNIT 14: FITS IN PRESS TOOLS ASSEMBLY

pole beams intersect.





Fits

When two parts are to be assembled the relation resulting from the difference between their sizes before assembly is called a fit. The fit signifies the range of tightness or looseness which may result from the application of a specific combination of allowances and tolerances in the design of mating parts.

UNIT 15: DIE SETS

Fit is the relation between two mating parts, this is also depending the function of the elements. The maintaining of proper fits between related elements in press tools will effects all the below points effectively.

Importance of Fits in press tool

1. Improves tool Life.
2. Improves Component dimensional accuracy
3. Reduction of wear & tear
4. Improves cut edge characteristics
5. Improves rate of production
6. Minimizes tool maintenance

Different types of Fits in Press tools

SL NO	Description	Fits	Remarks
1	BETWEEN GUIDE PILLAR & GUIDE BUSH	H7/h6	PRECISION SLIDING FIT
2	B/W GUIDE BUSH & TOP PLATE	H7/h6	PRECISION SLIDING FIT
3	B/W PUNCH & PUNCH HOLDER PLATE	H7/m6	MEDIUM DRIVE FIT
4	B/W PUNCH & STRIPPER PLATE	H7/h6	PRECISION SLIDING FIT
5	B/W PILOTS & PUNCH HOLDER PLATE	H7/k6	LIGHT KEY FIT
6	B/W PLATES & DOWELS	H7/m6	MEDIUM DRIVE FIT
7	B/W STOPPERS & DIE PLATE	H7/m6	MEDIUM DRIVE FIT
8	B/W STAGE STOPPERS & STRIP GUIDES	H7/h6	PRECISION SLIDING FIT
9	B/W SHEDDERS & PUNCHES	H7/h6	PRECISION SLIDING FIT
10	B/W SHEDDERS & DIE PLATE	H7/h6	PRECISION SLIDING FIT
11	BETWEEN PILOTS & STRIPPER PLATE	H7/h6	PRECISION SLIDING FIT
12	B/W GUIDE PILLAR & BOTTOM PLATE	H7/p6	PRESS FIT/FORCE FIT
13	B/W PUNCH & CORRESPONDING DIE OPENING	Calculated clearance fit	

Colour Codifications for Fits

Generally, it is advised to have color codifications in design depending upon the type of fits followed between two mating parts.

Type of fit	H7/m6	H7/p6	H7/k6	H7/h6
Color	BLUE	GREEN	ORANGE	MEGENTA

DIE SET:

These are the ready tools like drills reamers cutters etc., readily available in the market to accommodate speedy work in manufacturing process of the **PRESS TOOLS**. The assembly of A) Top plate B) Guide bush. C) Guide pillar D) Bottom plate. Is known as DIE

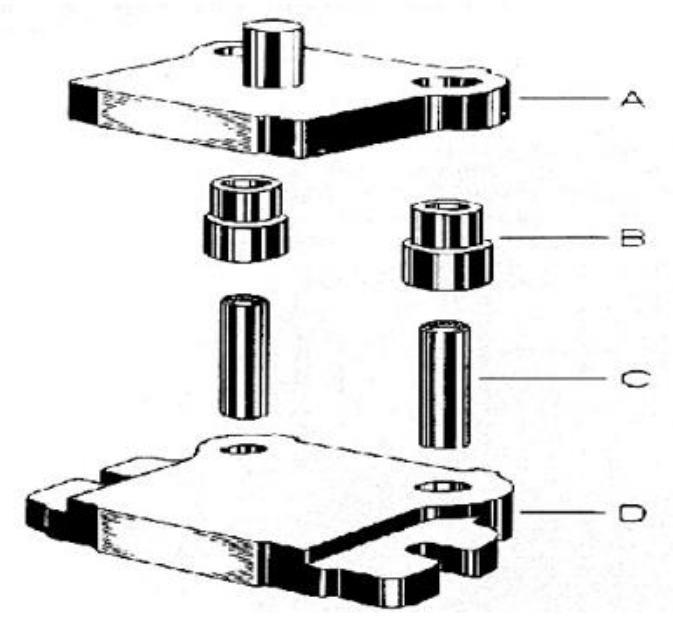
SET

ADVANTAGES OF USING STANDRED DIE SETS

- This reduces the time of manufacturing press tools.
- The accuracy of the die sets is more as they are made from SPM and skilled persons. The cost of die sets is less.
- They are available in size of 50mm X 50mm to 1mtr X 1mtr.as per requirements

The following elements are considered before selecting the die set.

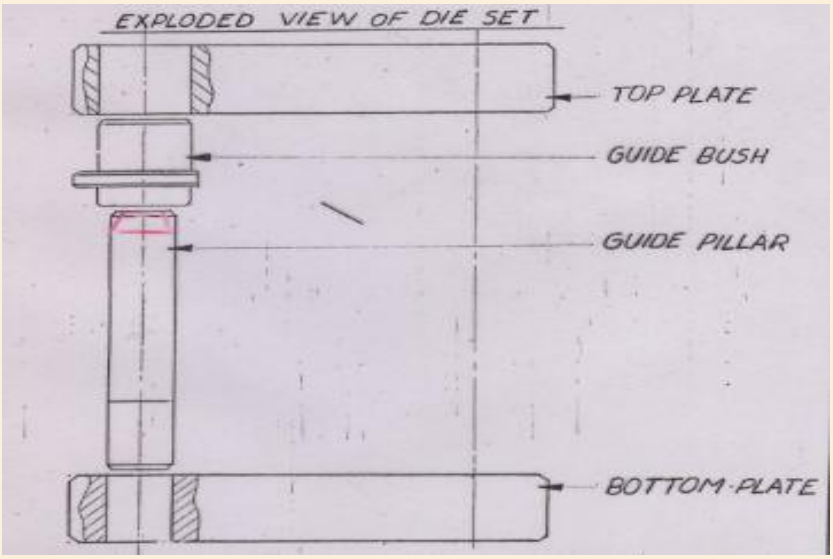
1. Make or manufacture,
2. Type,
3. Size,
4. Material,
5. Thickness of the die holder,
6. Type & length of the bushing,
7. Thickness of the punch holder,
8. Length of guidepost,
9. Shank diameter,
10. Grade of precision.



A. Top plate B. Guide bush C. Guide pillar D. Bottom plate

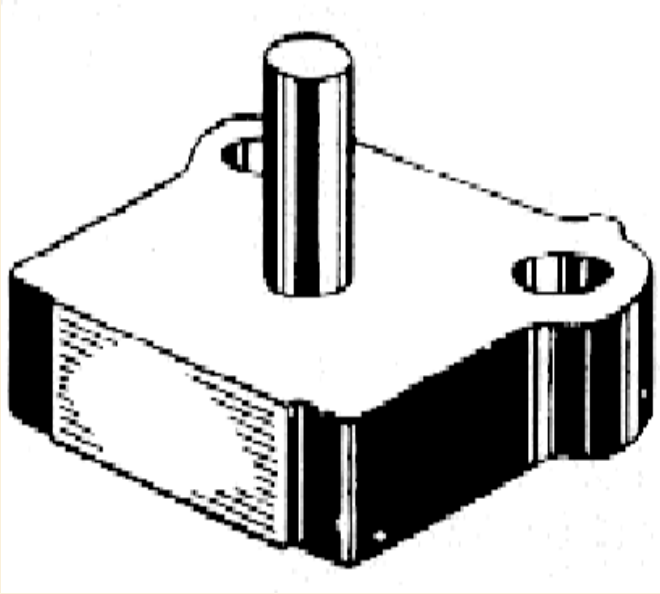
DIE SET COMPONENTS:

A. Top plate. B. Guide bush. Guide pillar. D. Bottom plate.



TOP PLATE:

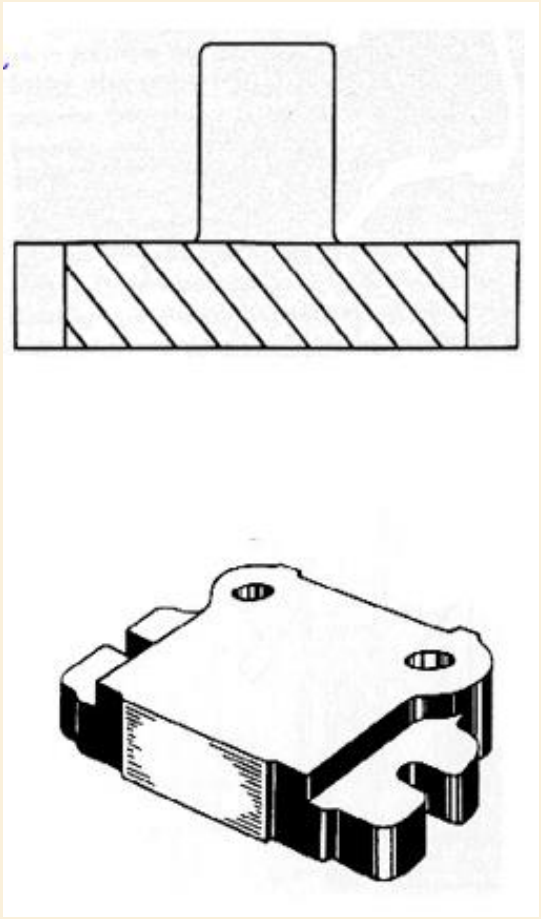
The upper working member of the die set is called the top plate. The upper surface of the top plate is bears against the underside of the press ram. The top half or Punch components are fixed (fastened) to the lower finished surface of the top plate. The top plate is generally made out of MS.



PUNCH SHANK:

The punch shank projects above the top plate and it align the center the die with the center line of press. In operation the shank is securely clamp to the press ram and it drives the punch portion of the die, rising and lowering the die.

For semi steel die sets, the punch shank is cast integrally with the body of the top plate and it is then machined. To supplement their holding power of the shank, cap screws are often inserted upward to engage tapped in the press ram.



BOTTOM PLATE:

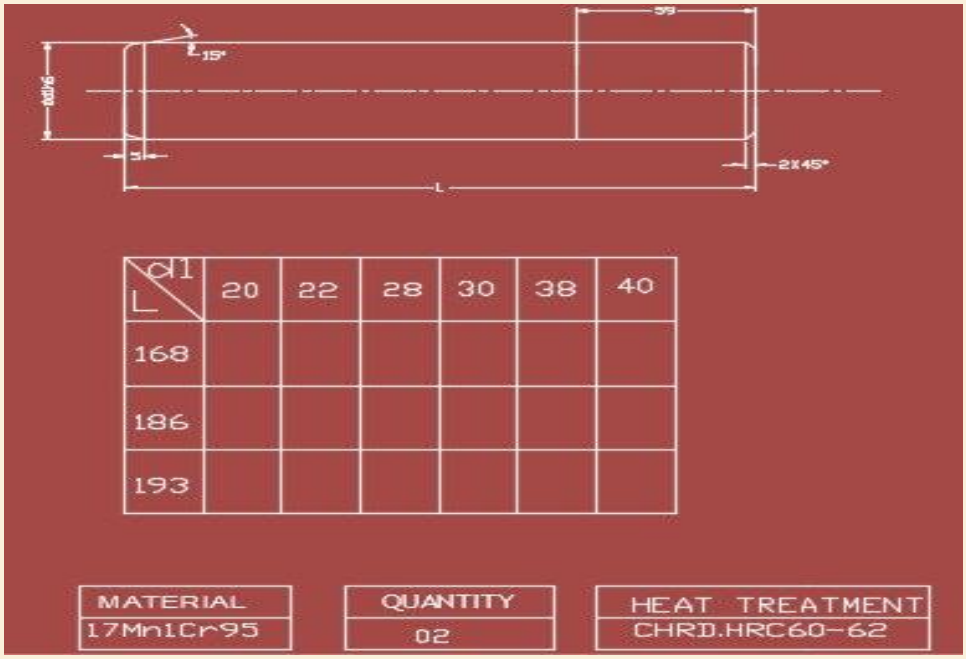
The bottom plate is the lower working member of the die sets. Usually the bottom plate is made thicker than the top plate to observe the load & shocks then compensates the weakening effect of the slug and blank holes, which must be machined through it. Generally, bottom plate is made up of MS or cast iron.

