MACHINING

Level - III

Learning Guide 9

Unit of Competence: Manufacture Press Tools and Die

Module Title: Manufacturing Press Tools and Die

LG Code: IND MAC3 09 0217

Instruction Sheet	Learning Guide #1

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Determine and prepare job requirements
- Select materials
- Manufacture components
- Assemble components

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, **upon completion of this Learning Guide, you will be able to**:

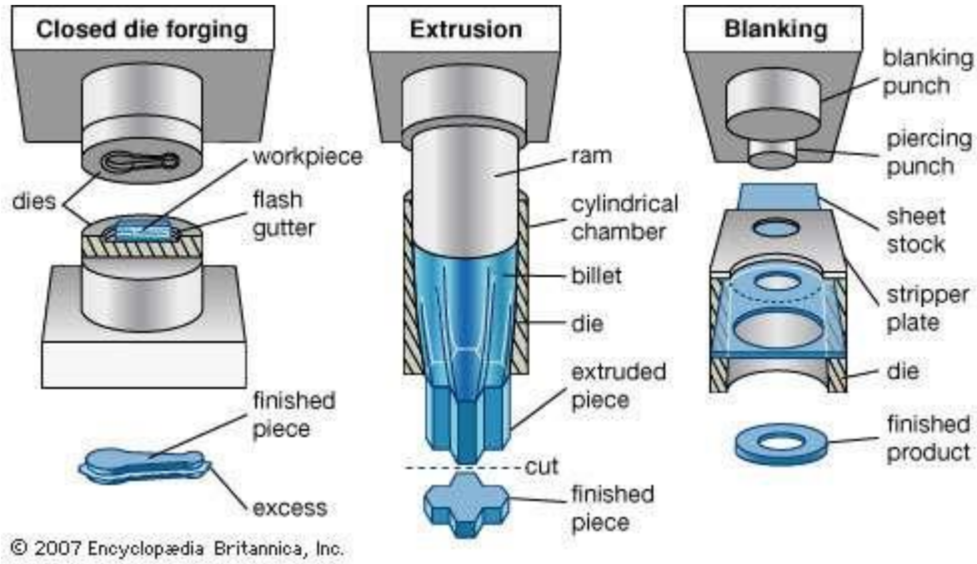
- tool and die design based on applied standards
- Appropriate materials are selected and obtained to meet tool and die requirements due to standards
- manufacture tooling components to specification
- Hand tools and hand held power tools if necessary to produce components to specification

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 41.
3. Read the information written in the information “Sheet.
4. Accomplish the “Self-check.
5. Do the “LAP test”.

Introduction

Tool and die making, the industrial art of manufacturing stamping dies, plastics molds, and jigs and fixtures to be used in the mass production of solid objects.



The fabrication of press working dies constitutes the major part of the work done in tool and die shops. Most press working dies are utilized in the fabrication of sheet-metal parts that range in size from the finger stop on a dial telephone to the panels of an automobile body. Each press working die consists of two sections, called punch and die, or male and female. Both sections are mounted firmly in an electrically or hydraulically driven press. In a working cycle the press ram, on which the male section is mounted, descends into the fixed female section. Any metal interposed between the sections is cut or shaped to a prescribed form. Like the dies, the presses range in size from extremely small to gigantic. A bench press is often small enough to be picked up manually; but the press that stamps out the roof of a car is generally about three stories high and capable of exerting tons of force.

The tooling involved in plastic molding is quite similar to that of stamping dies. The principal difference is that stamping requires force, while molding does not. In plastic molding, two units are required whose design is such that, when brought together, they make up a system of closed cavities linked to a central orifice. Liquid plastic is forced through the orifice and into the cavities, or molds, and when the plastic solidifies, the molds open and the finished parts are ejected.

The development of modern tools and dies can be traced to the American inventor and manufacturer Eli Whitney, who first implemented the concept of the planned manufacturing of interchangeable parts. Each part was manufactured to prescribed dimensions with the aid of tooling, so that the highly skilled craftsmen previously required for manufacturing were no longer needed since no additional fitting or selective assembly of the parts was necessary. Whitney's tooling consisted of templates (tool-guiding patterns) and rudimentary fixtures—the antecedents of today's tools and dies—and he successfully demonstrated the feasibility of manufacturing interchangeable parts by mass-producing firearms for the War of 1812.

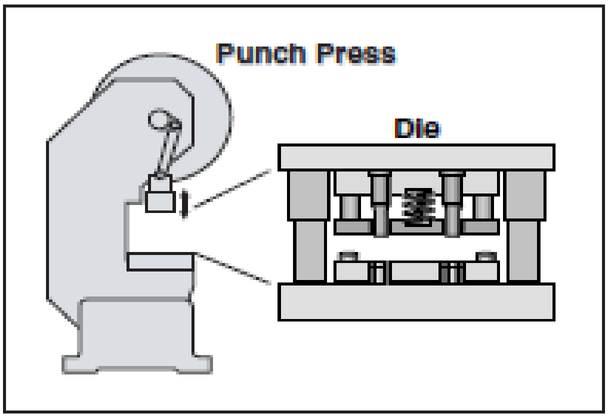
The successful introduction of interchangeable parts and the development of machine tools, both in the 19th century, brought the modern machine shop into being. Then, as now, the independent machine shop was called a job shop, which meant that it had no product of its own but served large industrial facilities by fabricating tooling, machines, and machine part replacements. Eventually, some machine shops began to specialize in tooling to the exclusion of other work.

The development of the power press gave rise to a demand for another form of tooling, the press die, the function of which is to cut and form sheet metal into predetermined shapes and configurations. The work of fabricating press dies is similar to, but not identical with, that of producing jigs, fixtures, and other tooling, which led to many of the specialized machine shops labeling themselves tool and die shops. The 20th-century developments of die casting and injection molding have brought about the demand for still other forms of tooling—the dies used in die casting and plastic molding. The making of these tools has also been taken over by the tool and die shops.

In the second half of the 20th century, however, the traditional tool and die shop was gradually replaced by specialized job shops that produce only one form of tooling. This trend can be attributed to the growing sophistication of tooling, for shops with the skills and equipment necessary to fabricate one form of tooling are seldom equipped for another. Even the single form of toolmaking called die making is becoming specialized; some shops now limit themselves to dies for special applications, such as automotive body dies.

Punch Press

Perforation is generally the most severe operation performed in a die. That's because the punch press applies forces ranging from a few tons to more than 1000 tons. Proper press alignment is essential. While die set has some effect on alignment during operation, it cannot offset poor press alignment.



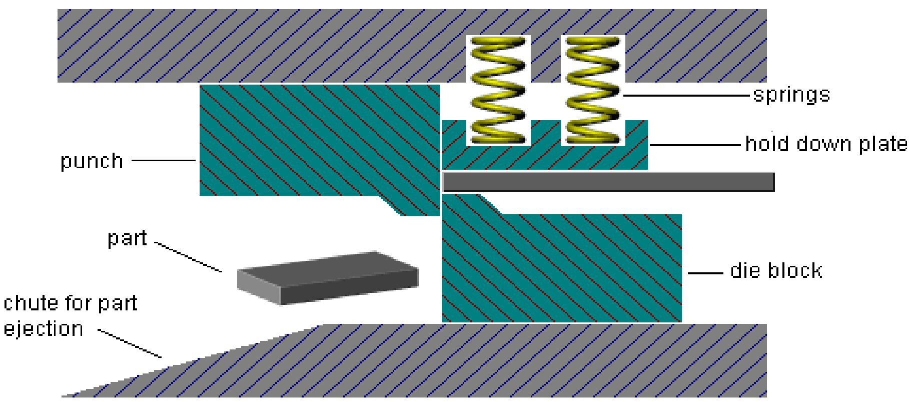
Simple Die

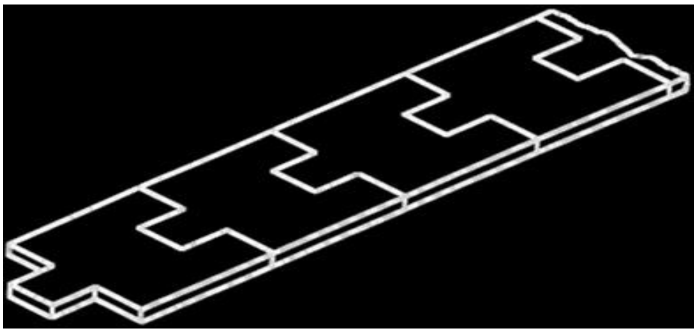
A simple die typically perforates holes in a part or blanks out the part using punches in conjunction with mated lower die components (matrixes). Simple dies also commonly produce basic forms as well as perform notching and lancing operations.

Simple dies require a press operator to load and unload parts and part material before and after each press cycle.

CUT OFF DIE

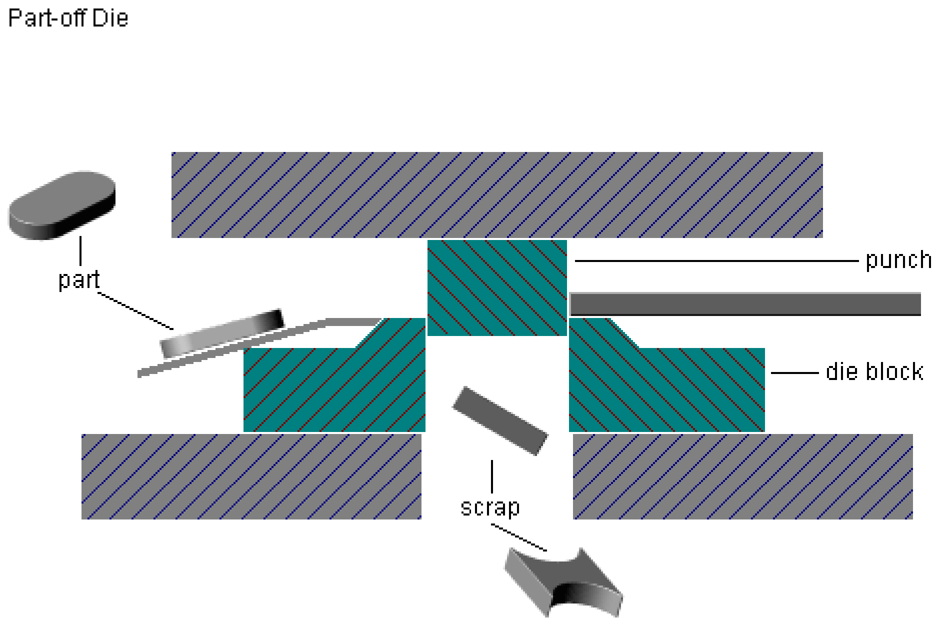
Cut-Off Die

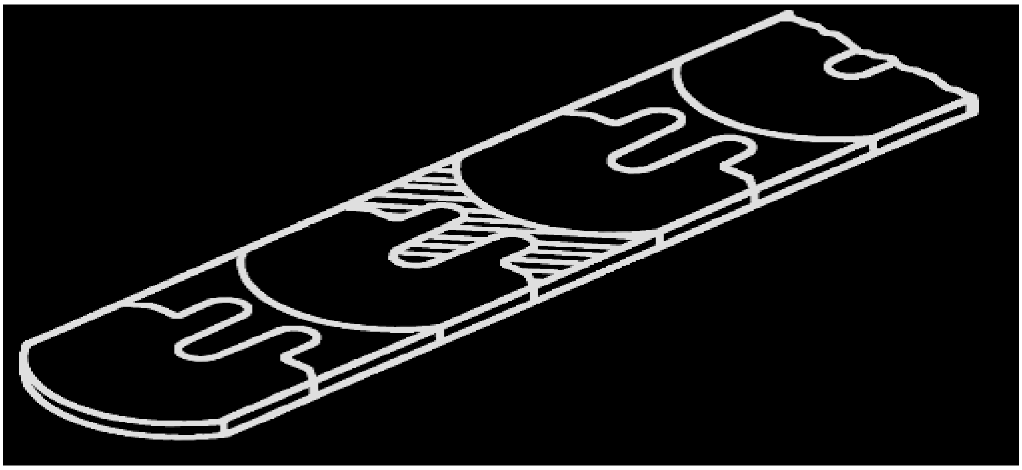




□Design parts with straight parallel edges and “jig-saw” ends -minimizes scrap and can be produced on simplest cut-off die

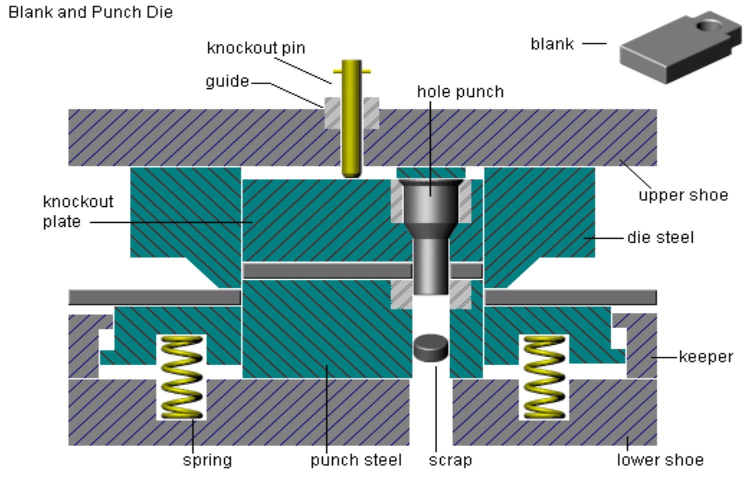
Part-off Die



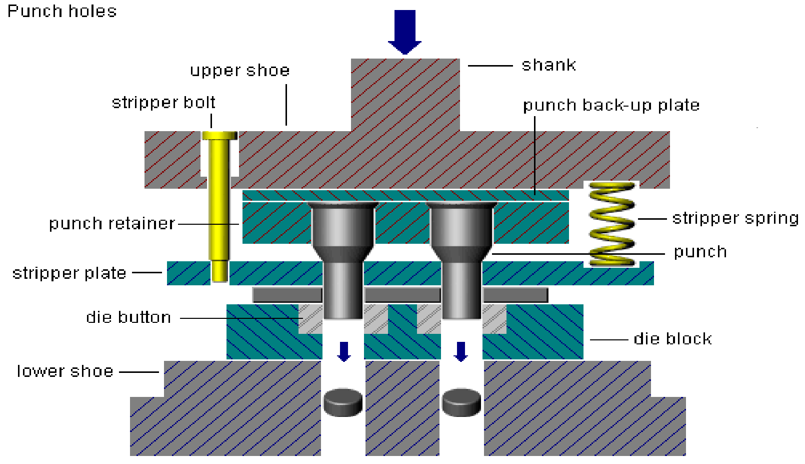


Design parts with straight parallel edges -reduces edge scrap and requires simpler part-off die

BLANK and Punch Die

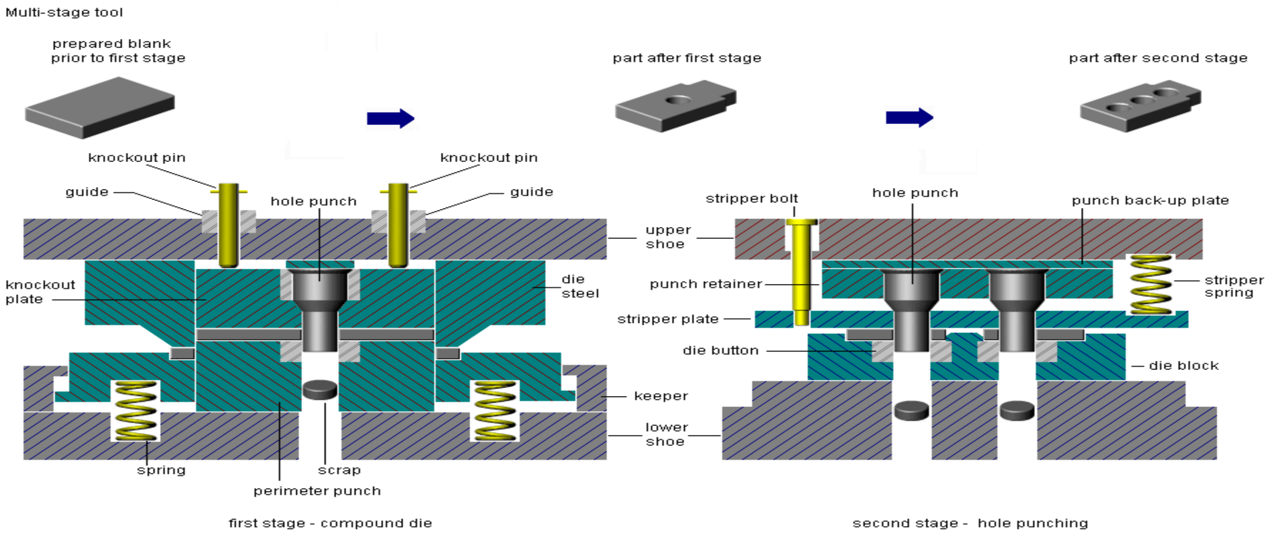


Hole Punching Die



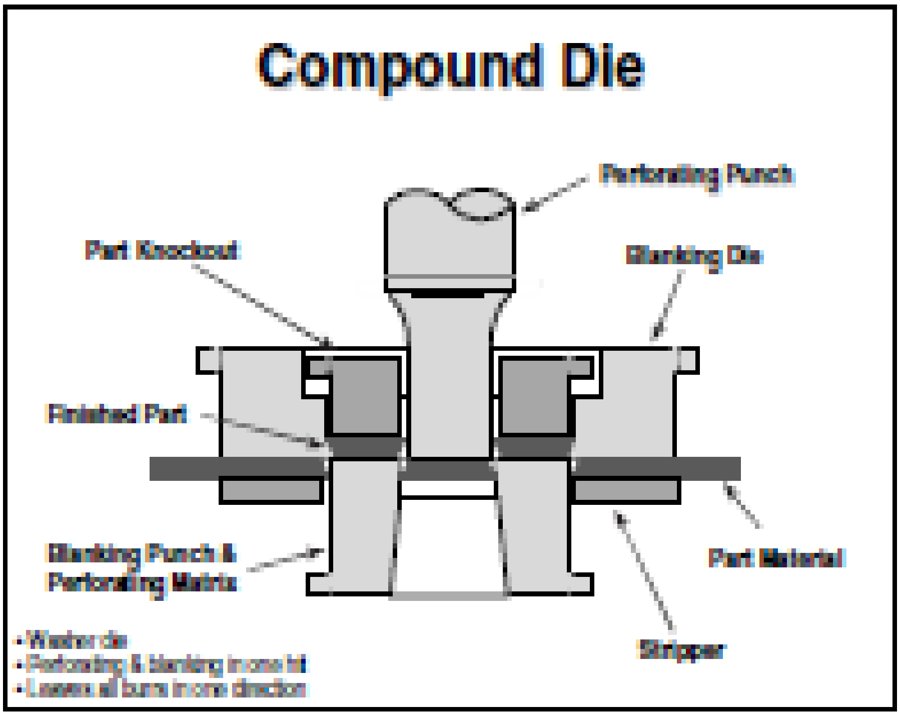
Multi-stage Stamping

Multi-stage Stamping



Compound Die

A compound die blanks and perforates a part at the same time in the same station. In most cases this operation perforates a hole or holes down, while the part blanks up. This allows slugs from those holes to fall through the die. This method leaves the part in the die, requiring some means of part removal.



Compound dies commonly run as single-hit dies. They can run continuously with a feeder, provided you can remove the part in a timely manner. Open Back Inclinable (OBI) presses - in the inclined position along with an air blowoff - aid in part removal.
Advantages of a compound die include:
• Minimal space in the press
• All burrs in one direction
• Superior accuracy between holes and trim edges
• More economical to build than a progressive die
A disadvantage of a compound blank die is its limited space that tends to leave die components thin and weak. This concentrates the load and shock on punches and matrixes, resulting in tooling failures.

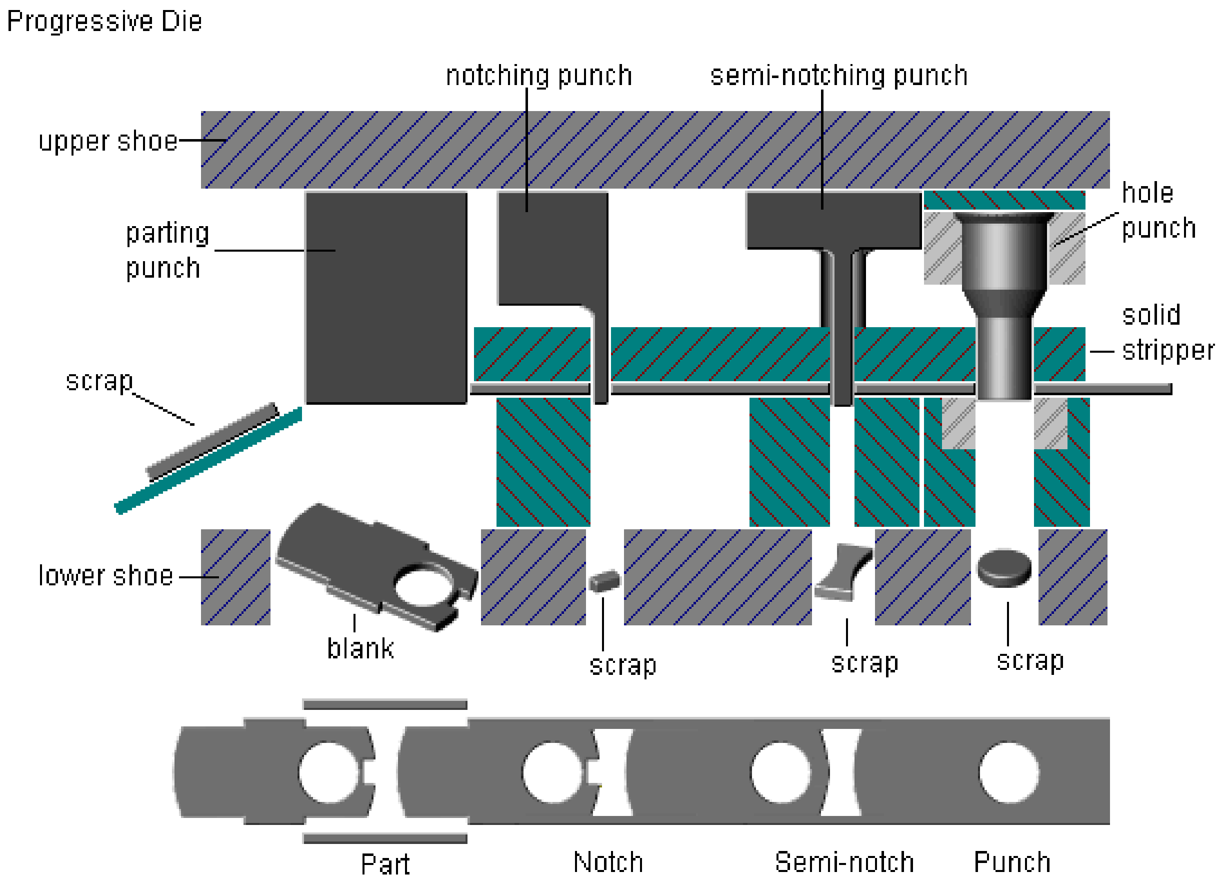
Progressive Die

Progressive dies provide an effective way to convert raw coil stock into a finished product with minimal handling. As material feeds from station to station in the die, it progressively works into a completed part.

Progressive dies usually run from right to left. The part material feeds one progression for each press cycle. Early stations typically perforate holes that serve as pilots to locate the stock strip in later stations.

There are many variations of progressive die designs. The design shown here illustrates some common operations and terminology associated with progressive dies.

PROGRESSIVE DIE



Stripper Designs

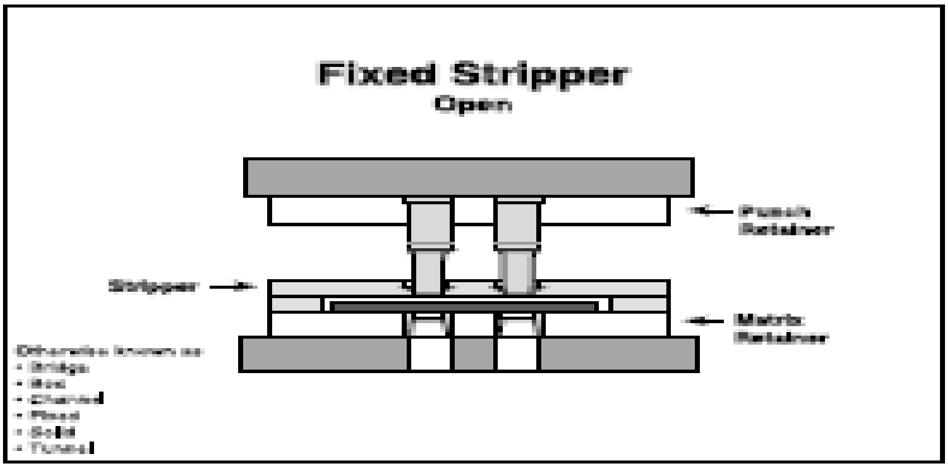
Stamping dies require some means of stripping the part from the end of the punch at withdrawal. Common types of strippers for accomplishing this include Fixed, Urethane and Spring. Stripping force varies based on part material type and thickness as well as
punch-to-matrix clearance. This force ranges from nearly zero to as much as 25% of the force required to perforate the initial hole. Most applications do not exceed 10% of the perforating force.

Fixed Stripper

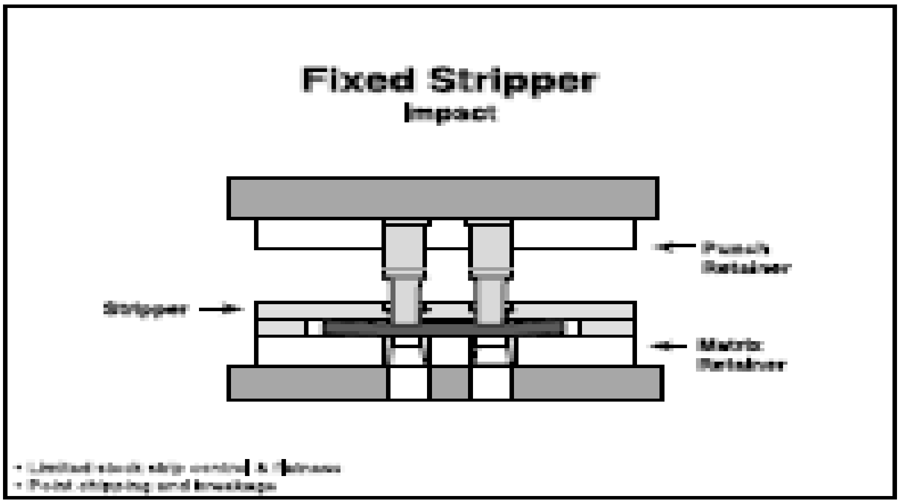
Fixed strippers go by many names:

• Box • Bridge
• Channel • Positive
• Solid • Tunnel

A fixed stripper is a steel plate with a clearance slot that allows the part material to pass under it. This plate mounts to the die retainer in a fixed position. Clearance holes cut through the stripper plate let the punches extend through without interference. At withdrawal the part material hits the stripper, preventing it from lifting as punches retract. The part material strips from the end of the punch.