GUIDE PILLAR:

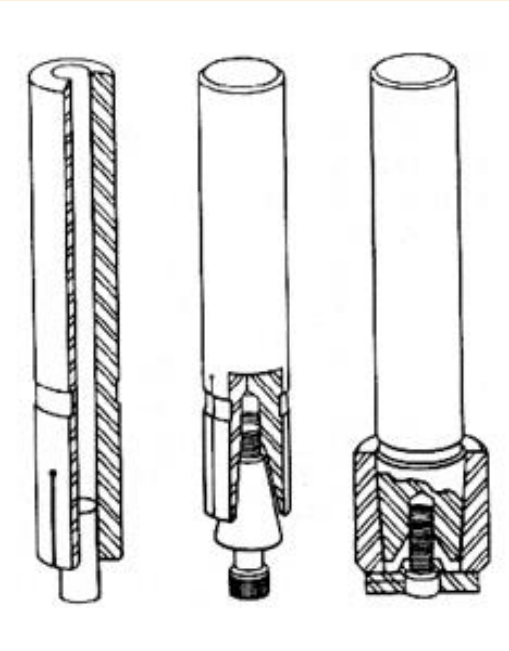
Guide pillars are precision-ground pins which are press fitted into accurately bored holes in the bottom plate. They align punch & die components with the high degree of accuracy. Most GUIDE PILLARS are made up of tool steel hardened up to 58-60HRC

Guide pillars are used for precision die sets are chromium plated to provide high degree of accuracy of resistance to wear. The addition of chromium reduces wear up to 50%.

They are specified at least 20-25MM shorter than the shut height.



REMOVABLE GUIDE PILLAR:



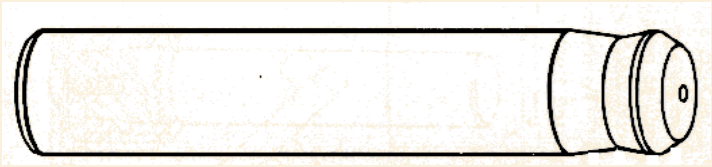
Pillars may be removed for die sharpening, especially in large dies. In first kind of removable pillar have an axial hole machined through them are tapered at one end to engage a taper pin.

In second type of removable pillar, the taper pin is advanced for locking by means of a socket cap screw.

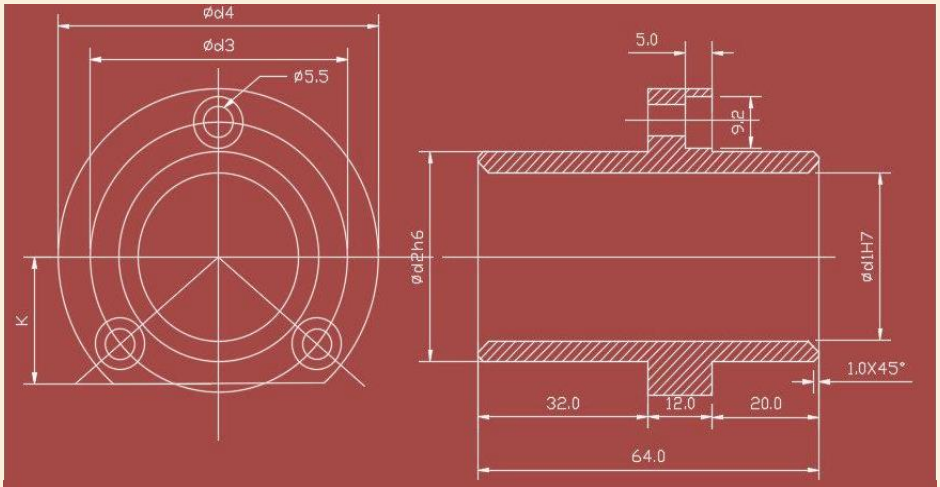
In third type of removable pillar a socket head cap screw is engaged in retaining cap to clamp the pillar to the bushing.

NON STICKING GUIDE PILLARS:

In initial engagement the jamming of top plate and bottom plate is problem to avoid this kind of problem non-sticking pillars are used. Sticking occurs until the bushings have engaged the pillars sufficiently for complete alignment.



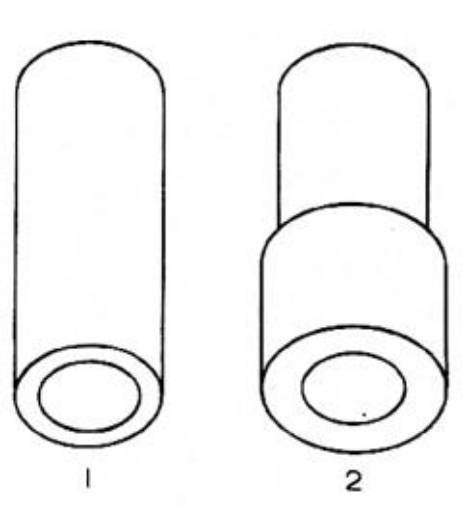
GUIDE BUSHS:



d1	d2	d3	d4	K
22	32	44	56	18
"	"	"	"	"
28	40	52	64	21
30	"	"	"	"
"	"	"	"	26
40	50	62	74	"

MATERIAL	QUANTITY	HEAT TREATMENT
17Mn1Cr95		C,HRD HRC 58-60

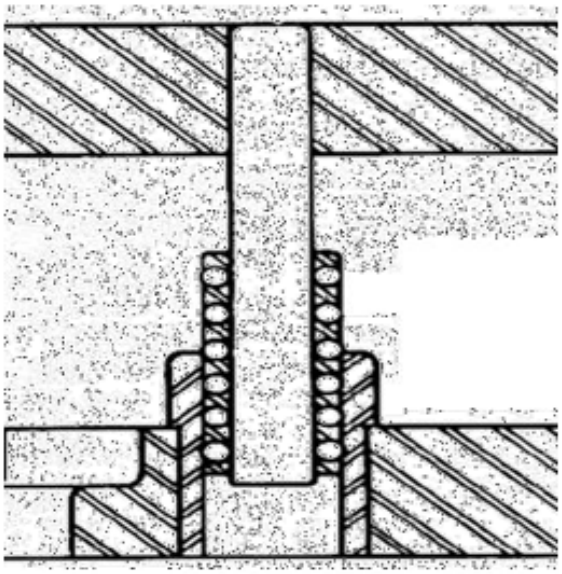
Guide bushes are engaged with the guide pillars for aligning to the top plate with the bottom plate. Most bushings are made up of tool steel hardened up to 56-58HRC they are also available in bronze.



There are two types:

1. Plain bushing are simple sleeves, pressed into the top plate.
2. Shouldered bushings are turned down at one end and they are pressed into the top plate against the shoulder thus formed.

BALL BEARING DIE SETS:



Some die sets are provided with ball bearing. Guide pillars are pressed into the top plate and thy engage linear ball bearings.

Lubrication is provided by cup greasing and this is sufficient for entire run. Ball bearings should take more place than conventional guiding and they reduce die space a small extend.

Self-lubricating Bushings

These self-lubricating bushings contain graphite plugs which are impregnated with oil. When the bushing reach 80 -90°F as a result of friction between the guide bushes and guide pillars oil is drawn from the plug, thus lubricating the wear surface.

PILLAR ARRANGEMENT:

Different Ways of positioning the pillars in a die set.

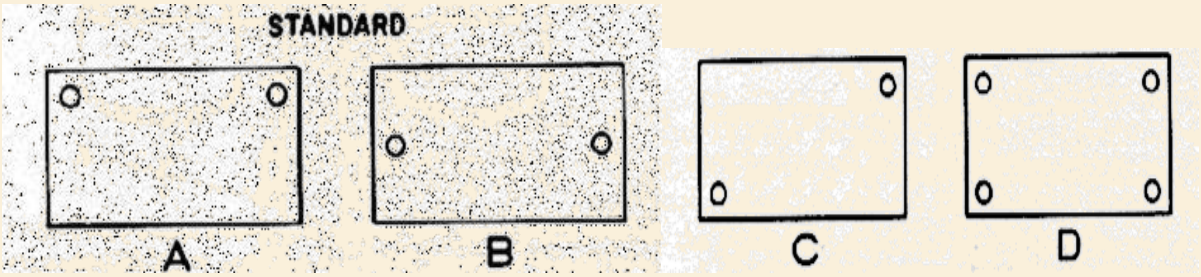
A. Two pillars are applied at the back of the die sets. This is most commonly used two pillar arrangement.

B. Pillars are applied at the sides force feeding strip from front to back.

C. The pillars are arranged diagonally.

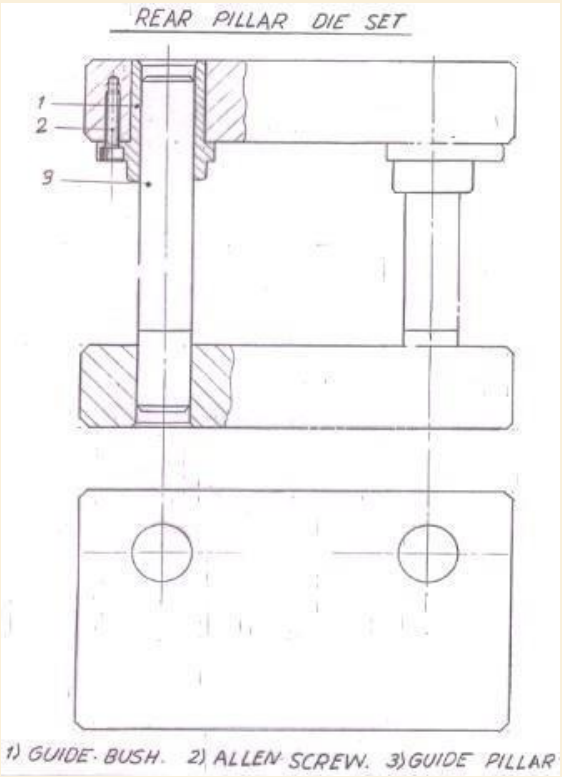
D. Four pillars are used the foregoing are standard pillar arrangement as listed in die set catalogue.

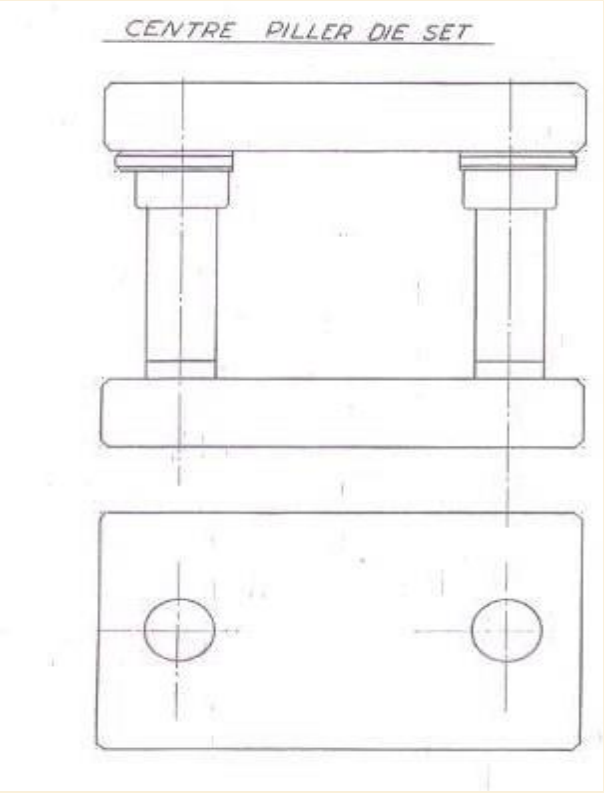
Types of DIE SETS



A- REAR PILLAR DIE SET

The pillars are fixed at the rear end of the plates these die sets are used where lesser force is applied in the tools specially for bending tools single stage tools & smaller size components manufacturing tools. The visibility of strip movement is clear in this type of DIE SETS.





b. CENTRE PILLAR DIE SET

The pillars are fixed at the center of the plates these die sets are used where medium force is applied in the tools especially for compound tools, single stage tools & combination components manufacturing tools. These die sets are also used for secondary operation work. The of movement strip is generally front to back or back to front in this type of DIE SETS.

FACTORS-TWO PILLAR DIE SETS:

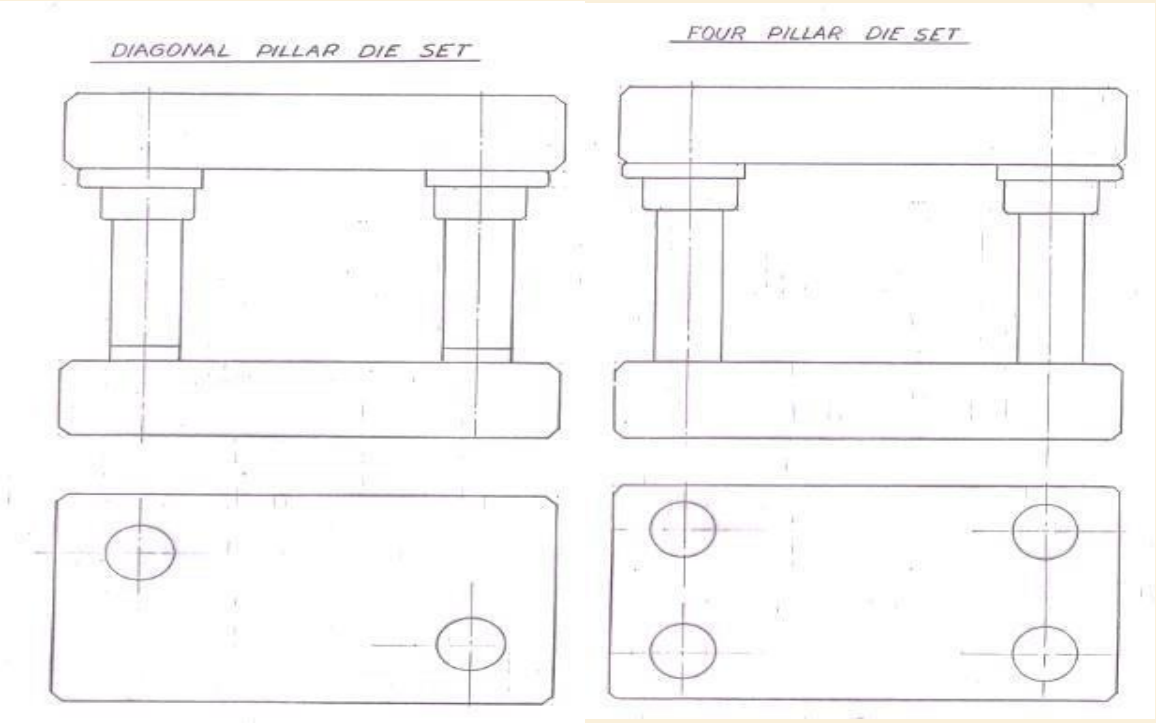
Most tools are provided with two guide pillars applied at the back of the die set because this type gives maximum visibility and accessibility since it is open on three sides.