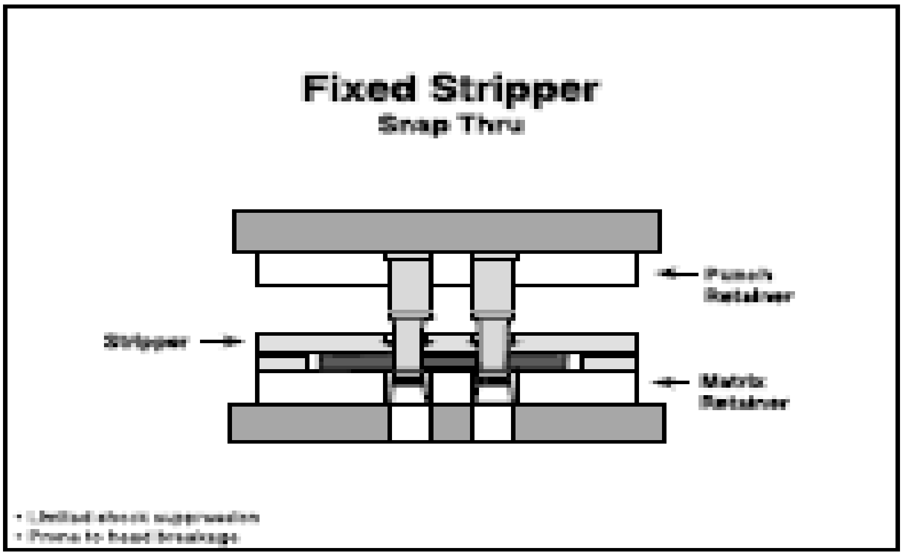


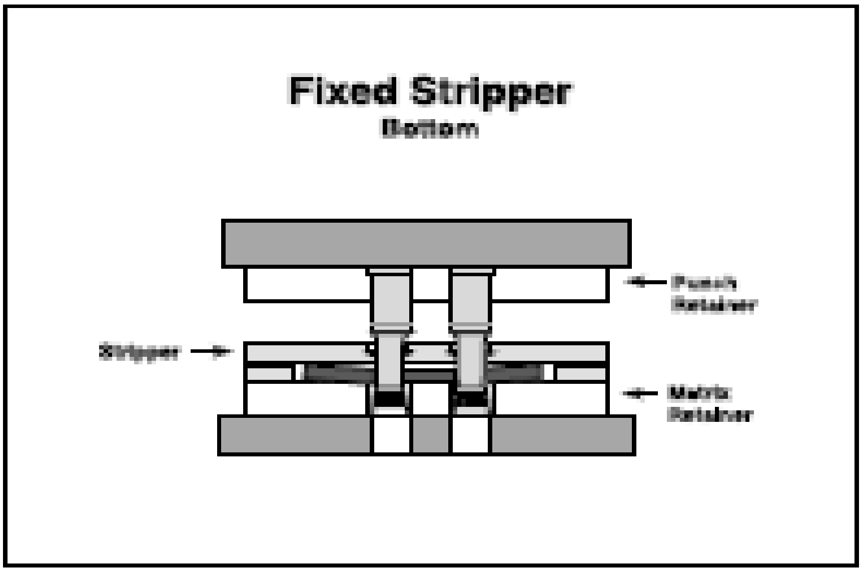
Fixed strippers have several drawbacks. They do not hold the stock strip flat and are unable to absorb impact and snap-thru shock. The result is poor part flatness and premature punch failure.



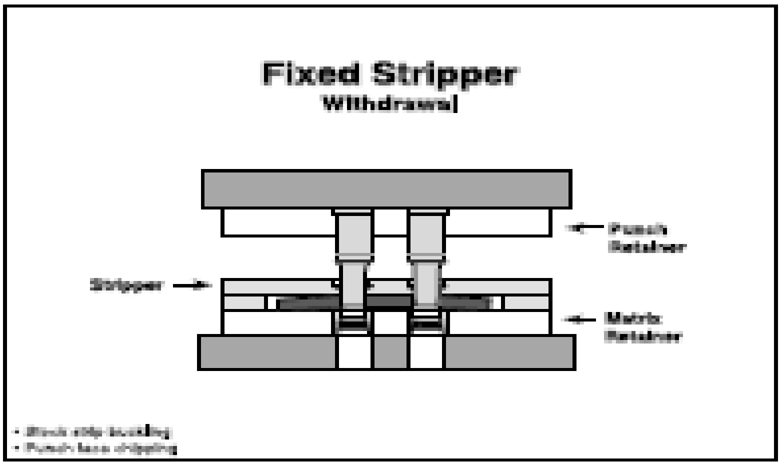
We generally do not recommend fixed strippers for high-volume or high precision jobs. A typical clearance under the stripper is 11⁄2 times the material thickness - 1/16” to 1/8” is common clearance on the sides of the stock strip.

Clearance under a fixed stripper is commonly 11⁄2 times the part material. This allows for variations in part material thickness and for stock strip deformation. This deformation allowance under the punch point results in punch point chipping. That deformation can also cause lateral movement of both part and punches, resulting in punch point breakage and poor part quality. At snap-thru there is a sudden unloading of pressure on the punches and part material. This generates shock, which can lead to punch head breakage.



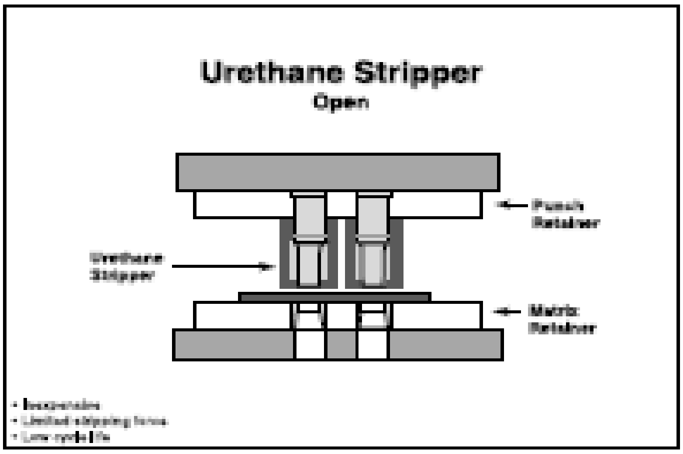


The buckling effect binds the part on the ends of the punches, which increases stripping pressure and potentially chips the punch face.

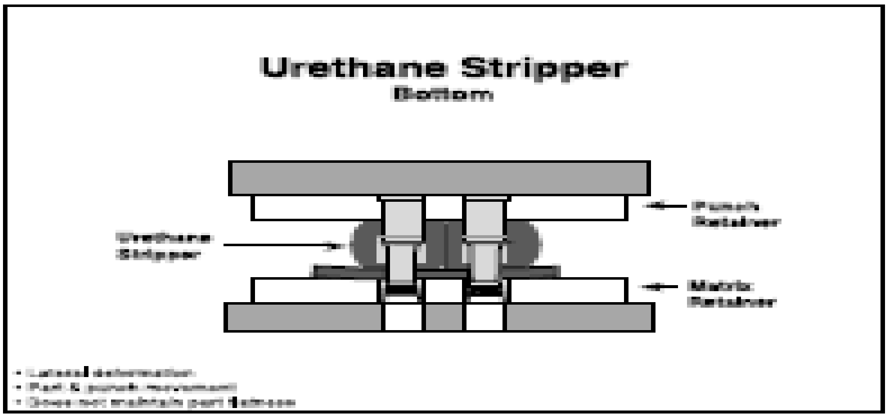


Urethane Stripper

Urethane strippers are inexpensive and simple to use. They slide over the end of a punch with a slight press fit, which prevents the stripper from falling into the die during operation.



Through use, urethane strippers fatigue and become loose on the punches.
You must continually monitor them to prevent them from falling into and damaging the die. Some urethane strippers are molded with a head designed to fit a standard urethane retainer. This greatly enhances urethane stripper life and reliability.

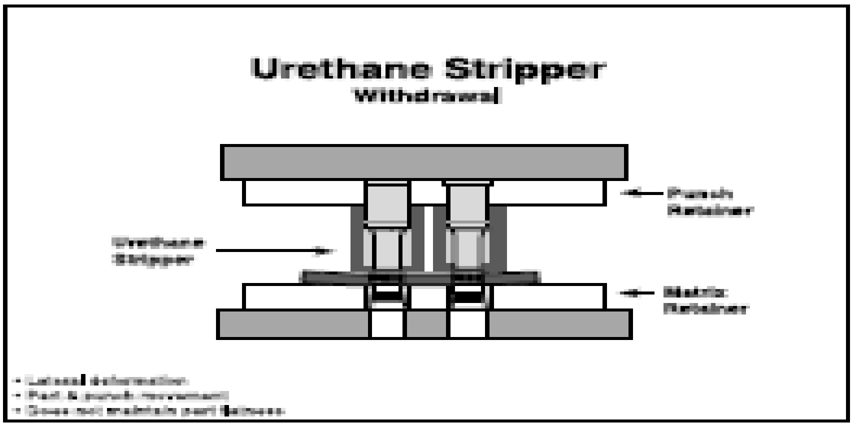


Urethane stripper performance - especially during the bottom and withdrawal steps of the punch cycle - prompts special consideration before use.

1. Urethane does not compress. Under load urethane deforms. If the volume displacement necessary for this deformation exceeds the available space in the tool, the urethane stripper likely creates space by moving or breaking tooling components.
2. Because urethane does not provide a rigid flat surface, it cannot hold the stock strip or part flat.
3. Urethane strippers prevent air from venting in around the punch point or through the side vent hole of ejector punches, which can cause slug-pulling problems.

Deformation and movement of the urethane strippers can move the stock strip or part laterally, creating punch-to-matrix alignment problems.

A urethane stripper strips the part off the ends of the punches as it returns to it’s original shape. Due to the urethane’s pliable nature, the part material may distort during the perforating and stripping process.



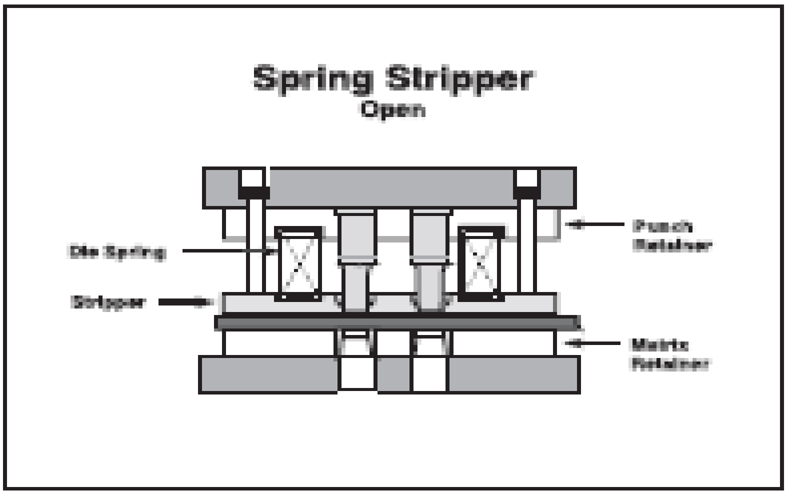
Some urethane strippers have a steel washer attached to the end to minimize part distortion. Exercise caution when using this type of urethane stripper on shaped punches or applications where large amounts of pre-load are required. Catastrophic punch failure can occur if the punch face catches the steel face prior to hitting the part material.

The optimum urethane stripper should have a combination of two different grades of urethane: a high hardness grade of urethane for the face and a medium hardness grade for the body. This helps maintain part flatness without sacrificing durability and elasticity.

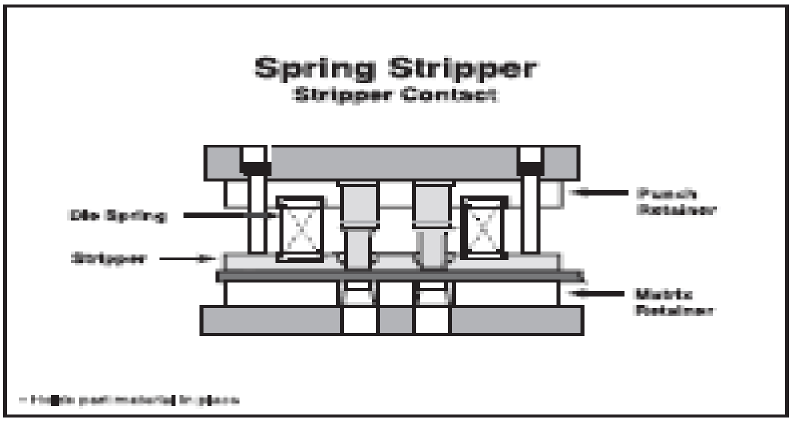
Spring Stripper

Spring strippers offer superior performance. Their main advantage is that as the die closes, they hold the stock strip or part flat and in place during perforating. A spring stripper prevents the part material from lifting or hanging up on the punches at withdrawal.