There are three most distinct types of back/rear pillar or caterpillar die sets.

1. **Regular:** This type is employed with average proportions.
2. **Long:** This type is used for dies, which are long and narrow.
3. **Reverse:** This type is used for dies, which are relatively longer in measurement from front to back than their measurement from side to side.

DIAGONALPILLAR DIE SET:

The pillars are fixed at the diagonal corners of the plates, these die sets are used where much more force & heavy force are applied in the tools especially for multi stage tools, heavy force required tools & progressive components manufacturing tools. The of movement strip is generally left to right in this type of DIE SETS.

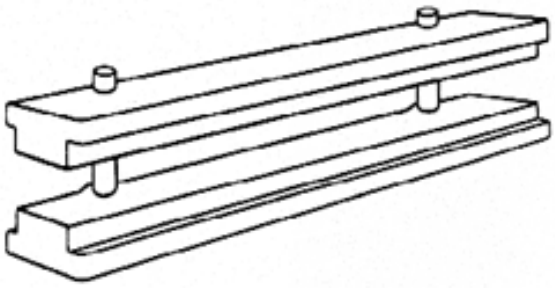


FOUR PILLAR DIE SET:

The pillars are fixed at the all four corners of the plates, these die sets are used where heavy force are applied in the tools especially for multi stage progressive tools, heavy force required draw tools & progressive components with different operations. The of movement strip is generally left to right or front to back in this type of DIE SETS.

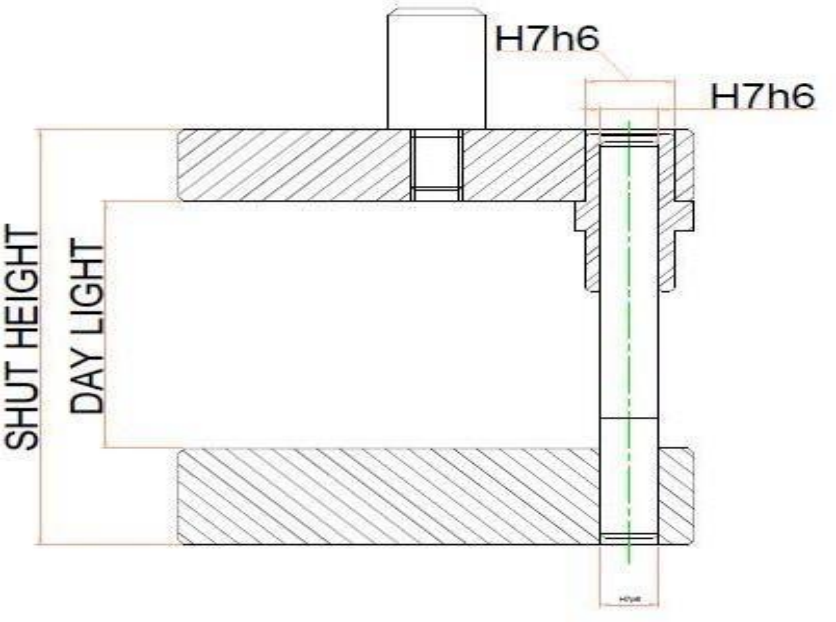
LONG NARROW DIE SETS:

This type of die set is used to retain tools for cutting, bending and forming of long, narrow parts. They are back pillars sets, and they are available with either two or three pillars. Two pillars are specified for sets ranging from 12 to 72 inches in length and three pillars for sets ranging from 84 to 240 inches.



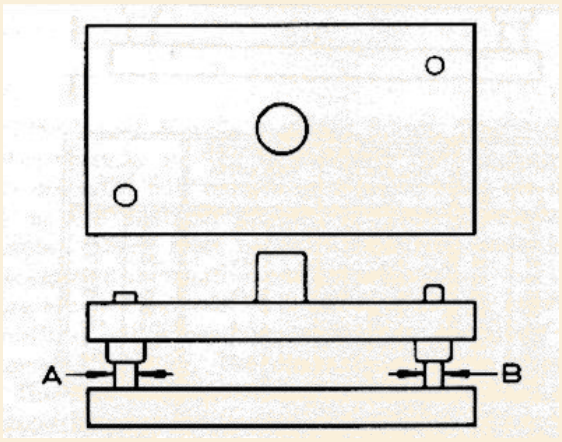
Shut Height-The distance between top surface of the top plate to the bottom surface of the bottom plate at the closed condition is called as Shut Height

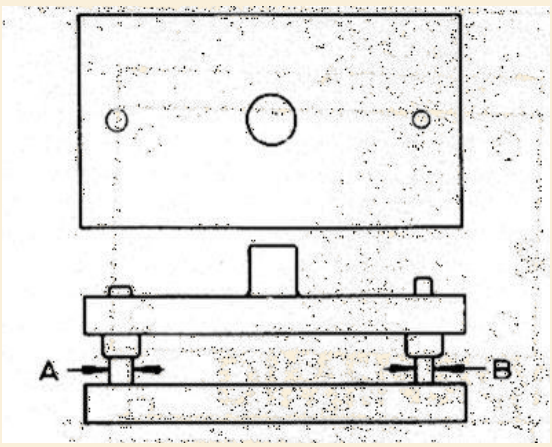
Day Light-The distance between bottom surface of the top plate to the top surface of the bottom plate at the closed condition is called as Day Light.



DISET SET-FOOL PROOFING:

The Die set are provided with different diameter pillars, dimension A and B Thus, the top plate cannot be reversed on the bottom plate for the purpose of fool proofing.





UNIT 16: PROGRESSIVE TOOL

PROGRESSIVE TOOL:

In a progressive tool strip is moved in stages from station to station. Different operations are performed on it at each station except idle stage. A complete strip is removed at the final stage. Progressive tool may be considered as series of tools placed side by side with the strip passing through each successively. Before designing the tool, the piece part may be studied carefully. This is to plan the operation to be carried out in different stations. For this process strip lay out is made.

The strip lay out carries the following information.

1. Feed direction.
2. Pitch maintained.
3. Position of stopper.
4. Width of the strip.
5. Scrap bridge/Side scrap
6. Different operations.
7. Pilot position & type of pilots
8. Total no of stages.

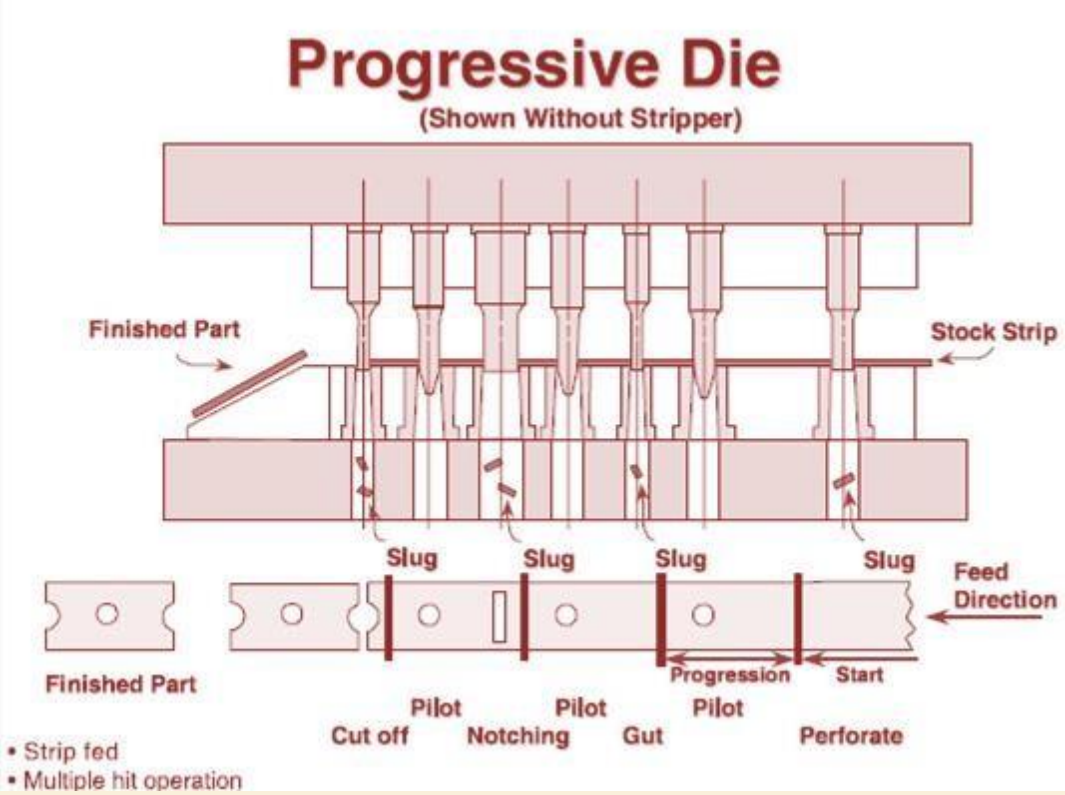
The method employed in laying out the strip influences the economic success. The strip lay out is such that maximum area of strip is utilized for the production of the stamping.

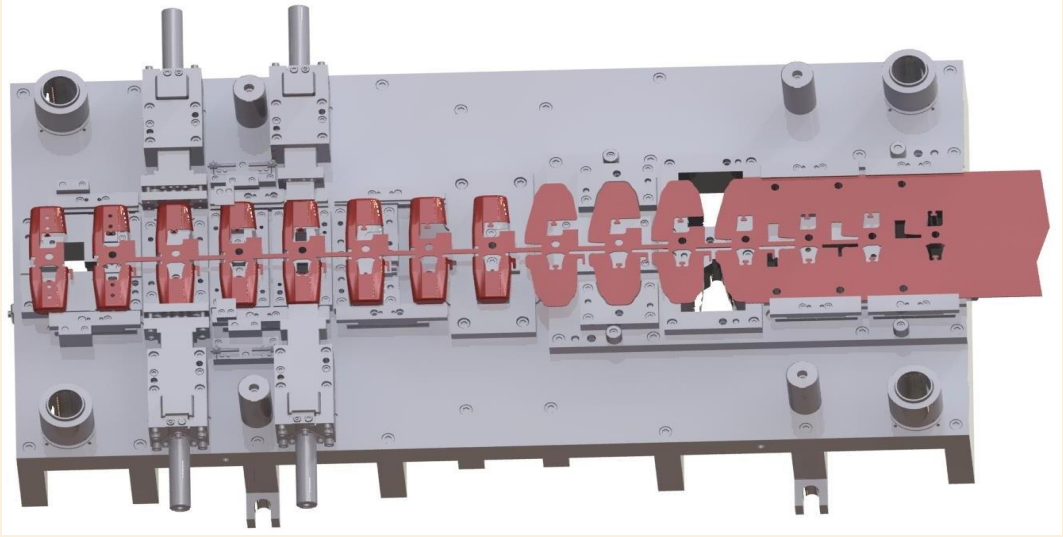
The tool shown in figure the finish part is produced through three stations. The strip is stopped at the first station by the auxiliary stopper, and 2 holes are pierced.

In second station the pilot enters into the holes. In third station the piece part is blanked and pierced component is obtained.

DIFFERENT TYPES OF PROGRESSIVE TOOL

1. Progressive Blanking Tool
2. Progressive Cut off Part off Tool
3. Progressive Draw/Form Tool and trimming
4. Progressive Cut & Carry Tool





Progressive Blanking Tool This is a metalworking method that can encompass punching, coining, bending and several other ways of modifying Sheet metal raw material, combined with an automatic feeding system to transform in to required components in large scale final stage accompanied by blanking operation.