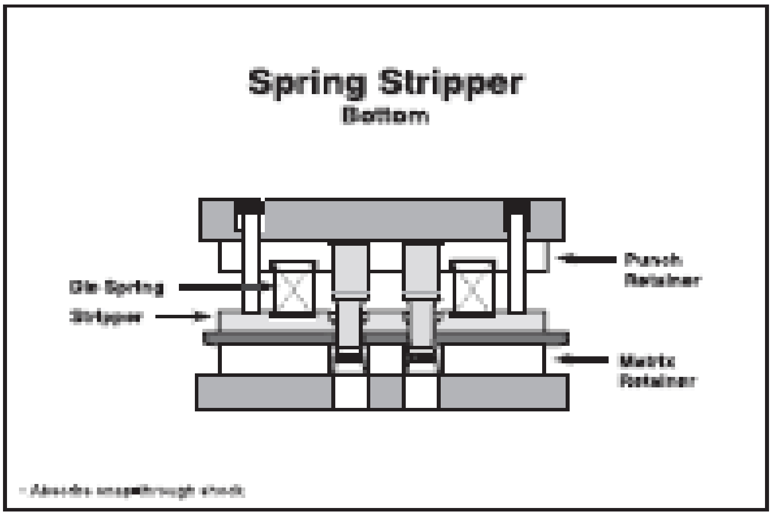
Because the stripper lifts away from the part material after each stroke, you can visually monitor die performance.



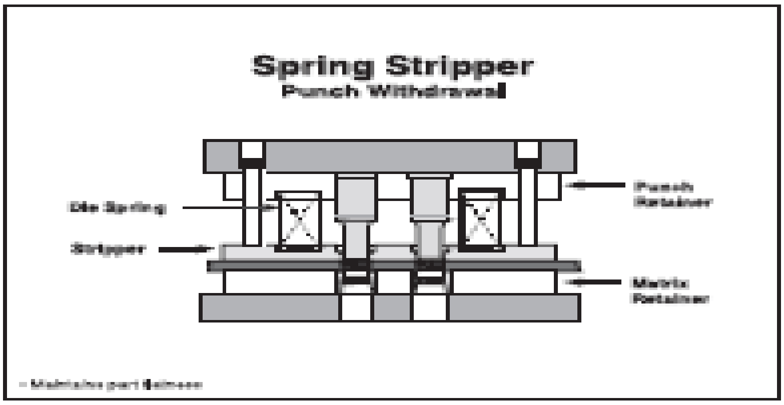
A spring stripper hangs below the ends of the perforating punches. As one of the first components to contact the part material, it holds the part in a fixed position throughout the cycle of the press.



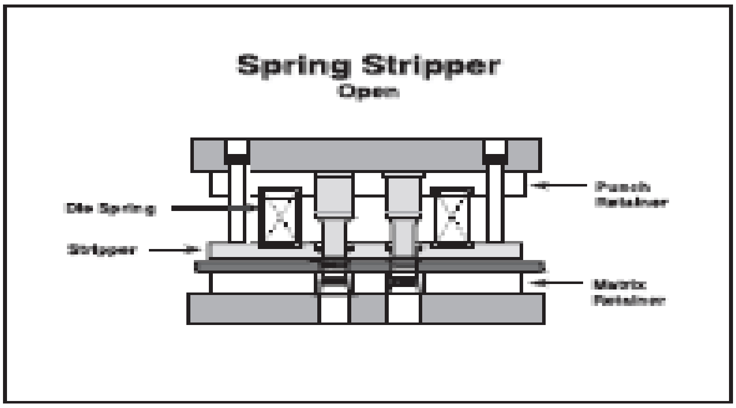
A spring stripper absorbs shock at snap-thru and eliminates shock at withdrawal that would otherwise damage the tooling and possibly the press.



The main purpose of a stripper is to pull material from the ends of the punches. This function occurs at the withdrawal phase of the perforating process.
Stripping force varies based on part material type and thickness as well as punch-to-matrix clearance. This force can range from nearly zero to as much as 25% of the force required to perforate the initial hole. Most applications do not exceed 10% of the perforating force.

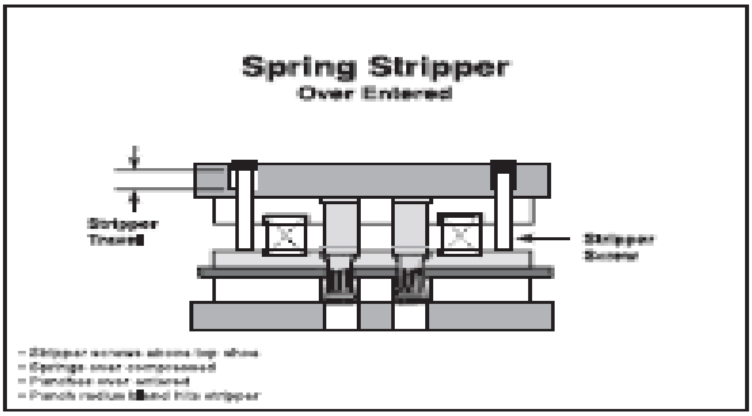


Continuous pressure throughout the working portion of each press cycle provides superior performance in tool reliability, part quality and press life.



Over-entry or closing a die below its recommended shut height can have catastrophic consequences.
Excessive stripper travel can:

1. Drive stripper screws into parallels or the press ram, potentially breaking the screws or bending the stripper.
2. Compress die springs beyond design limits, causing premature failure.
3. Cause stripper interference with the radius blend on the punches, resulting in broken punch points and heads. Punch over-entry also causes excessive galling and wear on the punch points.



Punches

Punches and dies are the most basic components of every die. Their bodies and shapes can be Electro Discharge Machined (EDM) from a block or blank, or from a bar stock or other materials. The material these tooling elements are made from is of a great importance, not only for its hardness and ductility, but for its behavior in production, resistance to galling, resistance to changes in material structure due to heat, frequency of sharpening, and the like.

A sample of a typical punch, its dimensioning and tolerances is shown in Fig. 4-2. Notice the diameter of the cutting portion *P* is quite precise. *This dimension is always that of the opening to be pierced*. The cutting tolerance is added to the die opening.

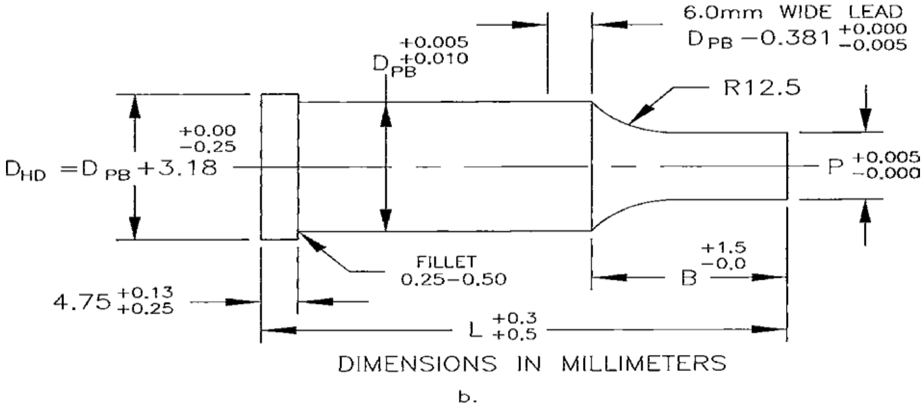


FIGURE 4-2 Detail of a punch.

Mounting of punches is evaluated in Fig. 4-3 with respect to the two mounting techniques already described: Either the shank is press-fit within the block while the head is loosely contained in the counterbore (Fig. 4-3*a*), or the head is press fit and the shank is loose (Fig. 4-3*b*). The second method of mounting is reserved for special instances, whereas the first method is commonly used for mounting of majority punches.

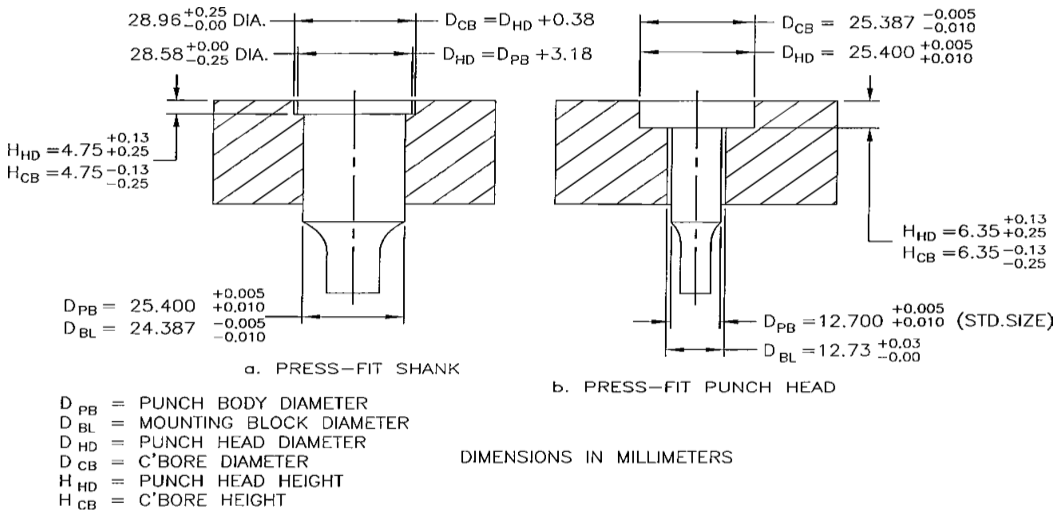


FIGURE 4-3 Mounting of punches.

Die Button or Die Bushing

Die button, or die bushing is shown in Fig. 4-13 in several variations. The first, a version, is used and dimensioned for piercing of a single opening, while the b style may produce the inner and outer diameter at the same time. The headless die button (Fig. 4-13*c*) is often used with a lighter type of work or with parts such as wave washers. The absence of the heel may reduce the cost of such a bushing's manufacture and assembly, but the disadvantage of such an unsecured press fit may be considerable.

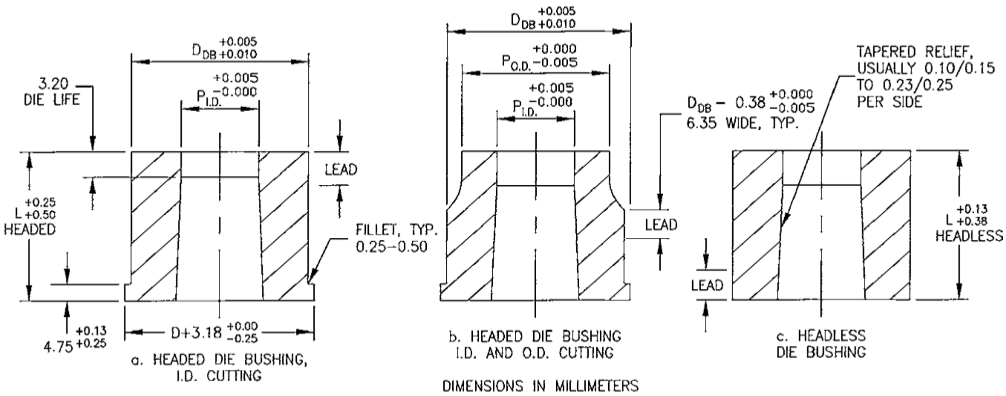


FIGURE 4-13 Die button.

Every die bushing has an opening into which a punch slides when cutting the sheetmetal
material. Such an opening is absolutely straight and precisely finished. It is called the "die life" (or "land"), and it is the amount of the die height which can be used up for subsequent sharpenings.

Slug Removal

The three types of slug relief, a tapered and counterbored relief with a die life (also called "land"), and a relief that is tapered through with no die life. Each of these designs has its advantages and disadvantages.

For example, the tapered relief controls the movement of flat slugs through the die, while the counterbored opening allows them to tumble and jam. The jamming of slugs, their spinning around, bridging against each other and sticking together, can have a detrimental effect on the quality of the pierced part and naturally, it is endangering the tooling as well. The tapered die relief is more supportive to the cutting edge, and as such, this die often outlasts counterbored openings. Therefore, it may be summarized that most often, the improperly chosen or improperly produced slug-relief openings are the main causes of many slug-related problems.

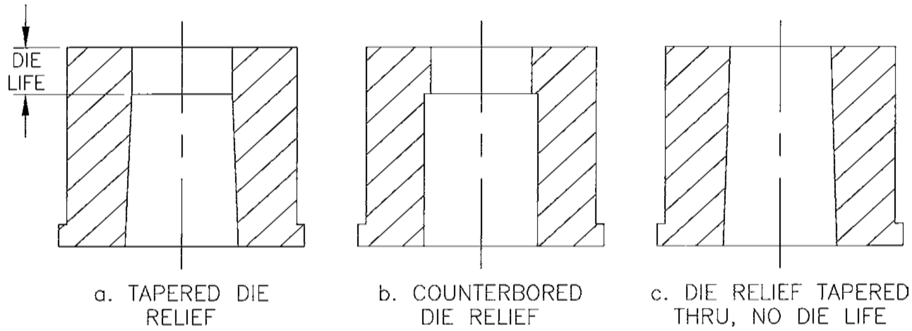


FIGURE 4-14 Three types of die relief.

Mounting methods

Mounting methods of guide bushings are similar to mounting methods for punches. Therefore, the earlier description of the procedure applies here too. The height of the bushing in Fig. 4-20*a* should be equal to the thickness of the die block; the bushing shown in Fig. 4-20*b* must be higher than the die block to allow for dual cutting.