Progressive Cut off Part off Tool The feeding system pushes a strip of metal (as it unrolls from a coil) through all of the stations of a progressive die. Each station performs one or more operations until a finished part is made. The final station is a cutoff operation, which separates the finished part from the carrying web. The carrying web, along with metal that is punched away in previous operations, is treated as scrap metal. Both are cut away, knocked down (or out of the dies) and then ejected from the die set, and in mass production are often transferred to scrap bins via underground scrap material conveyor belts.

The progressive die is placed into a reciprocating stamping press. As the press moves up, the top die moves with it, which allows the material to feed. When the press moves down, the die closes and performs the stamping operation. With each stroke of the press, a completed part is removed from the die by part off operation.

Since additional work is done in each "station" of the die, it is important that the strip be advanced very precisely so that it aligns within a few hundredth of an as it moves from station to station. Bullet shaped or conical "pilots" enter previously pierced round holes in the strip to assure this alignment since the feeding mechanism usually cannot provide the necessary precision in feed length.

Progressive Draw/Form Tool and trimming Progressive Tools can also be produce components of drawn or form shapes, these tools transfer from flat sheet metal in to different forms. The components in final stage are trimmed to get the finished component.

Progressive Cut & Carry Tool The components produced from these Progressive Tools are remains as an integral part of the strip even after the final stage, hence these tools are called as Progressive Cut & Carry Tool. The components are removed by manually or by external method of removing agents.

PROGRESSIVE DIE DESIGN:

Selection of progressive die:

Following factors are considered for the selection of progressive die.

1. Stock material thickness overall size of the die.
2. Number of station.
3. Total press tonnage.
4. Quick change die and flexible manufacturing requirement exits.
5. Press level and condition. Problems with worn bearings that can damage precision tooling

These are tools that transfer the components from one station to the next with the use of mechanical "fingers". For mass production of stamped parts which do require complicated in-press operations, it is always advisable to use a progressive press. One of the advantages of this type of press is the production cycle time. Depending upon the part, productions can easily run well over 800 parts/minute. One of the disadvantages of this type of press is that it is not suitable for high precision deep drawing which is when the depth of the stamping exceeds the diameter of the part. When necessary, this process is performed upon a transfer press, which run at slower speeds, and rely on the mechanical fingers to hold the component in place during the entire forming cycle. In the case of the progressive press, only part of the forming cycle can be guided by spring- loaded sleeves or similar, which result in concentricity and ovality issues and non-uniform material thickness. Other disadvantages of progressive presses compared to transfer presses are: increased raw material input required to transfer parts, tools are much more expensive because they are made in blocks with very little independent regulation per station; impossibility to perform processes in the press that require the part leave the strip (example beading, necking, flange curling, thread rolling, rotary stamping etc.).

The dies are usually made of tool steel to withstand the high shock loading involved, retain the necessary sharp cutting edge, and resist the abrasive forces involved.

The cost is determined by the number of features, which determine what tooling will need to

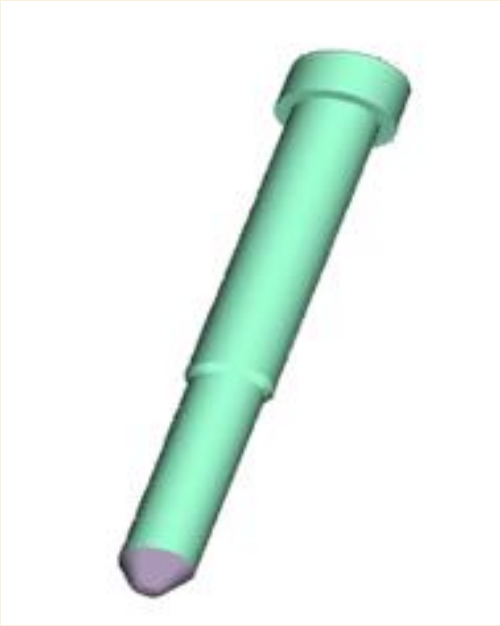
be used. It is advised to keep the features as simple as possible to keep the cost of tooling to a minimum. Features that are close together produce a problem because it may not provide enough clearance for the punch, which could result in another station. It can also be problematic to have narrow cuts and protrusions.

An excellent example of the product of a progressive die is the lid of a beverage can. The pull tab is made in one progressive stamping process and the lid & assembly is made in another, the pull tab simultaneously feeding at a right angle into the lid & assembly process. Also various car brake calipers have plates that are bent into shape, possibly cut too using these methods.

STRIP LAYOUT CONSIDARATION FOR PROGRESIVE TOOLS:

The following guidelines are used for designing the progressive tools.

- The solid margin around the die is 1.2 times the sheet thickness.
- Margin between 2 blanks, strip edges should be adequate.
- The shank should be loaded at the center of the press.
- Scrap disposal should be provided.
- For precision pilots must be provided.
- The tonnage, table area, ram face area must bead equate.



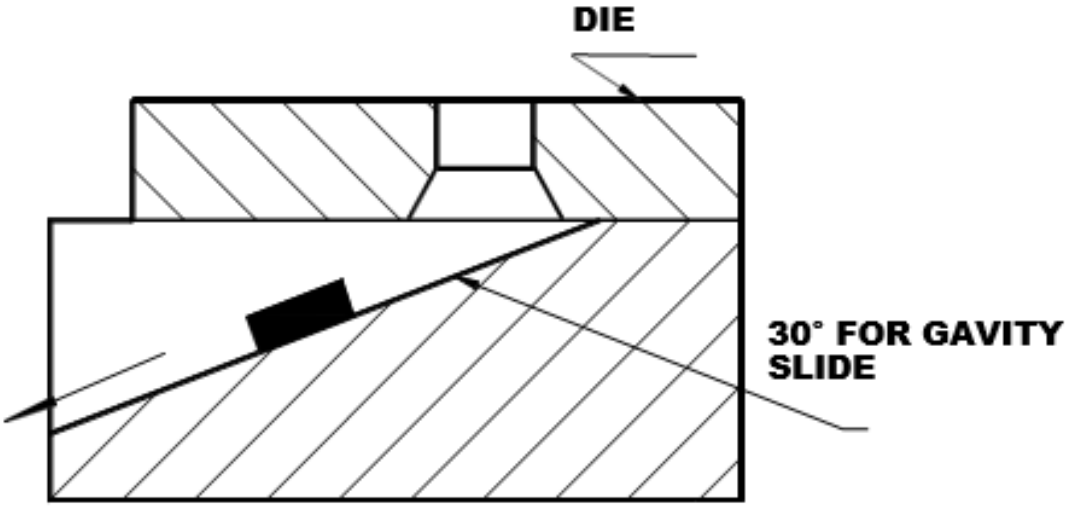
PILOTS:

- The blanking punch is fitted with pilot for accurate centralization of the piercing hole.
- Pilots can be spring loaded with a grub screw for adjusting the spring compression.

Generally, the trigger stopper of blanking tool with pilots is adjusted in such a way that the strip is fed about 0.1mm more than the pitch. This allows the strip to move freely towards left as the pilot centralizes the pierced holes.

SCRAP DISPOSAL:

In progressive tools the scrap is spread in a wider area. The shank must be placed in such a way that all the scrap falling through the die has got clear passage through the press table.

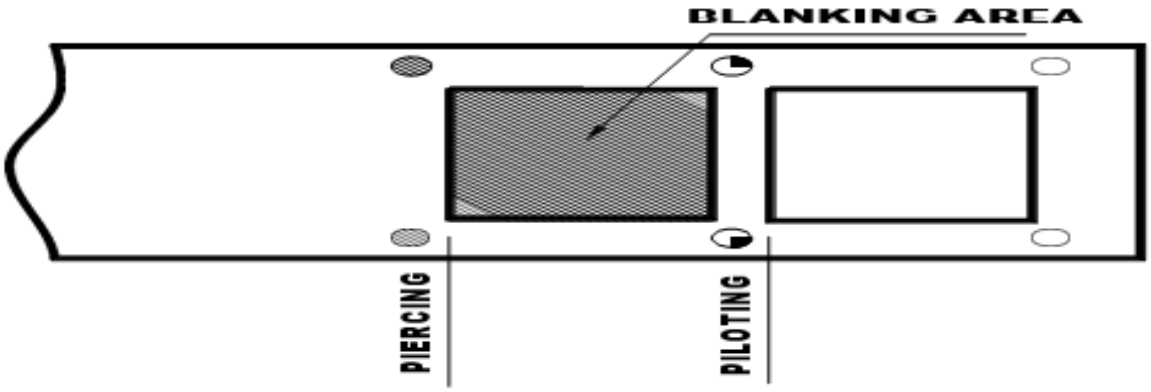


FOUR STAGE TOOL FOR WASHER:

In this tool the strip fed is stopped by auxiliary stopper in first stage. In second stage a hole is pierced. IN next stage piloting is done, and in fourth stage the punch blank the strip & piece part is obtained. In this tool the punches should be spaced widely to provide healthy margin.

STAGE STOPS:

When a new strip is taken, the first stage stop is pushed against the spring end is held against the stage stop to pierce one central hole in the strip. In second stage the strip is fed to second stage stop, which too must be held, pressed against the spring during the second stage feeding. Stage stopper stops the strip at each station of the tool.

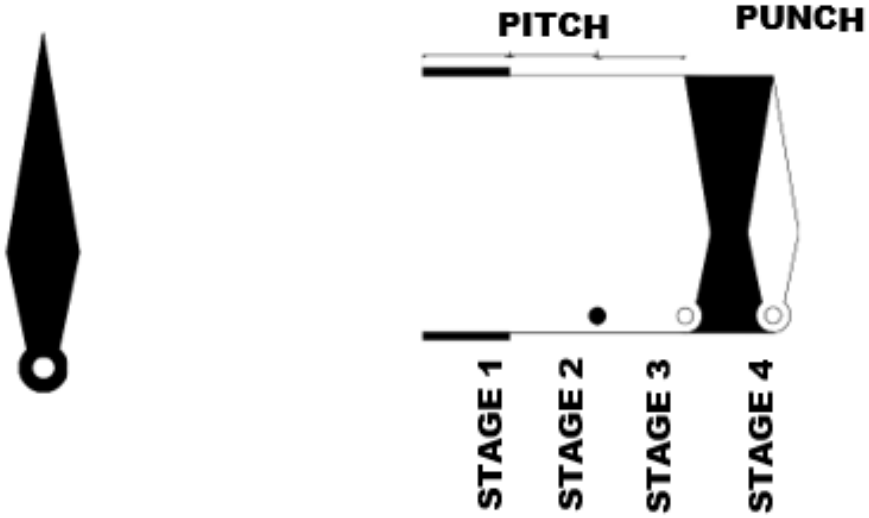


If the work piece has got no holes' additional pilot holes can be provided to utilize the strip area. The additional holes are also provided in the case where the accuracy requirements are high, or the holes are very smaller in diameter.

In such cases the pilots are provided on the scrap bridge or where the adequate space is available accept blanking area.

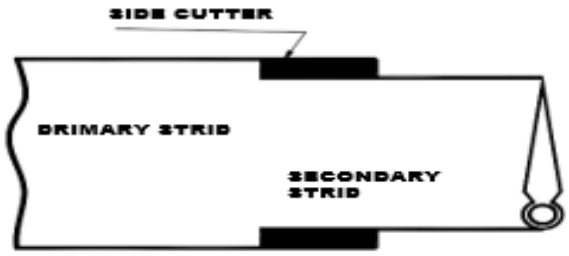
FOUR STAGE TOOL WITH SIDE CUTTING STOP:

Figure shows progressive tool for a pointer. Blanking punch for this component is rather difficult. It is more convenient to sacrifice the strip material and make sturdy punches and dies. The utilizes less than 1/3 rd of the raw material but runs trouble free.



SIDE CUTTING STOPS:

The side cutting stop controls the pitch during feeding. The side cutting stop uses two punches that sheared the strip width accurately. The width of the side cutting stop is equal to the pitch. The side cutting punches have a step. The non-cutting rear side of the punch is made longer than the cutting side so that it engages with the die cut out before the punch commences cutting.