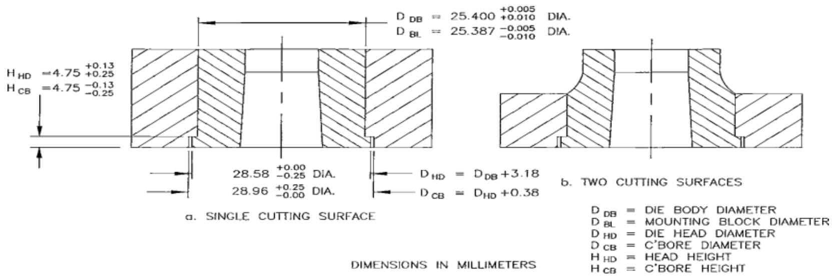


FIGURE 4-20 Mounting of a die.

Locating Methods for Punches and Dies

Other than round punches should be well aligned with their respective bushings and either part of the assembly should not rotate or otherwise deviate during the die function. This, along with the correctness of the initial installation, is assured by keying the punch or die's head and placing a standard keyway against its surface. Key flat portions are obtained by grinding the punch head all the way toward the shank diameter, as shown in Fig. 4-21. Some punches may have a single key flat; others may have two. With headless bushings, an undercut may be produced to serve the same purpose

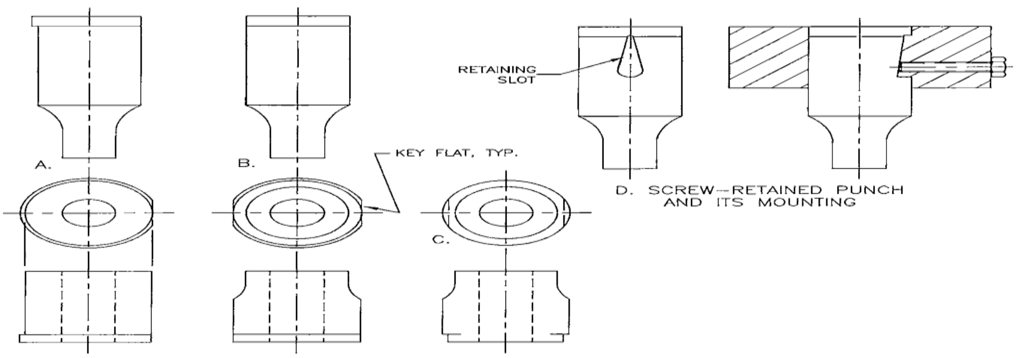


FIGURE 4-21 Locating methods for punches and dies.

Another locating feature is a retaining notch in the shank of a punch (Fig. 4-21d). A screw inserted through a side opening in the punch plate will secure the punch against rotational movement and against any vertical displacement.

Pilots

In construction, pilots are similar to punches, with the only difference being in their smooth, radiused end (Fig. 4-22). In the die, pilots provide for a guidance of the strip by sliding into at least two pierced openings, located at the extreme edges of the Sheetmetal strip, and positioning, or fine-adjusting the surrounding material around their

bodies. Pilots are always longer than any punches, to assure their contact with the strip prior to the occurrence of any cutting. Their diameter may be −0.003 in. (−0.08 mm) smaller than the diameter of the punch used for piercing pilot holes. Mounting of pilots utilizes the same procedure as that described for mounting of punches. Pilot punches should always be as sturdy as possible. After all, these are first to engage the advancing sheet-metal strip and force it, where misfed, to conform to the positioning requirements. Headed, larger diameter pilots are therefore preferable.

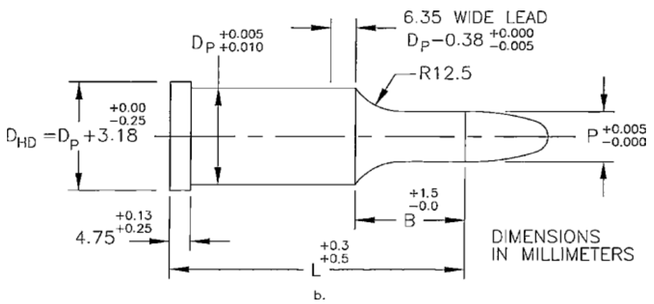


FIGURE 4-22 Detail of a pilot.

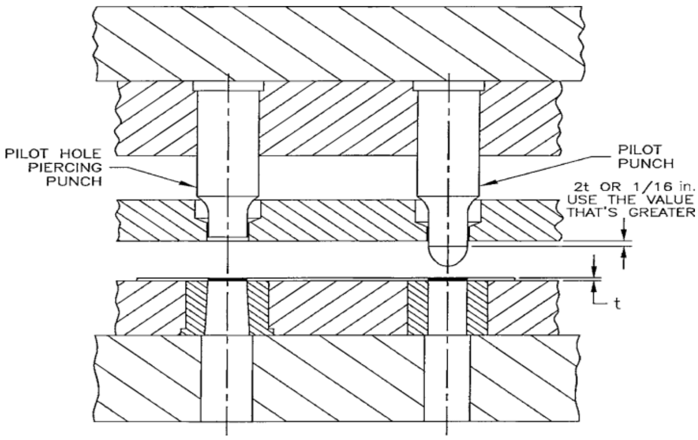


FIGURE 4-23 Function of a pilot punch.

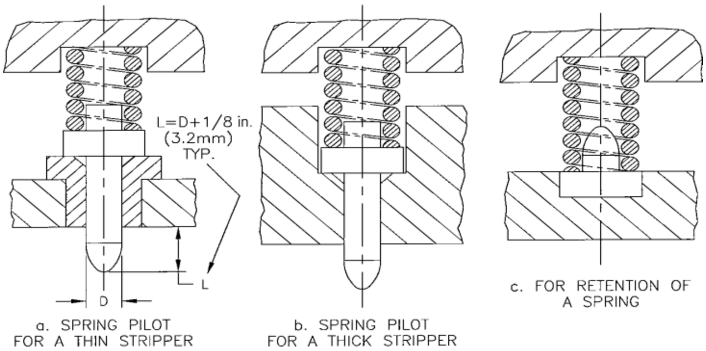


FIGURE 4-24 Spring pilots and their use.

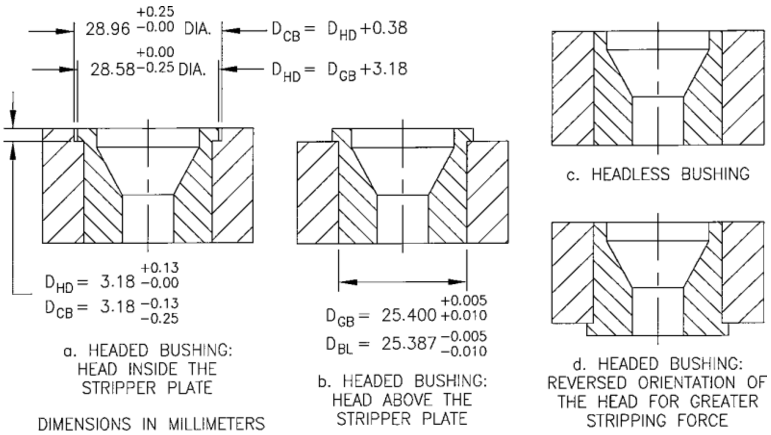


FIGURE 4-26 Mounting of guide bushings.

Strippers

Stripping of parts off the face of the tooling is a complex problem, influenced by the thickness of material and its type, by the surface finish of the strip, and by the surface condition of the tooling as well.

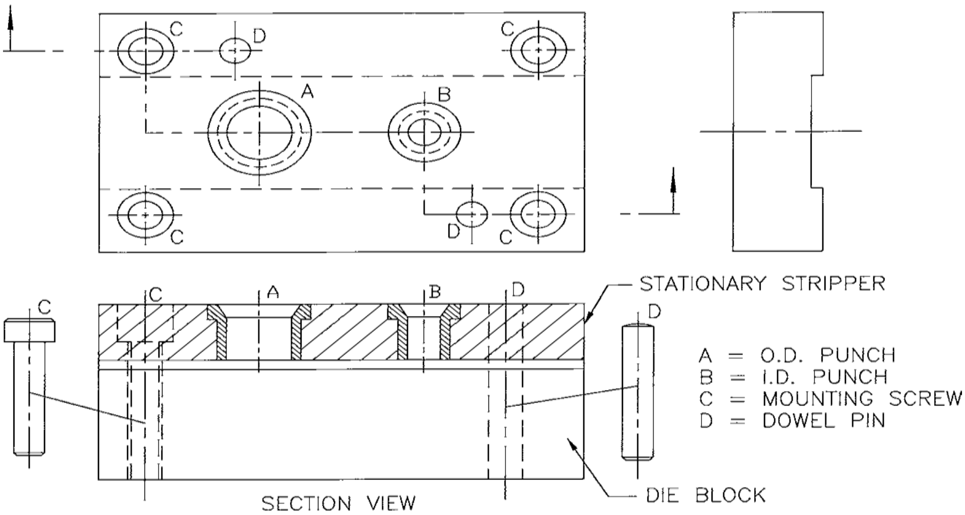
Stationery and Spring Strippers.

Strippers, as used in the die work, are either stationary (nonmoving) or spring-loaded (moving). Stationary strippers are low in cost when compared to spring strippers. Therefore, spring-backed stripping arrangements should be used with thin, fragile punches, where the immediate stripping action may prevent their breakage.

Spring strippers are of advantage also where additional flattening or material-retaining function is needed or considered beneficial.

Stationary strippers are provided with a milled channel made to accommodate the strip material. It retains the strip in a fixed location, preventing it from moving anywhere, up, down, or sideways.

The stationary stripper (Fig. 4-30) is attached to the die block and it can be using the same screws and dowel pins necessary for attaching the die block to the die shoe. This way, a single set of dowel pins provides for the alignment between all plates, and a single set of screw is used for their attachment.



The holes containing dowel pins must be precision-reamed throughout all plate. But the holes for screws cannot be tapped all the way through, as a misalignment, binding, and a host of other difficulties will be encountered during assembly. Openings for screws must be relief openings all the way through the blocks, no matter what their number or height should be, with only the final block being tapped.

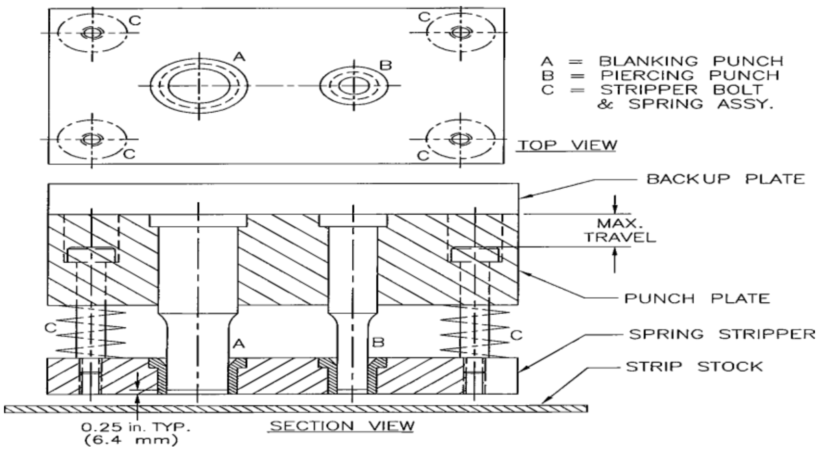


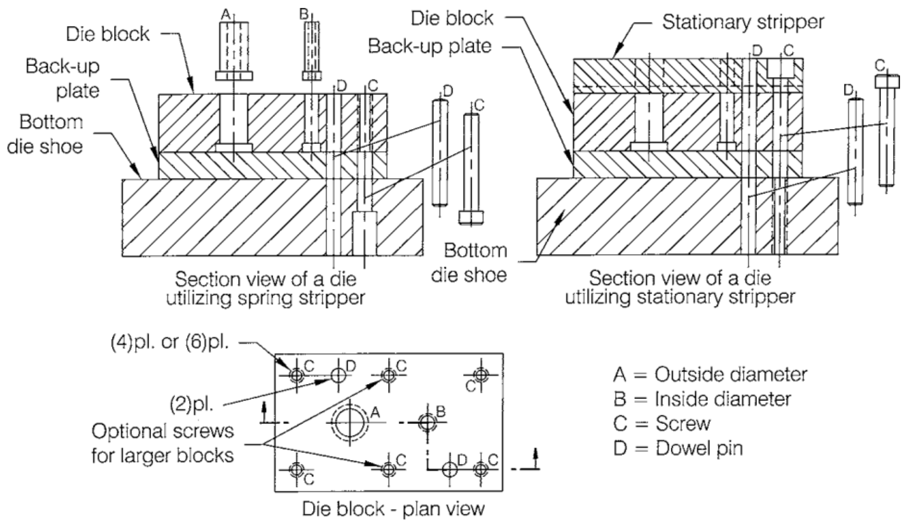
FIGURE 4-31 Spring stripper.

MOUNTING OF BLOCKS

All the punches and dies described earlier are assembled within their respective blocks. The blocks themselves are firmly and with great precision attached to their supporting backup plates (where used) and to their die shoes. For mounting of blocks, ***socket head cap screws*** are most often utilized. The precision alignment is achieved by at least two dowel pins per block. Usually, with smaller blocks, four screws and two dowel pins will suffice. With larger blocks, six or more screws and four dowels should be used.