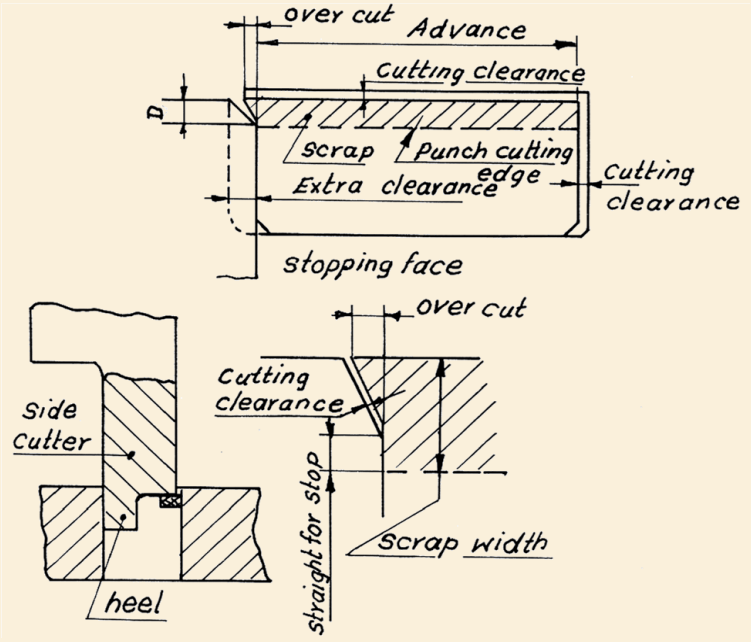
PITCH PUNCH:

They are installed in the first position of the tool. this eliminates extra stops and simplifies both construction and operation of the tool. Usually the pitch punch is located along the front edge of stock strip, because of the fact that the strip is usually meant to gauge of the tool

A PITCH PUNCH is a punch, which trims the side of the stock material, providing a shoulder. This shoulder is stopped against a hardened insert provided in the spacer. In small tools the spacer may be fully hardened to avoid the insert. The width of the pitch punch is equal to the pitch. The allowance for side cutting depends upon the type and thickness of the stock material.

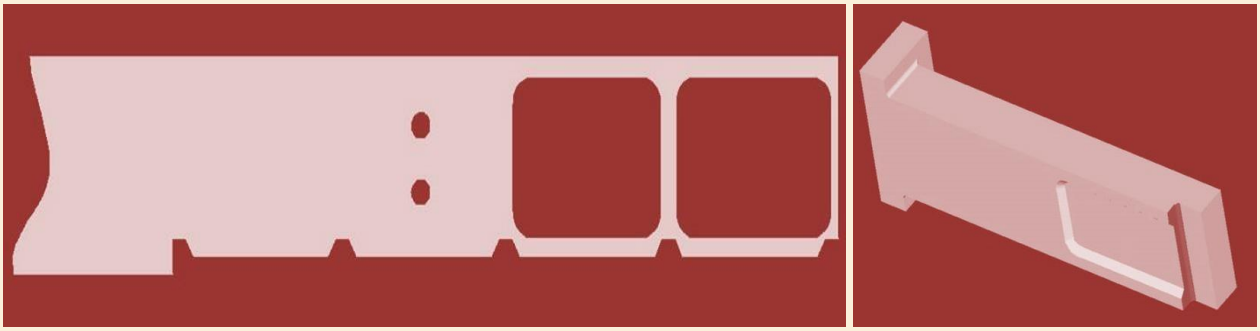
The size of the pitch punch will be more than the pitch by 0.05-0.1 for the purpose of registry the strip with the pilot known as OVER FEED ALLOWANCE (OFA). But in case of tools without pilot, the pitch punch is made equal to the pitch. The stop position and registry position will be the same.

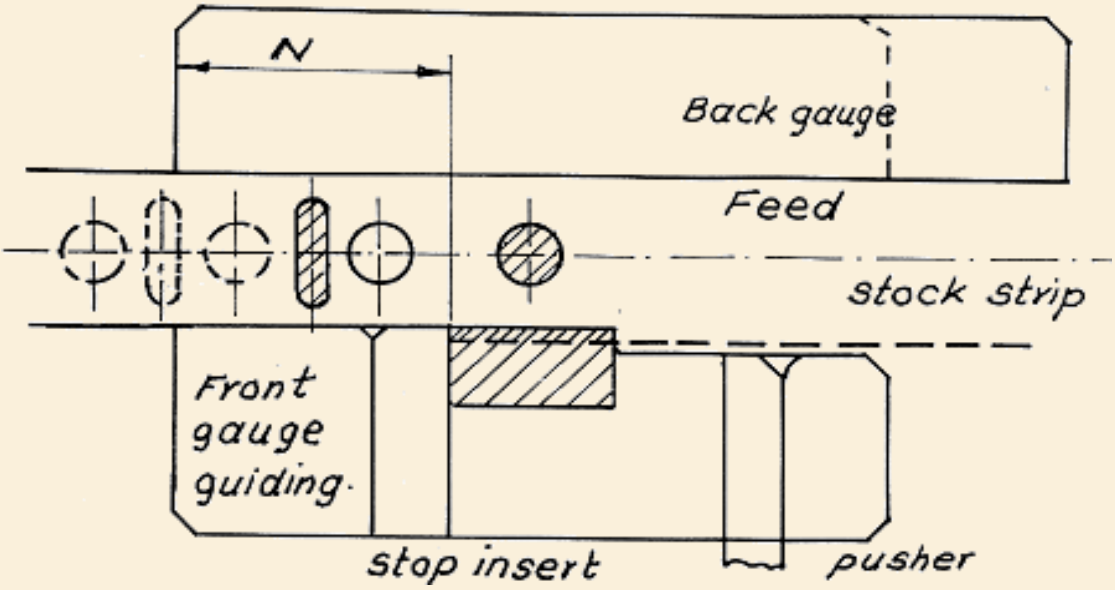
Due to the unbalanced cutting force acting on the side of the punch, the pitch punch is provided with heels. The undercut provided on the pitch punch eliminates the difficulties of feeding due to thorn formation. Thorns are small projection, which occurs at the side of the strips due to the punch wear out. In side cutting there is a tendency of the slugs being coming up with the punch, causing difficulties in further punching. Slug pushers are used to avoid this. A standard pitch punch shape is shown below



THE ADVANTAGES OF PITCH PUNCH:

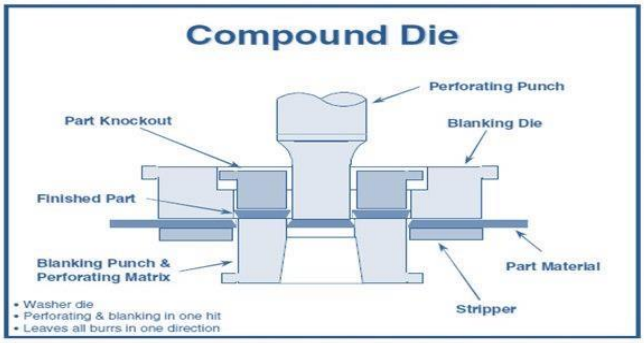
1. It is a safer method than stop pin
2. Avoids the danger of the deformation of margins of thinner strips by the stop pins, when pressed against it.
3. Preferred for small punching where it could be difficult to employ other types of stops.
4. It is economical and avoids complications in tools where numbers of stages are more.
5. Pilots can be avoided for punching components with moderate accuracy.
6. The movement of strip will be accurate.





UNIT 17: COMPOUND TOOL

Compound die

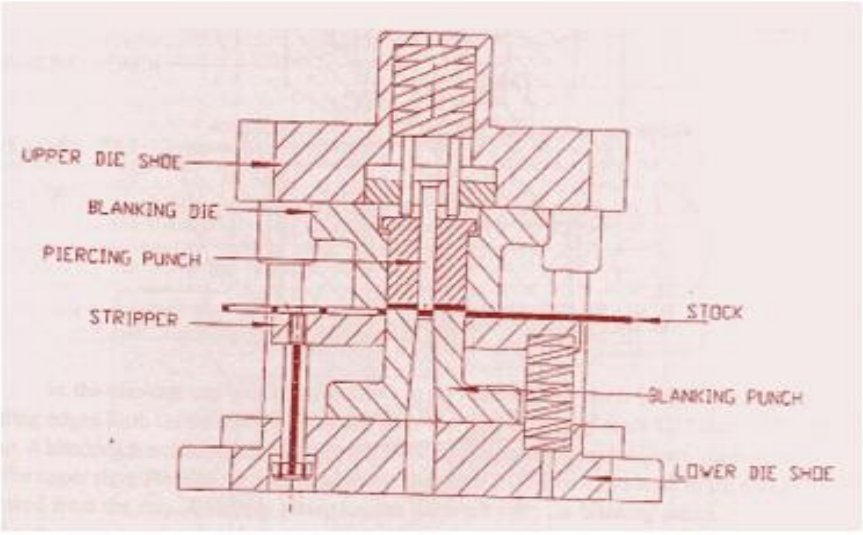


- All the operations are carried out at a single station in single stroke of ram.
- It contain compound die which consists of necessary set of punches and dies.
- During stroke, piercing of hole is done and followed by blanking.
- Blank is done opposite to the direction of piercing, so punch used for piercing becomes die.
- Compound dies are slower and more accurate than the progressive die.
- Components with small strips can also made easily.

Compound Tool:

Compound tools are usually used for manufacturing pierced blanks of close dimensional tolerances. The sheet material is lifted off the blanking punch by spring actuated stripper, which provides guide to feed the material. The blank remains in the die that is removed by spring stripper or by knock out.

Blank holder is used when blanking thin and springy material and accuracy and flatness is required. Ejection of the blank from the die by springs or positive knock out makes angular clearance unnecessary.



Construction of Compound Tool:

In this type of tool, the arrangement of die and punch is reversed and the punch is mounted on the die shoe with the knockout pins and the combined pressure pad and the stripper. This type of die is known as inverted die.

The inverted die has the advantages that the cutting edges are kept clear of chips by the operation of the stripper and ejector.

A common characteristic of compound dies is the inverted construction. The blanking die is on the upper die shoe and blanking die on the lower half. The pierced slugs pass through holes in the lower blanking punch (die shoe) & bottom plate. The spring loaded stripper mounted on the bottom plate guides the strip with the help of guide pins. It also removes the strip form the bottom blanking punch the component has to be collected manually or by air blowing. The blanking die mounted on the top plate houses an ejector (shedder) which ejects the component from the die block after blanking. The ejector guides the piercing punch also which again held on to the top plate. The ejector is closely guided in the inverted die and is actuated either by springs or knock out rod.

CONSTRUCTION OF COMPOUND TOOL: Open & closed condition

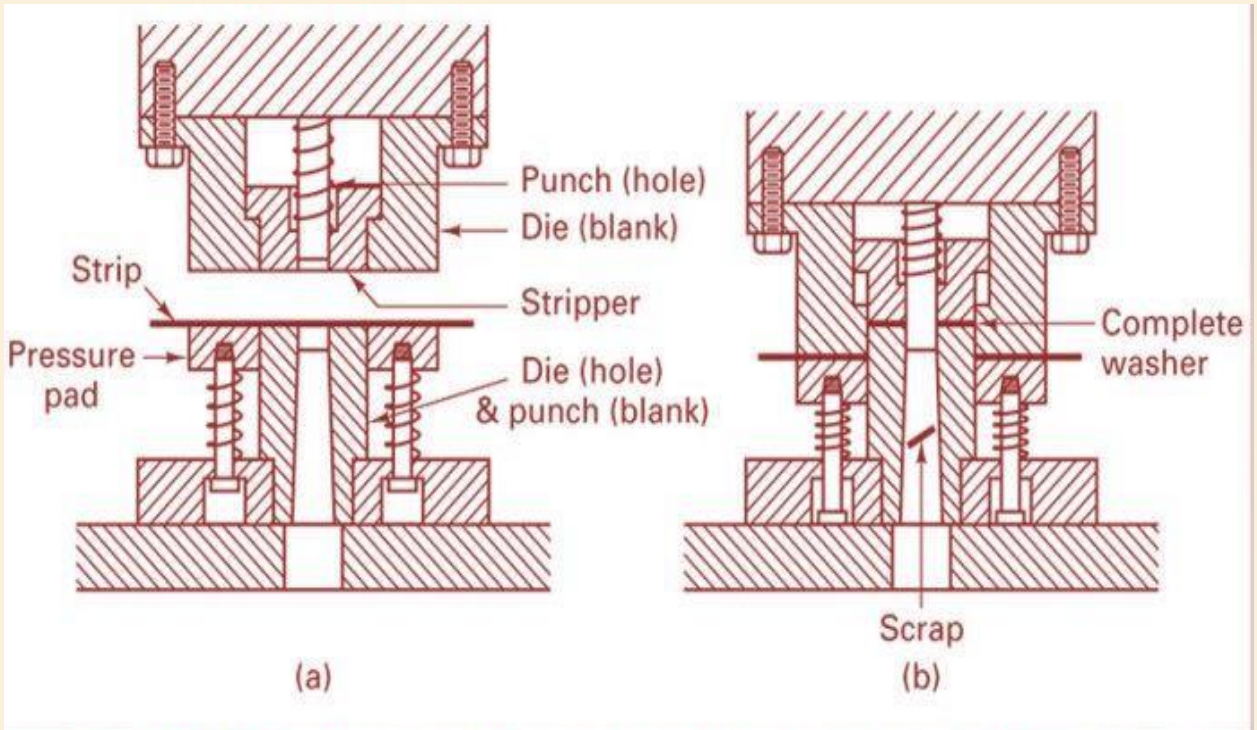
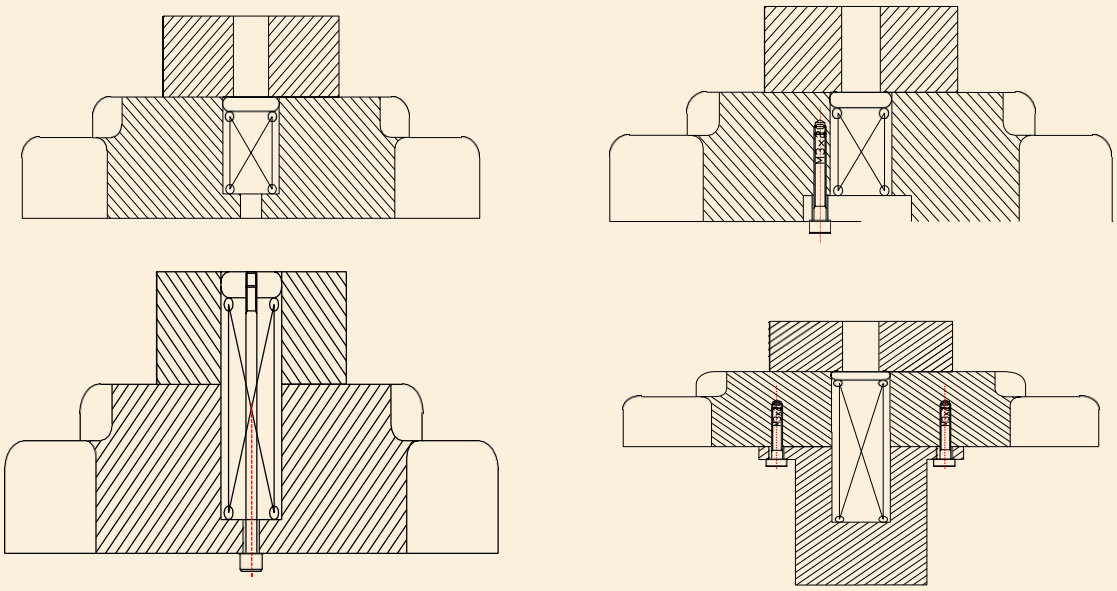