Die Block

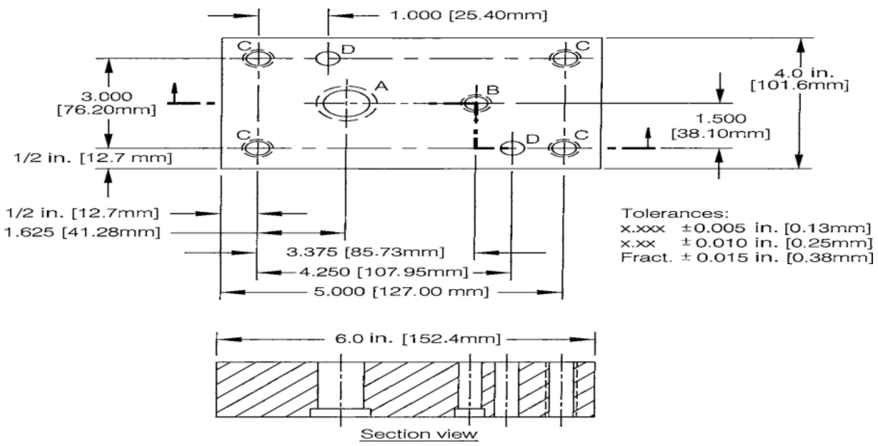
The die block is made of high-quality steel, hardened and precision ground to exact size.



Die blocks, running in dies with a stationary stripper, would not contain tapped holes for screws; in such a situation the screws are inserted off the stripper's top surface, with counterbores in the stripper plate, relief holes through all the blocks, and a final tapped hole in the bottom die shoe.

With a spring stripper, which is not attached to the die block at all, the screws for the attachment of die block are driven in from the opposite direction, which is the bottom surface of the lower die shoe. In such a case, the die block contains tapped holes, with relief openings through all the adjoining plates and a counterbore for the screw heads in the die shoe.

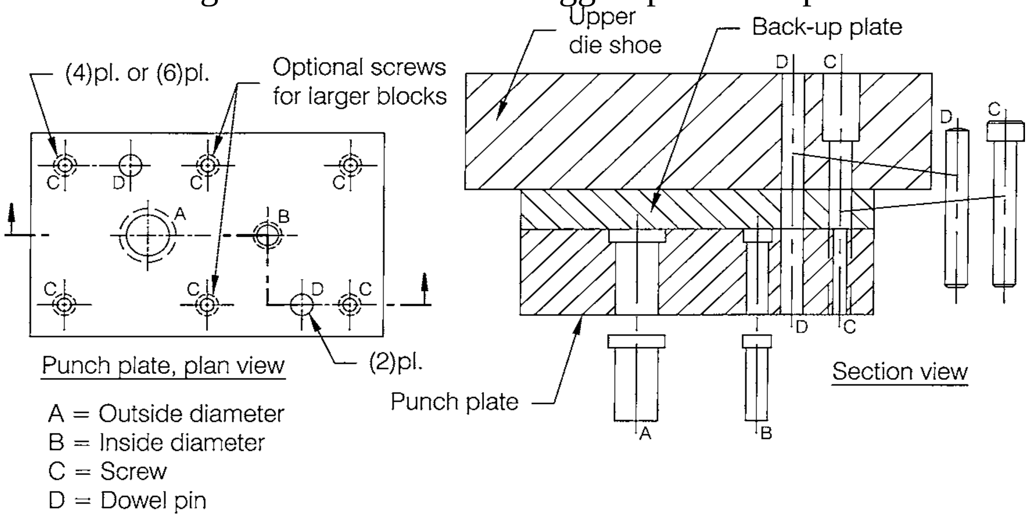
When dimensioning the die block for manufacturing purposes, all the dimensions should go off one opening, which should be the only one to be dimensioned off the block's edge. A common range of general tolerances is added for illustration



Punch Plate

The punch plate is designed, dimensioned, and manufactured similarly to the die block.

There is one difference though, when considering the view location: The die block is always viewed off its top surface, whereas the punch plate is usually seen from below. The punch plate, since it provides the support for all punch shanks, must be adequately thick but not in excess of what is necessary, in order not to increase the weight of a die. The correct thickness of this plate is in the range of ***1.5D***, with *D* being the diameter or the largest dimension of the biggest punch the plate should



accommodate.

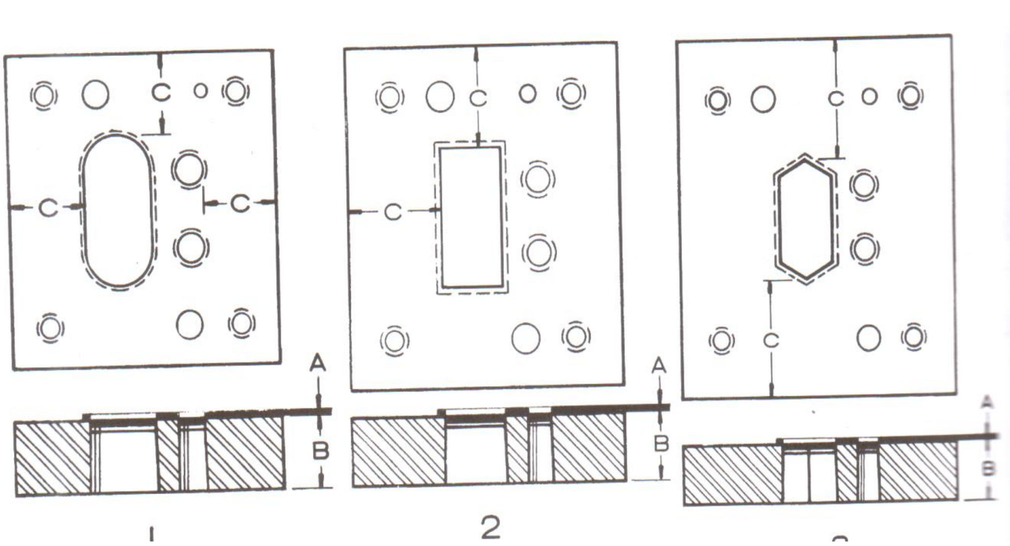
Backup Plates

Where used, both backup plates are made of hardened steel, 3/8 in. (9.5 mm) thick for general work, 1/2 in. (12.5 mm) thick for heavy-duty jobs.

The hardness should be in the vicinity of 40 to 50 HRc, as a harder plate will not provide the proper support to the punches and/or dies and these may have a tendency to bounce off, or resonate. This in itself will certainly destroy them much sooner than planned. A2 steel is preferred to oil-hardened steels, which tend to be warped by the heat treatment, which affects their flatness. Backup plates contain only clearance openings for screws and precision-finished openings for dowels. In slug-producing stations, however, they must have openings for the slug disposal; in blank-producing stations, such openings are used for parts' disposal.

DIE PLATE DESIGN DATA:

Die block thickness and other die dimensions may also be selected from the following table.

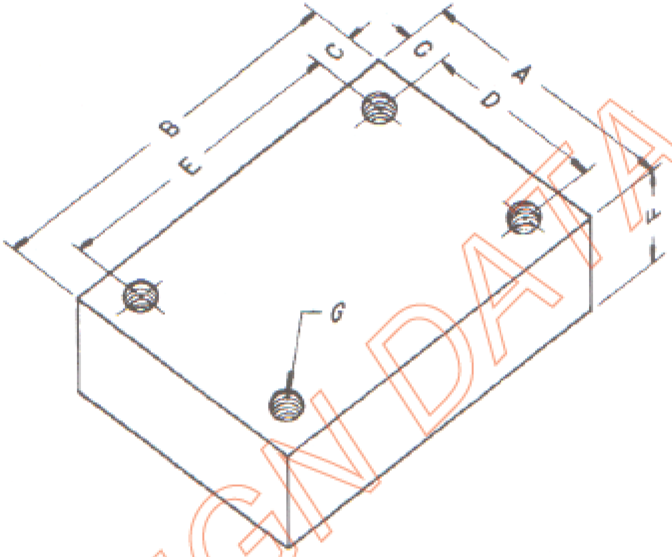


:

A	B	C Minimum Distance – Die Hole To Outside Edge		
		1 Smooth Die Hole Contour (1.125 B)	2 Inside Corners (1.5 B)	3 Sharp Inside Corners (2 B)
Strip Thickness	Die Block Height			
0 to 1.5	24	27	36	48
1.5 to 3.1	29	33	44	58
3.1 to 4.7	35	39	53	70
4.7 to 6.3	42	47	63	84
Over 6.3	48	54	72	96

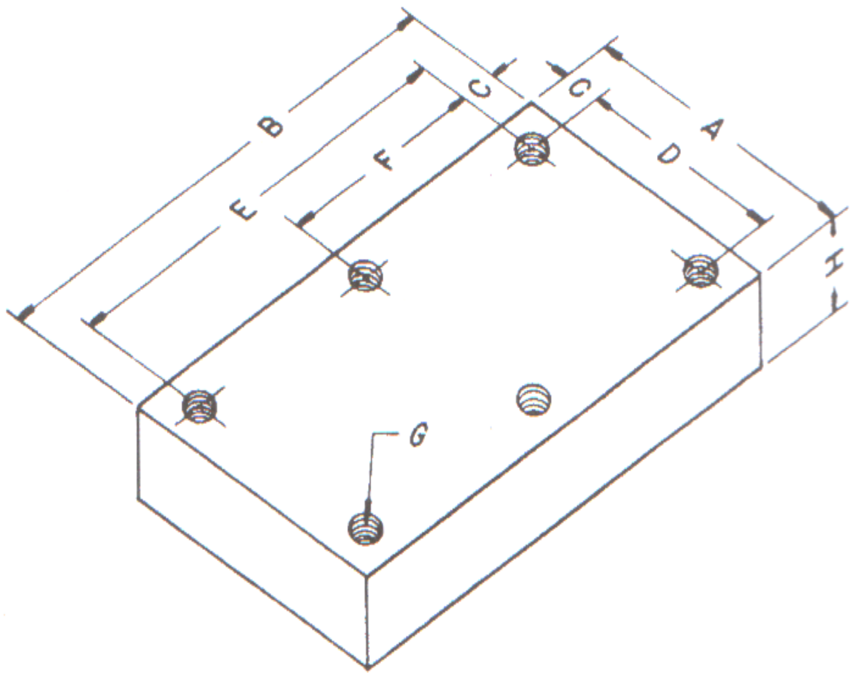
Table 3.2 - Recommended minimum C distance for various die hole contour and die block heights B

Tabulation of suggested standard die block sizes:



A	B	C	D	E	F	G
76.2	88.9	15.8	44.4	57.1	23.8	M8 TAPPED THROUGH HOLE
76.2	127	15.8	44.4	95.2	23.8	M8 TAPPED THROUGH HOLE
101.6	101.6	15.8	69.8	69.8	23.8	M8 TAPPED THROUGH HOLE
101.6	127	15.8	69.8	95.2	23.8	M8 TAPPED THROUGH HOLE
101.6	152.4	15.8	69.8	120.6	23.8	M10 TAPPED THROUGH HOLE
127	127	19	88.9	88.9	23.8	M10 TAPPED THROUGH HOLE
127	152.4	19	88.9	114.3	23.8	M10 TAPPED THROUGH HOLE

Tabulation of suggested medium size die block sizes:

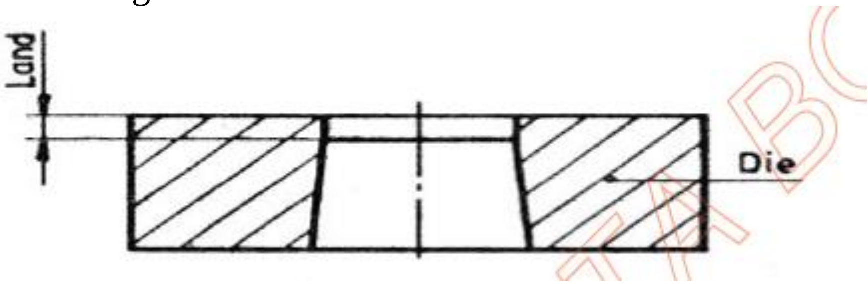


A	B	C	D	E	F	G	H
101.6	177.8	19	63.5	139.7	69.8	M10 TAPPED THROUGH HOLE	28.5
101.6	203.2	19	63.5	165.1	82.5	M10 TAPPED THROUGH HOLE	28.5
127	203.2	19	88.9	165.1	82.5	M10 TAPPED THROUGH HOLE	28.5
127	254	19	88.9	215.9	107.9	M10 TAPPED THROUGH HOLE	28.5
152.4	203.2	19	114.3	165.1	82.5	M10 TAPPED THROUGH HOLE	28.5
152.4	254	19	114.3	215.9	107.9	M10 TAPPED THROUGH HOLE	28.5
177.8	279.4	19	139.7	241.3	120.6	M10 TAPPED THROUGH HOLE	28.5

Die land

Die land varies depending upon the no. of regrinding requirements (die life expectancy).

But in general die land given as 3 to 5 mm.