Figure 17-18 Method for making a simple washer in a compound piercing and blanking die. Part is blanked (a) and subsequently pierced (b) in the same stroke. The blanking punch contains the die for piercing.

EJECTORS AND SHEDDERS:

In conventional drop through type blanking tools, the punch forces the blanking to the die. The blank will be retaining within the die cavity till the subsequent blanks push it pass the land. Then it falls down through the opening in the die shoe and subsequently through the opening in the press bed.



Shedders and ejectors are used when it is not possible to remove the blanks in the conventional method due to the following reasons.

1. Size of the blank does not allow it to conveniently pass through the opening in the press bed.
2. Counter of the blank is such that it tends to stick and get distorted during its travel through the die cavity.
3. Opening in the press bed fitted with die cushion, which will interfere with the piece part disposal.
4. Close tolerance specified for the flatness of the blank.
5. Tools of Inverted nature.

EJECTORS:

- In the conventional position, die is the lower member of the tool.
- If the expulsion of the blank is achieved by forcing it upwards, the action is known as “ejection”. The element of the tool, which ejects the blank, is called as “ejector”.

- Ejectors may be actuated by compression springs, rubber, pneumatic devices or hydraulic devices.
- Ejectors if used with spring stripper always return the blank into the spring due to the simultaneous stripping and ejecting action.
- In some progressive tools, the blanking station is provided with an ejector to return the blank into the strip to be carried forward to the next station for further operations, known as the cut and carry method.

SHEDDERS:

Another way to accomplish the expulsion of the blank from the die cavity is by making use of the knock out mechanism on the press. For this purpose, the tool should be of the inverted design.

In inverted tools, Die becomes the upper member of the tool, being clamped to the press ram. The expulsion of the blank is achieved by forcing them downwards. This action is generally known as "shedding" and the element of the tool, which sheds the blanks, is known as the "shedder".

COMPRESSION SHEDDERS:

- Shedders hacked up by compression springs; hard rubbers or disc springs called compression shedders. Such shedders always tend to return the blank in to the strip if employed with compression type traveling stripper.
- Compression shedders could be used to great advantage to produce flatter and neatly sheared blanks. They are also used if the blanks are too large to allow the incorporation of an efficient positive knock out system.

SHEDDER PINS:

- The stock material is usually coated with rust preventive solution.
- It is obvious that any liquid or oil deposit left on the stock material will cause the blank to stick to the face of the shedder.
- Spring loaded shedding pins are employed to overcome this problem. Even absolutely clean and dry stock material tends to adhere to the shedders, due to the atmosphere pressure.

Therefore, regardless of the conditions of the stock, the illustration of shedding has to be considered to be absolutely necessary.

Shedding pins will be more effective if applied to one side of shedder face rather than in the center.

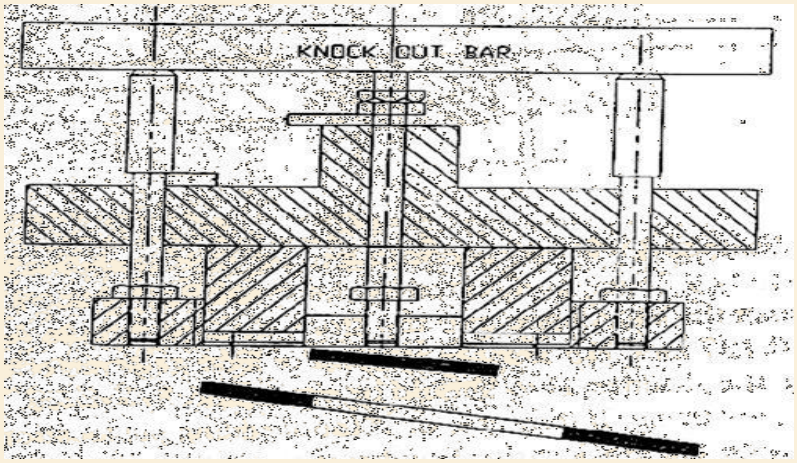
KNOCKOUTS:

Positive knockouts are classified in to two groups

- ✓ Direct knockouts
- ✓ Indirect knockouts

DIRECT KNOCKOUT:

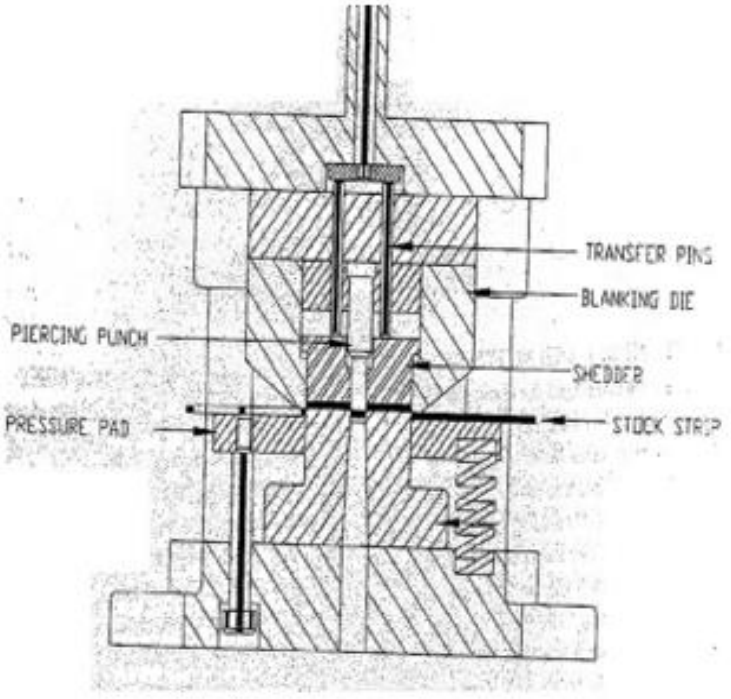
In a knock out system if the knock out rod is directly in contact with the shedder the system is known as direct knock out system.



INDIRECT KNOCKOUT:

As the passage of the knockout rod is through the shank, any punch which comes in line with or near to the center line of the shank will obstruct the knockout rod from coming in direct contact with the shedder. In such cases an indirect knock out system should be employed.

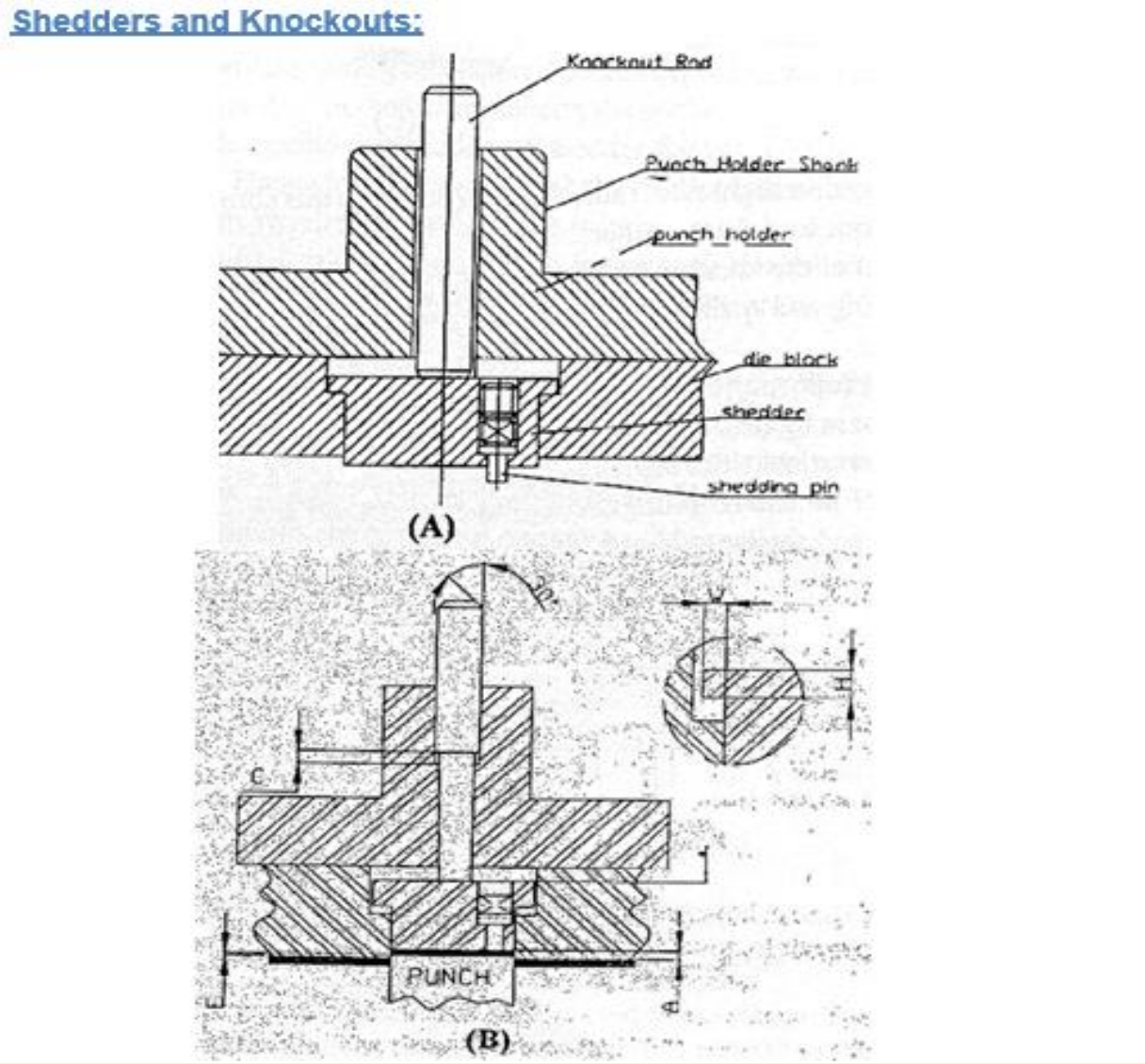
In addition to the shedder and the knock out rod, it consists of a knock out plate and transfer pins as shown in the fig. The location and number of transfer pins depend on the size and shape of the blank.



Shedders and Knockouts:

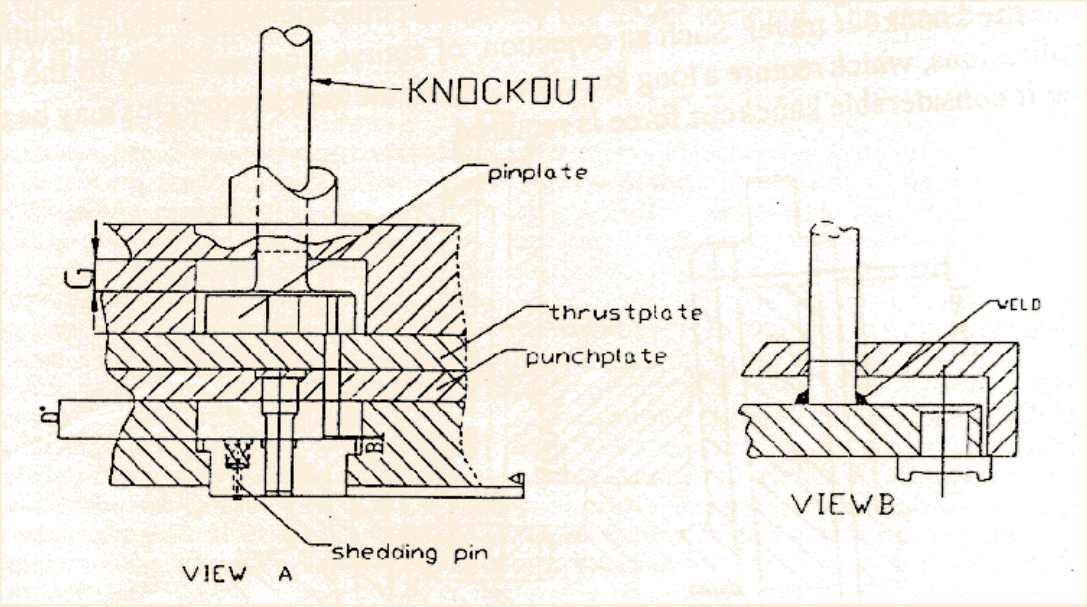
Positive Shedders:

Positives shedder is shedder, which is not actuated by springs or other compression media. Fig below illustrates the basic positive shedder actuated by means of a knockout rod. This type of assembly is used for inverted type dies. The flanges are an integral part of the shedder; act as keepers, retaining the shedders within the die cavity this type of knock out is called as direct knock out system.

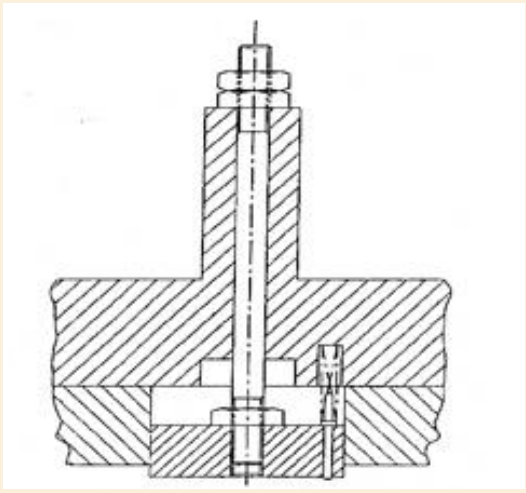


In this fig the transfer pins are assembled by pinning them in the pin plate.

In view A the pin plate and knockout rod are also fitted together and secured by pining. This method is for light duty, where the knockout forces are evenly distributed and balanced in relation to the shedder counter. The knockout assembly shown in view B is stringer, since knockout rod is welded to pin plate.



In this fig the knockout rod is pined to the assembly to the shedder. A collar ring is assembled to the knockout rod by means of a cross pin. The collar acts as a stopper limiting the protrusion distance of the shedder.



DIFFERENCE BETWEEN PROGRESSIVE TOOL & COMPOUND TOOL

PROGRESSIVE TOOL	COMPOUND TOOL
➢ Component accuracy depends on the accuracy of the strip movement between two successive stations/stages	➢ Components produced from this tool are very accurate & all are identical as all operations are carried out in single station.
➢ Stock strip sheared to strip width size are used to produce component	➢ Scrap strip from other tools can be economically employed to produced components
➢ Components from these tools have burrs on opposite sides for piercing & blanking operations	➢ Components from these tools have burrs on same sides for both piercing & blanking operations
➢ The die & tool construction is very rigid when compared to compound tool as different operations are carried in different stations	➢ The die & tool construction is not rigid when compared to compound tool since many operations are carried in single stations
➢ The die section is strong enough to carry out operations on a thicker sheet material.	➢ It is very difficult and delicate to design and manufacture die for a thicker sheet material from the view point of strength of die section.
➢ Both cutting & non cutting operations carried in these tools in different stages	➢ Only 2 or more cutting operations can be carried in the tool only in single stages

BURR SIDE RELATION IN COMPOUND TOOLS

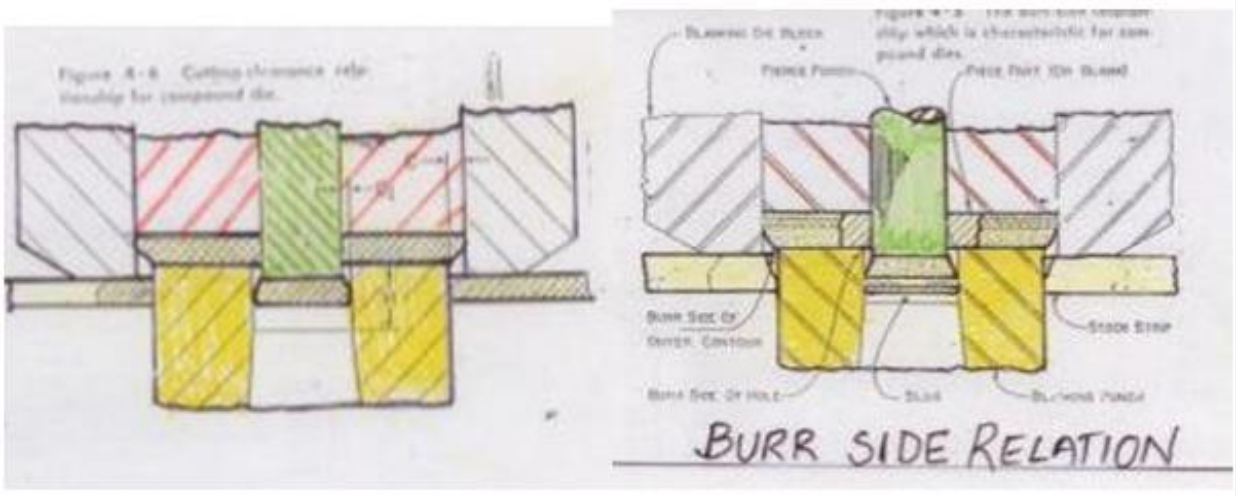
Components produced by these dies have only one burr side, the burr side of openings pierced within the component will agree with the burr side of the blanked outer contour of the component. This characteristic burr side effect can be major consideration which influences to the decision to build new compound tool in order to produce a given component.

The factors which apply to burr side location are-

- The burr side of a blank or of a slug is always towards its respective punch.
- The burr side of a pierced opening is always towards its respective die opening.

Therefore, the burr side on the outer periphery of the blank will be towards the blanking punch. Since the pierce-die opening is contained in the blanking punch, the burr side of the pierced opening in the blank will also be towards the blanking punch.

The burr side effect as related to compound tools is shown in the below fig.



PRESS TOOL QUESTIONIERS

1. What is a tool?

Anything which is necessary to make a product is called tools.

2. What are the classification of tools?

Press tools, Molds, Jigs and fixtures, Cutting and assembly tools, gauges and measuring instruments.

3. What is a press tool?

Press tool is a custom built tool in which we make sheet components that not readily available in the market.

4. What do you mean by stampings?

The sheet metal which makes with the help of press tool is called stampings.

5. Name the different types of rolling?

Hot rolling, cold rolling.

6. What is Stock materials?

Sheet metal from which stampings made is called stock material.

7. What are the press tool operations? Cutting, non-cutting and combination of both.

8. What is strip?

Each piece of sheet metal called strip.

9. What do you mean Blanking?

In this operation, cut out material will be the component remaining is scrap.

10. What is piercing?

Process of making opening on sheet metal is called piercing. The cut out material will be waste.

11. What is called cutting off?

Material is going to cut in a single line, there won't be any waste.

12. What is parting off?

Double line cutting material in between the line will be waste.

13. Describe about a side cam tool?

14. Transforms vertical motion of the press ram into horizontal motion of the tool. It is used for side piercing.

14. What is perforating? Making no. of holes at a time.

15. What is dinking?

Press tool cutting operation for soft materials like paper, leather, wood etc.

16. What is trimming?

Removing large amount of material from the edge of the piece part.

17. What do you understand shaving?

Removing small amount of material from the previously blanked part.

18. What is broaching?

Series of teeth profile removes metal from blanked part.

19. Describe bending?

Bending can be explained as shaping of material around straight line axis. Result is a new plane which is at an angle to the mother plane.

20. What is lancing?

Combination of cutting and bending.

21. What is forming?

Press tool non cutting operations in which material is formed into different shapes.

22. What do you mean drawing?

Process of making cup or vessel is called drawing.

23. What is curling?

Rolling the edge of sheet metals.

24.Define bulging?

Internal forming operation to expand portions. 25.Name the common medias of bulging? rubber, urethane, oil etc.

26. What is swaging?

Opposite of bilge. External forming operation also called as necking.

27. What is extrusion?

Operation to produce collapsible tubes, shell etc.

28. Define coining?

Making depression and corresponding projection won't be there.

29. What is an assembly tool?

Assembling of two or more parts by riveting, press fitting etc.

30. Describe flaring, lugging, collar drawing?

Making collar so that no. of threads can be provided.

31. What is Planishing ?

Flattening of material is called Planishing.

32. What is progressive tool?

Multi stage tool in which perform work at number of stations.

33. What is compound tool?

All cutting features of the component perform at one stroke of the ram.

34. What do you mean by combination tool?

Small press operated in large one. Blank and form very small parts.

35. What is notching?

Small amount of material cuts from the edge of the component.

36. What do you understand by sub press tool?

Small press operated in large one, blank and form very small parts.

37. What is lowering?

Combination of cutting and forming.

38. What is shearing?

Method of cutting sheets without forming chips.

39. What are the stages of shearing? Plastic

deformation, penetration, fracture.

40. Result of plastic penetration stages is? Cut band

41. Result of plastic deformation stage is? Edge radius or roll over.

42. Result of fracture stages is? Break edge.

43. Name the types of shear load? Internal and external loads.

44. What are the types of external shear load?

Compressive load and tensile load.

45. Define tensile load?

Force acting on opposite direction in same axis.

46. What is shear load?

Load which is acting on same direction but not in same axis.

47. What is compressive load?

Forces acting on same direction in same axis.

48. Name the types of force based on speed? Impact force (quick force)

magnetic force

49. Describe about stress?

Load acting on a material per unit area.

50. Formula of stress? load /area

51. What is cutting force?

The force which acts on sheet metal to cut the blank.

52. Formula of cutting force? Fc

= LSTmax

L: Length of periphery to cut in mm.

S: sheet thickness in mm

TMax: shear strength in n/mm^2

53. Shear strength is …. % of tensile strength. 80%

54. Equation to calculate press force? Press force = cutting force + stripping force

55. Normal stripping force is? 10 to 20 % of cutting force.

56. What are the methods to reduce cutting force? Using stepped punch.

Grind the face of the punch or die to a small sheared angle

57. For blanking shear angle will be on? Die.

58. For piercing shear angle will be on? Punch

59. Briefly explain the capacity of the press?

Maximum amount of force can be given on the press. It is determined by KN or TONS.

60. What is the shear strength? Ability of material to resist shear stress.

61. 1 TON =……. Kgf 1kgf.

62. What is reason of drill breakage? Due to torsion and compression

63. U channel and angle iron made by …... process Extrusion

64. 1N =... kgf

9.8 kgf

65. What do you meant by cutting clearance ?

Gap between the side of the punch and corresponding side of the die in single side.

66. Cutting clearance is expressed as ...? Mm /side

67. Result of optimum cutting clearance will be... ?

Maximum cut band.

68. Result of excessive cutting clearance will be... ?

Maximum edge radius.

69. Result of insufficient cutting clearance will be .. ?

Maximum break edge.

70. Punch determines... ?

Piercing size

71. Die determines... ?

Blanking

72. Calculation of cutting clearance?

Sheet metal up to 3mm = C*S* root of (TMAX/10)

Sheet metal more than 3 mm=(1.5*s) *(s-0.015) * root of (TM ax /10)

73. What is called land?

To avoid jamming of material inside the die, we give straight portion of certain amount from the cutting edge. That is called land.

74. For sheet metal S up to 3 mm = land will be.....?

3mm

75. For sheet metal more than 3 mm = land will be .. ?

Sheet thickness.

76. Usually, angular clearance is provided in ....Degree?

1.5 degree /side.

77. Generally, soft material requires . Angular clearance?

more.

78. What are the types of guide plate tool?

Open guide plate tool

Stripper guide plate tool

79. Name the basic elements of tool? Punch and Die.
80. Punch and die materials?

    Good quality alloy steel (HCHCr ,D2).
81. Hardness of punch? 58-60 HRC.
82. Hardness of die? 60-62 HRC.
83. Stripper plate material? MS or medium carbon steel
84. Thrust plate material? OHNS.\
85. Hardness of thrust plate? 45-48 HRC
86. Top plate and bottom plate material ?