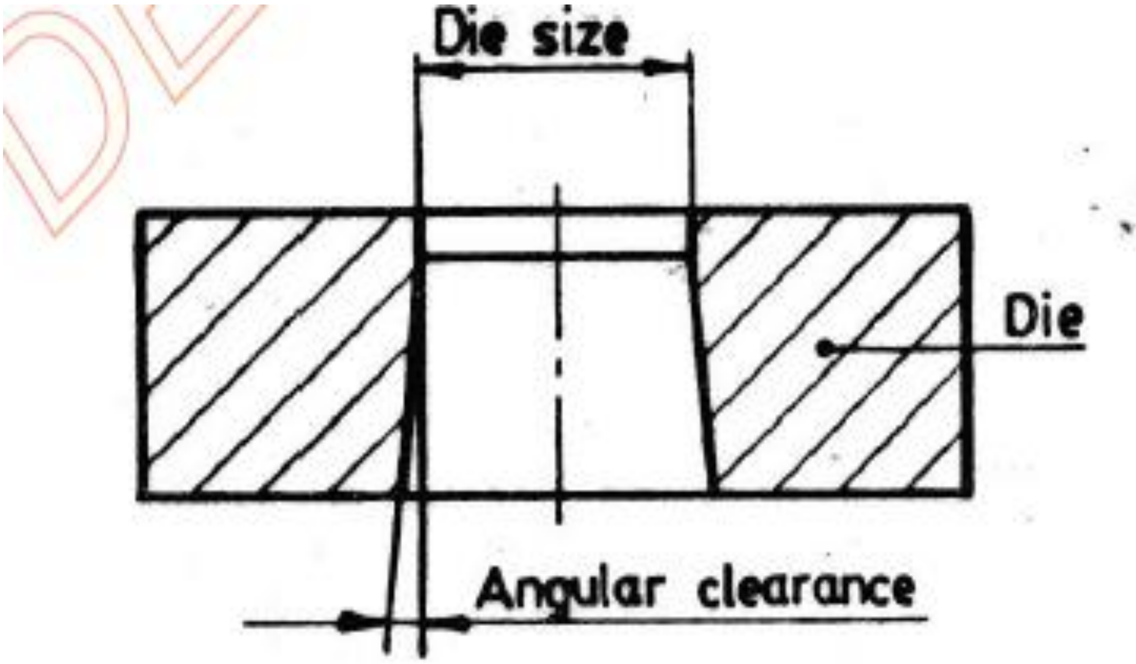


Angular clearance – Generally 1/4° to 1° angular clearance is provided. Increased die clearance weakens the die. Angular clearance may also be selected from the following

Angular clearance data

Strip thickness in mm	Angular clearance per side
0 to 1.5875	$1/4^{0}$
1.5875 to 4.76	$1/2^{0}$
4.76 to 7.9	$3/4^{0}$
Over 7.9	1^{0}

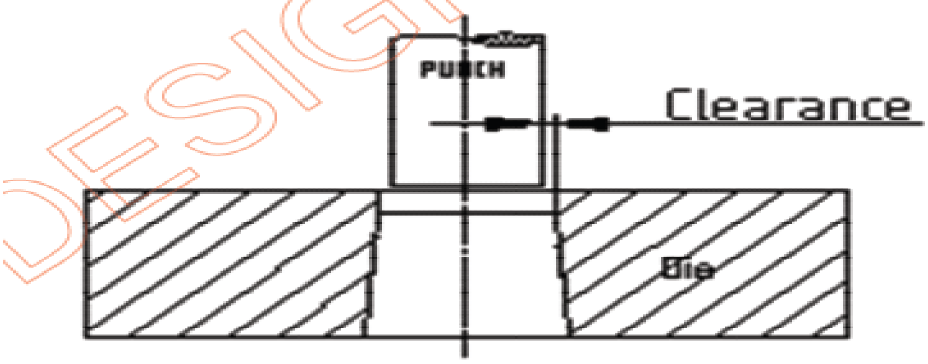
Soft materials require greater angular clearance than the hard materials



Die clearance:

Clearance per side = C *T * √ (τmax/10)
Where C= constant = 0.005 for very accurate components
=0.01 for normal component.
T= Sheet thickness in mm.
τmax = Shear strength of sheet material in N/mm2
Clearance per side can also be selected from the table given below:

Material	Die clearance per side in percentage of sheet thickness
Mild steel	2.5%-5%
Aluminum	1.5%-3%
Brass	1.5%-3%



STRIPPER DESIGN

STRIPPER PLATE THICKNESS = A = (W/30) +2t

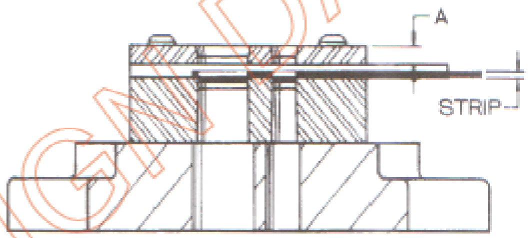
Where A = Stripper plate thickness in mm

W= Width of strip in mm

t= Thickness of sheet metal in mm.

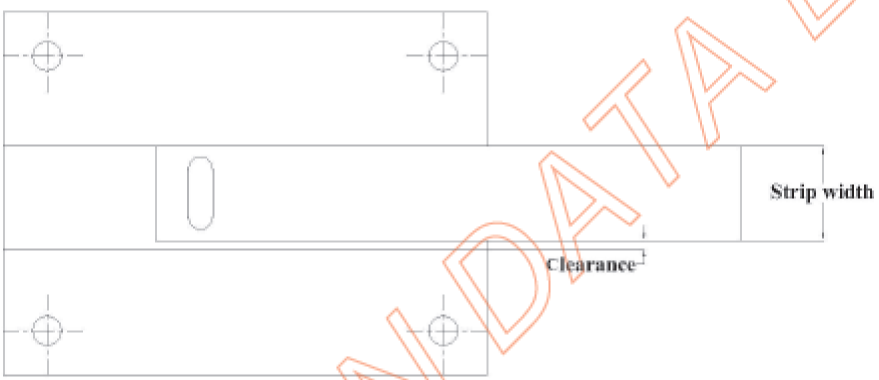
The stripper plate thickness can also be selected from the following table:

STRIP (thickness * width)	Stripper Plate thickness (A) in mm
1.6x75	6
1.6x150	8
1.6x225	10
1.6x300	14
3.2x75	10
3.2x150	12
3.2x225	14
3.2x300	16
4.8x75	12
4.8x150	15
4.8x225	18
4.8x300	20
6.35x75	16
6.35x150	18
6.35x225	20
6.35x300	22
7.8x75	18
7.8x150	22
7.8x225	24
7.8x300	26



Note:-
For design and manufacturing simplicity, the width and length of stripper is assumed same as that of the die plate

Clearance between strip and strip guide

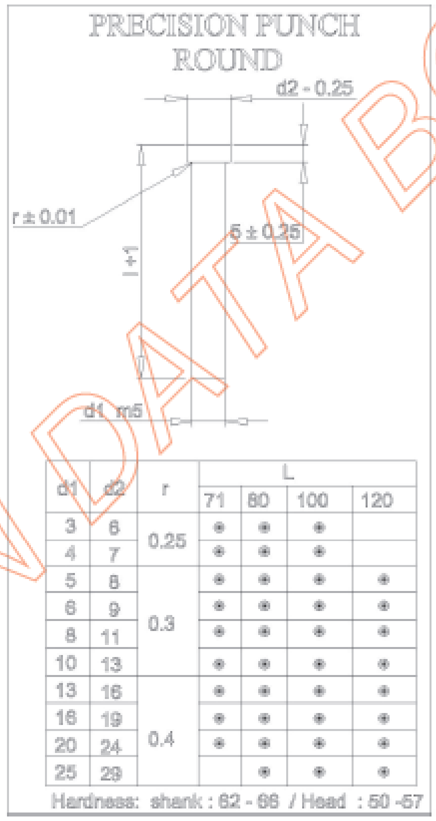


Strip thickness in mm	clearance for hand feed in mm	Clearance for automatic feed in mm
0-1.587	1.6	0.8
1.587-3.175	2.4	0.8
3.175-4.762	3.2	0.8
4.762-6.35	4.0	0.8
6.35-7.937	4.8	0.8

PUNCH DESIGN DETAILS

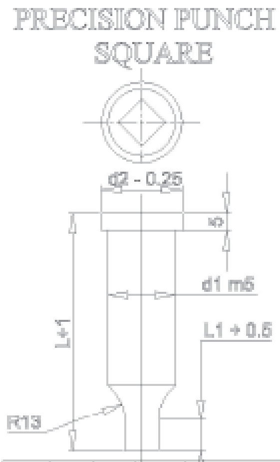
Strepped Round Punch

Round Punch



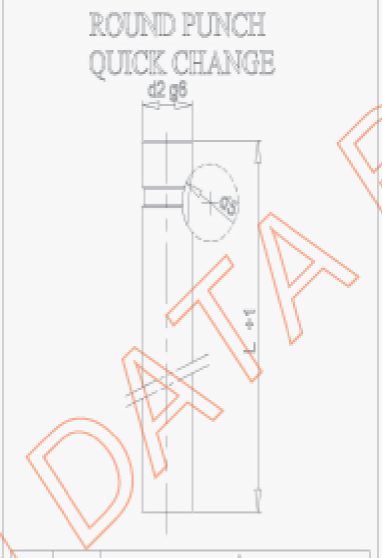
Square Punch

Quick change punch



d1	d2	L1	r	L 71	L 80	L 100	L 120
3	6	10	0.25	⊛	⊛	⊛	
4	7			⊛	⊛	⊛	
5	8		0.3	⊛	⊛	⊛	⊛
6	9			⊛	⊛	⊛	⊛
8	11	13		⊛	⊛	⊛	⊛
10	13	17		⊛	⊛	⊛	⊛
13	16		0.4	⊛	⊛	⊛	⊛
16	19			⊛	⊛	⊛	⊛
20	24			⊛	⊛	⊛	⊛
25	29				⊛	⊛	⊛

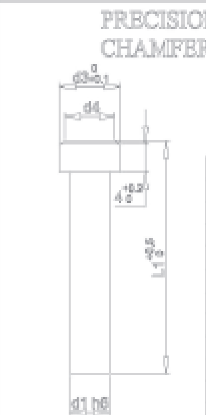
Hardness : Shank : 62-64
Head : 47-57



d2	d5	L 63	L 71	L 80	L 90	L 100
6	6	⊛	⊛	⊛	⊛	⊛
10	8	⊛	⊛	⊛	⊛	⊛
13	8	⊛	⊛	⊛	⊛	⊛
16	8	⊛	⊛	⊛	⊛	⊛
20	8	⊛	⊛	⊛	⊛	⊛
25	8		⊛	⊛	⊛	⊛
32	8		⊛	⊛	⊛	⊛
36	8			⊛	⊛	⊛

Punch Chamfered head

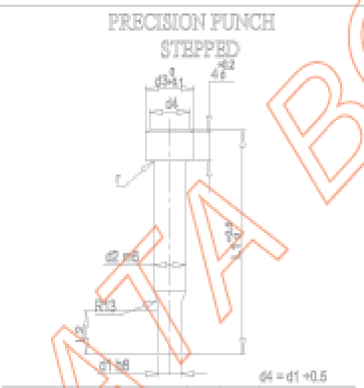
Stepped Punch



d1	d3	L1
2.0-2.2	3.6	stock length : 71,90 , 112 mm: other length and diameters on request.
2.3-2.5	4.0	
2.6-2.8	4.5	
2.9-3.2	5.0	
3.3-3.5	6.0	
3.6-4.0	7.0	
4.1-4.5	8.0	
4.6-5.0	8.5	
5.1-5.4	9.0	
5.5-5.9	9.5	
6.0-6.4	10.0	
6.5+7.0	10.8	
7.5+8.0	12.0	
8.5+9.0	13.0	
9.5+10.0	14.5	
10.5+11.0	16.0	
11.5-12.5	18.0	
13.0-14.5	20.0	
15.0-16.0	22.0	

d4 = d1 +0.5

Hardness : Shank : 62-64
Head : 47-57



d4 = d1 +0.5

d1	d1	d5	d3	L2	r	L1
0.5-1.9	0.05	2.0	3.6	7	0.2	lengths 71,90 ,112mm: available at short notice other lengths and diameters on request.
1.95-2.4		2.5	4.0			
2.5-3.1	0.1	3.2	5.0		0.3	
3.2-3.9		4.0	7.0			
4.0-4.9		5.0	8.5		0.5	
5.0-6.2		6.3	10.0			
6.3-7.9		8.0	12.0	16	0.7	
8.0-9.9		10.0	14.5			
10.0-12.4		12.5	18.0		1.0	
12.5-15.9		16.0	22.0			

Hardness : Shank : 62-66 Head : 48-55

COMMONLY USED PUNCH PLATE SIZES

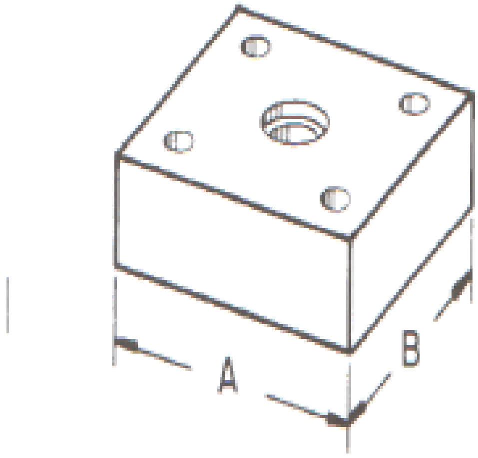
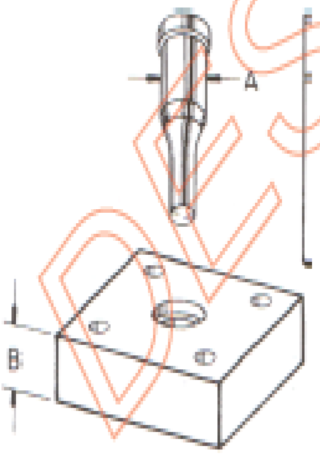


Table 3.17 - COMMONLY USED PUNCH PLATE SIZES

A	B
50	50
50	75
75	75
75	100
75	125
100	100
100	125
100	150
125	125
125	150
125	175
150	150
150	175
150	200
150	250
175	175
175	225
175	275