    MS or Cast iron.
87. Screws are to …… the parts ?

    hold
88. Dowels are to.....the parts?

    align
89. Name the types of cold rolled stock materials used?

    Hard, Three quarter hard, Half hard, Quarter hard, Soft, Dead soft.
90. What is the specialty of hard sheet metal?

    Cannot bend.
91. What is the specialty of 3 quarter hard material?

    Can bend 60 degrees across the grain.
92. Specialty of half hard material? Can

    bend 90 degrees across the grain.
93. Quarter hard material?

    Can bend 180 degrees across and 90 degrees along the grain direction.
94. Soft material?

    Can bend 180 degrees across and along.
95. Dead soft material?

    Can be formed into different shapes.
96. What is strip lay out?

    A layout which gives sequence of works and operations.

97. What are the factors effecting a strip layout?

Shape of the blank, production requirement, grain direction, burr side, stock material.

98. Formula of economic factor?

(area of the blank*no. of rows) / (pitch*scrap width)

99. What is pitch?

Distance between two consecutive operations.

100. What is scrap bridge?

Portion of the material remaining between two adjacent openings.

101. Scrap bridge nearer to the operator called…. scrap?

Front scrap

102. Scrap bridge away from the operator called…. scrap?

Back scrap

103. What are the types of strip layout?

Single row layout, double row, gang dies and angular.

104. Name the types of single raw layout? Narrow run, wide run

105. List about the types of punches?

Cutting punch, non-cutting punch and hybrid punch.

106. What are the groups of punches? Segregated punches and integrated punches.

107. What is segregated punch? Self-mounted by screwing etc.

108. What are the integrated punches? Mounting with the help of punch plate etc.

109. For beveled head punch bevel angle is ... ?

30 to 45 degree

110. What is perforator?

Punch of diameter 2mm and below.

111. What is bucking force?

Maximum force a punch can withstand without bucking.

112. Formula for buckling force? Fb = (ii2EI)/LP2

113. Modulus of elasticity of Steel?

200 to 220 GN/M2

114. Unit of moment of Inertia?

Mm4

115. The ultimate condition of buckling force is ..... ?
Buckling force =cutting force require for the operation =shear force on the punch

116. Material of solid die?

Non shrinking tool steel.

117. Die bushes are inserted in …...?

mid steel retainer plate.

118. Dies having more than one section called.... ?

Split dies

119. Material of carbide dies?

Tungsten carbide

120. What is the function of stopper?

Arrest the movement of the strip for one pitch length after each stroke.

121. Fundamental principles of stopper?

Stop position and registry position.

122. What is stop position?

Actual position of the stopper.

123. Describe registry position?

Exact position where strip has to be established.

124. Types of strippers?

Fixed and travelling

125. Function of stripper?

Strip the stock material off the punches after each stroke.

126. Tunnel width formula?

$X = w + f$

w = stock strip width at maximum tolerance

f = desired horizontal feeding clearance

127. Hook pins are made from.....?

Cold drawn steel rod

128. Gauge thickness for the material up to 1.5 mm is .....?

3mm

129. Gauge thickness for the material more than 1.5 mm is.... ?

Sheet thickness +1.5 mm

130. Prevention of wrong loading can be done by. ..?

Fool proofing

1. Press tool is used for producing **sheet metal** components.
2. Press tools are mainly manufacture for **high rate** of component production.
3. Press tool operations are of **3** types.
4. Classifications of press tool operations are **cutting , non-cutting , hybrid.**
5. Blanking is a type of **cutting** operation.
6. Blanking is producing a **flat** piece part from sheet metal. 7.Blanking these process entire is cut **external** profile of the shape.
8. Blanking cut piece is called as **blank.**
9. Blanking piece part of ready for assembly then it is called **component.**
10. **B**lanking piece part that is removed from strip is always the work piece and remaining strip is called **skeleton.**
11. Internal profile of the component is shape that to be cut is called **piercing**.
12. Piercing operation material cut from the sheet is scrap. It is called **slug.**
13. cut off is separating the piece part from the **parent** material.
14. In cut off the material is cut in a straight line **no** scrap is produced in operation.
15. Part off cutting operation is another name of **parting.**
16. Part off operation the removed material by the punch is called **scrap.**
17. Cut off and part off usually occurs in the **final** stage of progressive tool.
18. Notching operation removes are all **small amount** of materials from either or both edges of the strip or blank.
19. Shaving is a **secondary** and **finishing** operation.
20. Shaving is a **small amount** of material is removed around the edge of the component.
21. The excess metal is removed as small as **chip**.
22. Shaving is formed similar to material **cutting tool**.
23. Shaving allowance of approximately **0.2** to **0.3mm** of material.
24. Trimming is a **secondary** operation.
25. Trimming is used to remove the **excess** metal.
26. Trimming operation provides a **smooth edge** and the outer contour will be neat.

27. Broaching operation Are similar to **shaving** operation.
28. One after the other by the same tool called **broach**.
29. Side cam converts the **up** and **down** motion of press ram.
30. Side cam required in the **nature** of the work.
31. Dinking operation is performed on **non- metal** sheets.
32. Bending operation is one of the **Non-cutting** Operation.
33. Bending is s**haping** the material around the straight axis.
34. Forming is similar to **bending** operation.
35. Drawing is parent material subject to several **plastic deformations**.
36. Drawing dies transform flat are metal in to **Cups, shells.**
37. Horn dies are provided with an **arbor** or **over.**
38. Curling dies **curved** the edges of drawn shells.
39. Swaging's another name is **necking.**
40. Coining is process of performing **cold** metal in a tool.
41. Planishing are **planning** operation.
42. Coining is also called as **cold forming**.
43. Lancing is the **hybrid** operation.
44. Lancing is combined operation of **cutting** and **non-cutting** like cutting and **bending** along a line in the work material.
45. No metal is cut free during a **lancing** operation.
46. Lancing punch is deserved to cut on **two** or **three** sides and bend along **fourth axis**.
47. Lancing is very important **press** operation.
48. Lancing operation two or three sides **shearing** and one side bending or **forming**.
49. Lancing is widely used to **lock** the part of the other for proper **assembly.**
50. Lowering is a **hybrid** operation.
51. Lowering is a passage with **flat sloping** profile with one sides **opening.**
52. Lou ring allows **light** and **air** to enter.
53. Lou ring keeps rain water out is a **difficult** operation.
54. In Lou ring operation only **one** side will be cut.

55. Bending extends completely **across** the material.

56. One or more bends may be involved in **bending** dies.
57. Bending is large and important class of **press** tool.
58. Bending sheet material flows in the tool is always **Uniform**. Its thickness remains and changed.
59. Forming is a **non-cutting** operation.
60. In forming operation line bending is a long **curved** axis instead of a straight line.
61. In forming the metal flow is not **uniform**.
62. Forming dies applied more **complex** forms to the **work piece**.
63. Drawing is a **non-cutting** operation.
64. Drawing is **ferrite** Material is objected sever deformation.
65. Horning is a **non-cutting** operation.
66. Horning dies are provided with **arbor.**
67. Horning hard dies may also be used for **piercing** holes inside of shells.
68. Curling is a **non-cutting** operation.
69. Curling dies have **curled edges** of drawn shells.
70. coil over the **wire ring** for increased.
71. Bulging is a **non-cutting** operation.
72. Bulging dies expands the bottom of the previously **drawn shells**.
73. The bulged bottoms of the same type of coffee parts are formed in **bulging dies**.
74. Swaging is a **non-cutting** operation.
75. In swaging operation, the **drawn shells** or **tubes** are reduced in their diameters.
76. Swaging is also called as **necking** operation.
77. Extruding is a **non-cutting** operation.
78. Extruding is a special process to manufacture **collapsible** tubes shells.
79. The blank is also called as **billet**.
80. The amount of clearance between punch and die determines the **wall**

thickness.

81. Flanging is a **non-cutting** operation.
82. Flanging is a process of forming upward protrusive in a piece called **flanking**.
83. Flanging will be done stage tool as **progressive tool**.
84. Flanging are pre-piercing or direct flanging with **hybrid** punches.
85. Dimpling is a **non-cutting** operation.
88. Dimpling is forming dies which produce **conical** flange.
89. Coining is a **non-cutting** operation.
90. Coining is a process of performing **cold metal** in a tool.
91. Ironing is a **non-cutting** operation.
92. Ironing is an operation in which the wall thickness of the drawn shells or **bend** component.
93. Embossing is a **non- cutting** operation.
94. There are **two** types of planning.
95. Stamping is a **non-cutting** operation.
96. Stamping is an operation that it produces the profile on the **sheet metal** are component.
97. Stamping maybe projected or **depressed** on the components.
98. Example for stamping is **number plates of vehicles**.

1. Base Plate is also called as **die shoe** or **bolster plate**.
2. Bottom plate is made of **mild steel**.
3. Die plate is a **Female** part of press tool.
4. Die plate are made of **HcHcr** material for non-cutting operation.
5. Die plate are hardened and tempered to **60-62HRC**.
6. Die plate for non- cutting operations are made from **OHNS** material and hardened up to 55-58HRC.
7. Die plate provides **external** shape to the component.
8. In cutting press tool the thickness always depends on **shear** force required for operation.
9. Die plate is the **cube root** of the total shear force.

10. Punch is a **male** member of press tool.
11. Punches are made of **HcHcr** material for cutting operation.

13. Punches are made of **OHNS** material for non- cutting operations. Punches Provides **internal** shape of the component in non- cutting operation.
14. Stripper plate is made of **MS** material.
15. Stripper plates are usually kept in **soft** condition.
16. Stripper also **guides** the **strip**.
17. Punch holder plate is made of **MS** material.
18. The punch is usually inserted with a **light key** fit H7/K6.
19. Punch back plate is made of **case hardened steel**.
20. Punch back plate is also called as **punch retainer plate.**
21. Top plate is a soft plate made of **MS** material.
22. The top plate is clamped to top unit of the **press tool**.
23. Guide plates are thin plates mounted on the **die plate** for guiding strip.
24. Guide plates are normally made of **MS** material.
25. Guide plate for medium production press tool is made of **OHNS** material.
26. Stage stoppers will have **sliding** in slot made in these guide plate.
27. Guide pillars are also known as **Guide pins**.
28. Guide pillars provide `o'means of **alignment** to the die set.
29. Guide pillars are made of **17Mn1Cr95** material.
30. Pillars and bushes have **H7/h6** fit.
31. Bushes and top plate have **H7/j5** fit.
32. Pillars and bottom plate have **h7/p6** fit.
33. Guide bush are generally fixed in **top plate**.

34. Guide bush are made of **17Mn1Cr95** material.
35. Shank is made of **MS** material.
36. Pilots are generally **cylindrical** parts.
37. Pilots are made of **OHNS** material.

39. Direct pilots are mounted on the **cutting face** of the punch. Indirect pilots are placed **outside** the boundary of the component.
40. Stoppers are made of **OHNS** material.
41. Stoppers are used to **stop** the strip.
42. Dowels are case hardened cylindrical ground **standard** pins.
43. Taper dowel pins are normally used in **machine** tool.
44. Screws are used to **hold** the tool parts.
45. The result of the force is imposed on the **stock** material.
46. Shearing action occurs in **three** stages.
47. The stock material is placed on the **die**.
48. The punch is driven towards the **die**.
49. The punch contacts the **stock material** and exerts the pressure on it.
50. The elastic limit of the stock material exceeded is known as **plastic deformation**.
51. The radius is formed on the **top edge** of the hole and the bottom.
52. The radius is often referred as **roll over**.
53. Magnitude depends upon the **ductility** of the stock material.
54. The driving force of the **punch** is continuous.
55. Penetration is the actual **cutting** portion.
56. The punch causing a corresponding **bright bond** or **burnished area**.
57. The cut edges meets exactly at **breaking** lines.

58. The punch enters the **die** opening.
59. The edge radius appears more than using **soft** material.
60. The remaining **cut** portion is the fracture area or break.
61. Burr is the **projection** which appears during fracture.
62. Cutting clearance is the **intentional gap** provided between the punch and die.
63. The **optimum** clearance must often be determined.
64. The amount of **cutting** clearance to decrease.
65. The burr side of a **blank** or slug.
66. Cutting clearance given is **sufficient** then burnished area or cut.
67. Sheet thickness and the piece part separating from the **stock** material.
68. The cut band or the **burnished** area will be less than 1/3.
69. The material thickness and **tensile** burr will be more if the cutting clearance.
70. This is the **actual shift** between the punch and die.
71. The actual shift between punch and die results in **insufficient** cutting clearance.

REFERANCE BOOKS:

- Tool and die maker by Mahajan
- Design fundamentals by Pacquin
- Tool design by Donaldson
- Basic die design by Osterguard
- Advanced die design by Osterguard
- Fundamentals of Tool Design by SME
- Press Tools and Press Work by Waller