Plate sizes



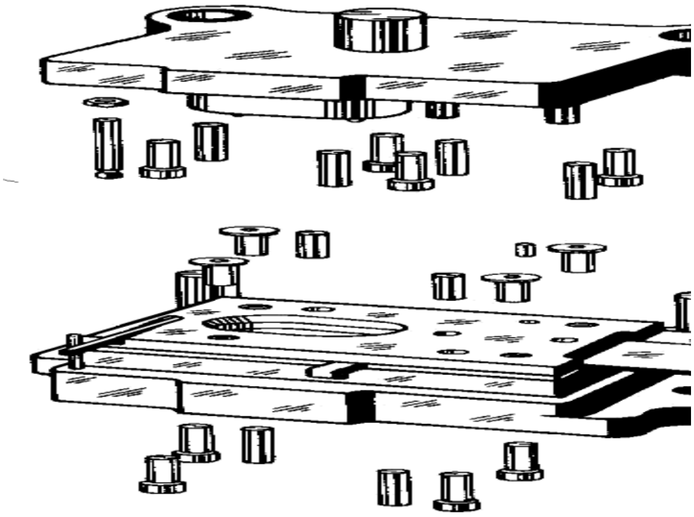
A	B
0 to 7.9	12.7
7.9 to 11	15.8
11 to 12.7	19
12.7 to 15.8	22.2
15.8 to 17.4	25.4
17.4 to 19	28.5
19 to 22.2	31.7
22.2 to 23.8	34.9
23.8 to 25.4	38.1

HOW TO APPLY FASTENERS

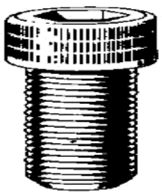
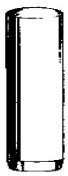
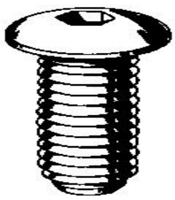
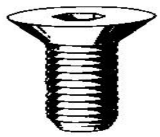
The subject fasteners is an important one because these components are applied so frequently and employed in large quantities. Although small, they perform the important functions. In the design of tools and dies, fasteners are often the “weakest link” in the tool and, if they are not selected and applied correctly, they can become the cause of failure of the entire tool or die.

Die fasteners

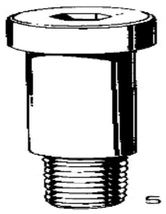
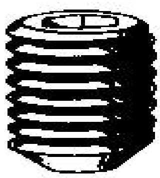
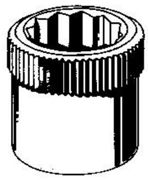
Fasteners, although small individually, form a substantial portion of the entire tool when taken together.



Types of Fasteners

SOCKET CAP SCREW DOWEL SOCKET BUTTON HEAD SOCKET FLAT HI

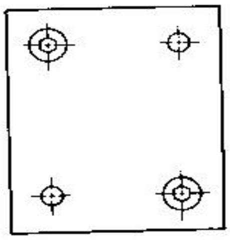
STIPPER SCREW SOCKET SET SCREW ALLEN NUT

SCREWS -used to hold components together

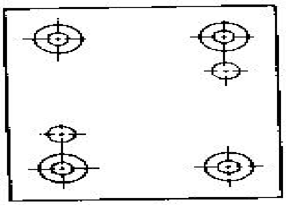
DOWELS -are applied to effect accurate relative positioning. This permits no movement between parts.

To Apply Fasteners

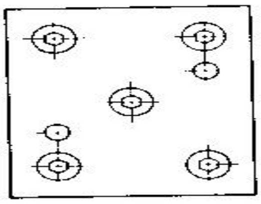
- Screws are applied at two diagonal corners and dowels at the other two corners. This is for small and medium size blocks and plates.



- For larger blocks, screws are applied at all four corners and dowels are offset.

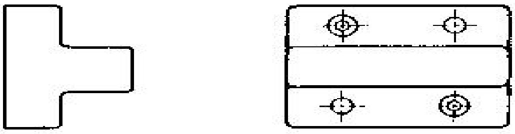


- When still larger forces are present, a fifth screw is applied to the center of the block.

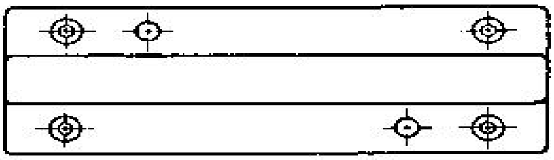


Flanged Punches

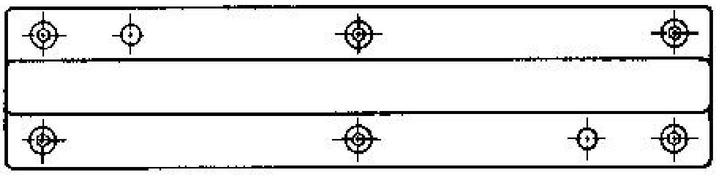
- When parts have a projection along the center as in flange forming punches, two screws and two dowels are applied at opposite corners when punches are short



- For longer punches, four screws are applied at the corners, dowels are offset.



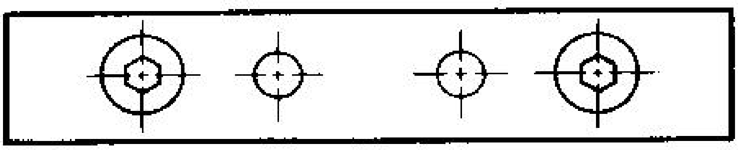
- Long punches may be fastened with six screws, applied each three to each side. Dowels facilitate lateral location and are applied in the same manner as for the punch B.



Spacing Fasteners

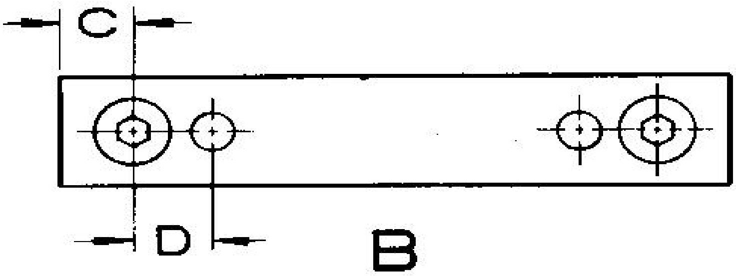
Proper spacing between holes an edges of parts is particularly important for tool steel parts to be hardened. If too little space is allowed, there is a strong possibility of the block cracking in the hardening process. But in the other hand, it is often desirable to have screw holes as close to edges as possible, to keep dowels far enough apart for accurate positioning.

- At A, screws have considerable space between them and outside edges. Also dowels have adequate space between them and their nearest screw holes. Unfortunately the dowels are too close together for effective positioning.



A

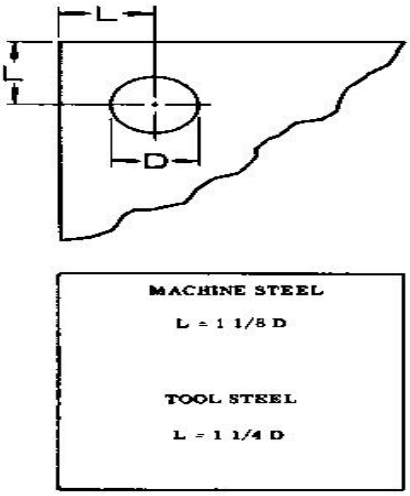
- Block B shows screws and dowels positioned properly. Space between dowels has increased considerably. We need to know the safe minimum distances D and C.



B

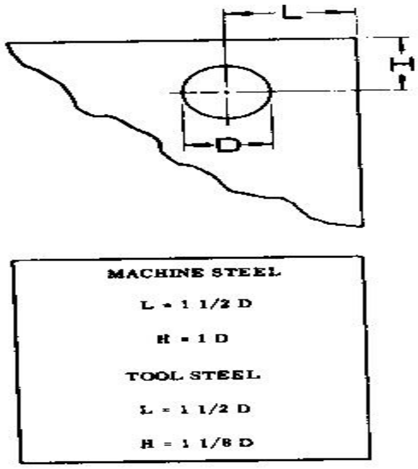
Spacing Guide

- At A is specified correct minimum spacing of holes applied at corners. Note that holes may be positioned closer to edges of machine steel parts than for parts to be made of tool steel.



A

- When a hole in tool steel is located in greater distance from one edge than in the previous example, it may be positioned closer to the adjacent edge, as shown at B. This condition occurs frequently in the application of screw holes in die blocks and in other tool steel parts.



B

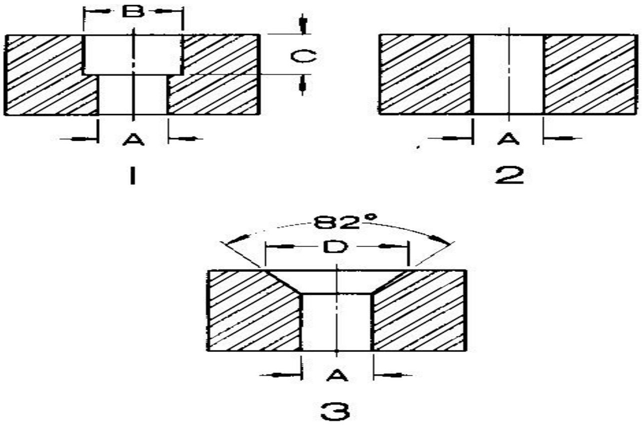
Fool proofing

A simple way to foolproof parts which might be resembled incorrectly in die repair is to reverse the relative positions of dowels. Obviously, gage positions cannot be reverse accidentally, nor could the gages be assembled upside-down because of the holes, counterbored for the heads of the screws.

Holes For Screws

In specifying holes for socket screws, observe the ff. rules;

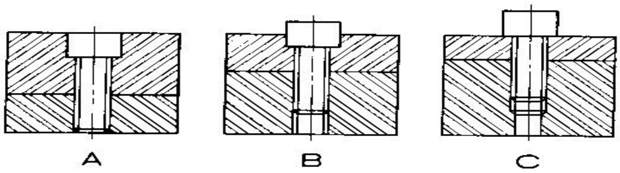
- Holes A which engage the screw bodies are specified 1/64 in. larger than body diameter.
- Counterbored holes B are specified 1/32 in. larger than the diameter of the screw head.
- Counterbored depth C is the same as the height of the head of the screw.
- Countersink diameter D is made the same as the head diameter of the flat head screw.



Socket Cap Screws

Socket cap screws are the most frequently used fasteners for tools and dies and they should be specified whenever it is possible to employ them. A socket cap screws are provided with a head within which has been broached a hexagonal socket for driving.
Nylock screws are socket provided screws with a projecting nylon pellet inserted permanently in the body.

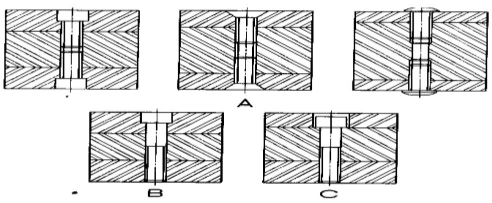
3 methods of applying socket cap screws:



- ❖ Counterbore the hole for the screw as at A. The screw engages this counterbored hole and its top comes flush with the surface after assembly.
- ❖ The hole is not counterbored to full depth, and the head protrudes a certain amount as at B.
- ❖ The hole is simply drilled and the screw head is left to protrude, as at C.

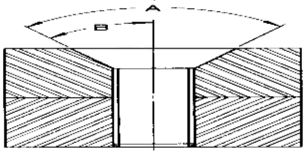
Fastening Plates

When components such as plates are fastened to both sides of a block, tap the block all the way through. Screws engage the block from both sides to hold the plates as shown at A. When the center block is not too thick, it is permissible to hold three parts by threading one and fastening the three with the relatively long screws, as at B. Sometimes it is desirable to fasten two details together through a third component. The screw head is reached for fastening through a hole which clears it, as at C.



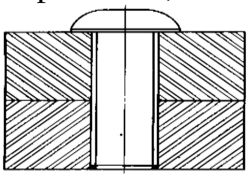
Socket Flat Head Screws

- Heads of these screws are machined to an 82 degree included angle, dimension A. They are employed for fastening thin plates which must present a flat, unbroken surface.



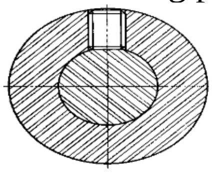
Socket Button Head Screws

- These screws are employed for fastening plates in applications where a raised head is not objectionable. They should be used when plates are too thin for counterboring for cap screws, and surface need not be flush or flat.



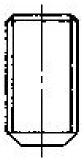
Socket Set Screws

- When first developed, it is called “safety” screws. They were employed to lock rotating machine parts to their shafts. They replaced screws with protruding heads which were dangerous because clothing become caught by the whirling projection

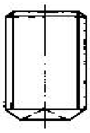


Point styles for set screws:

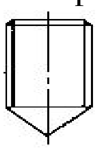
- Flat point-are employed as adjustable stops, clamp screws, and to lack hardened shafts.



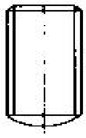
- Cup point-used to lock pulleys, collars, gears, and other parts on soft shafts.



- Cone point-same applications as cup point screws, however, a much more positive lock is effected because the shaft is first spotted or drilled to engage the co9nical point of the screw.



❖ Oval point-are employed to lock parts which are to be adjusted frequently relative to each other.



❖ Half dog point-are employed to engage the slots milled longitudinally in shafts.

❖ Full dog point-are employed for the same purpose as half dog point set screws. They are seldom used.