A PROJECT REPORT

ON

"DESIGN AND AUTOMATION OF CRIMPING MACHINE FOR JATO NOZZLE"

Submitted to

UNIVERSITY OF MUMBAI

In Partial Fulfilment of the Requirement for the Award of

BACHELOR'S DEGREE IN
MECHANICAL ENGINEERING

BY

MOHAMMAD SAMEER FARUQUI	15ME09
KHAN AYYUB NANNEH	15ME15
KHAN MARUF EBNESAUD	15ME19
LAD ALPESH CHANDRAKANT	15ME24

UNDER THE GUIDANCE OF
PROF. ALTAMASH GHAZI

DEPARTMENT OF MECHANICAL ENGINEERING
Anjuman-I-Islam's Kalsekar Technical Campus
SCHOOL OF ENGINEERING & TECHNOLOGY
Plot No. 2 3, Sector - 16, Near Thana Naka,
Khandagaon, New Panvel - 410206

2018-2019

AFFILIATED TO

UNIVERSITY OF MUMBAI

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CERTIFICATE

This is certify that the project entitled

"DESIGN AND AUTOMATION OF CRIMPING MACHINE FOR JATO NOZZLE"

submitted by

MOHAMMAD SAMEER FARUQUI	**15ME09**
KHAN AYYUB NANNEH	**15ME15**
KHAN MARUF EBNESAUD	**15ME19**
LAD ALPESH CHANDRAKANT	**15ME24**

is a record of bonafide work carried out by them, in the partial fulfilment of the requirement for the award of Degree of Bachelor of Engineering (Mechanical Engineering) at ***Anjuman-I-Islam's Kalsekar Technical Campus, Navi Mumbai*** under the University of MUMBAI. This work is done during year 2018-2019, under our guidance.

Date: / /

(Prof. ALTAMASH GHAZI)
Project Supervisor

(Prof. RIZWAN SHAIKH)
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Acknowledgements

I would like to take the opportunity to express my sincere thanks to my guide **Prof. ALTAMASH GHAZI**, Assistant Professor, Department of Mechanical Engineering, AIKTC, School of Engineering, Panvel for his invaluable support and guidance throughout my project research work. Without his kind guidance & support this was not possible.

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At last we must express our sincere heartfelt gratitude to all the staff members of Mechanical Engineering Department who helped me directly or indirectly during this course of work.

MOHAMMAD SAMEER FARUQUI
KHAN AYYUB NANNEH
KHAN MARUF EBNESAUD
LAD ALPESH CHANDRAKANT

Project I Approval for Bachelor of Engineering

This project entitled ***"DESIGN AND AUTOMATION OF CRIMPING MACHINE FOR JATO NOZZLE"*** by ***LAD ALPESH CHANDRAKANT*** is approved for the degree of ***Bachelor of Engineering in Department of Mechanical Engineering.***

Examiners

1. ....
2. ....

Supervisors

1. ....
2. ....

Chairman

....

Declaration

I declare that this written submission represents my ideas in my own words and where others ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

MOHAMMAD SAMEER FARUQUI
15ME09

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15ME15

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15ME19

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LAD ALPESH CHANDRAKANT
15ME24

ABSTRACT

Press working is the probably the earliest occupation known to mankind. Native metals have been formed technological and shaped 7000 years ago. Press working industry utilize million on man, production tool, forming processes, building and other related facilities, in order to form and produce the material to meet the increased demand of mankind. The high productivity of forming process, the simplicity of press operation, all leads to greater extension of this method manufacturing. Of course, the many alternative processes require the complementary tooling, while in the metal forming dies or press tools the trouble has often been traced to an adequate grasp of the basis of design construction.Press tools and metal forming processes in which they are used in an inadequate grasp on the basis of design and construction are greatly improved of lathe both in design and in regards to capacity.

Press working may be defined as the chip less mfg. process by which various components are made from sheet metal. These process is also termed as cold stamping. The machine used for press working is called press. The sheet metal operation done on press be grouped into two categories : i) Cutting Operation and ii) Forming Operation. In cutting operation, the w/p is stressed beyond it's ultimate strength. The stresses caused in metal by the applied force will be shearing stress. In forming operation, the stresses are below the ultimate strength of the metal. In this operation, there is no cutting of the metal but only the contour of the w/p is changed to get the desired product.

Keywords: Press working

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Chapter 1

Introduction

A die and punch assembly is a metal working process. That is convert raw material (sheet metal) into components. And also die is a tool to manufacturing of parts and component from sheet metal. The Compound die, combination die and progressive types of dies are produced in mass production quickly. The die placed on a press. When the press moves upward direction and die is opened. As the press is moved down and die is closed. The sheet metal move through die which is open and fed into the die a precise amount with each press. The die is a closed together, the die performed work on the metal and finish parts are ejected from the die. The die sheet metal operation such a way like as punching, bending and coining. Die key is made of tool steel to withstand high shock load, sharp cutting of edge and resist the abrasive forces involved.

COMPONENTS OF DIE AND PUNCH ASSEMBLY:

Main components of die are

- Die holder
- Die block
- Punch plate
- Stripper plate
- Back up plate
- Punch
- Guide pin
- Stroke

Die block: The die block contain with die cavity. The shape of cavity is replica of require shape of component. That is female part of die block.
Die holder: The die block is mounted on die holder and supported with bloster plate. Both die holder and block is mounted on press bed.
Punch plate: Punch plate hold the punch and attached to top ram of press.
Punch: It is male part of die assembly and also that fastened to ram press through punching plate. Which punch matches with die shape. This punches the metal strip again the die and necessary operation. Small clearance available between die and punch.
Stripper plate: During the forming and cutting operation when the stripper plate is used to strip the sheet metal.
Guide pin: The guide pin is used to align the upper and lower half and also used for die changed from one operation complete to start another operation.
Back up plate: The intensity of pressure does not reach the punch holder which is placed on die. It is also called as pressure plate. The pressure plates distribute the pressure over wider area.
Stroke: It is distance between ram moments from upper position to lower position.

Spray Nozzles

A spray nozzle is a precision device that facilitates dispersion of liquid into a spray. Nozzles are used for three purposes: to distribute a liquid over an area, to increase liquid surface area, and create impact force on a solid surface. A wide variety of spray nozzle applications use a number of spray characteristics to describe the spray. Spray nozzles can be categorized based on the energy input used to cause automation, the breakup of the fluid into drops. Spray nozzles can have one or more outlets; a multiple outlet nozzle is known as a compound nozzle. Spray nozzles range from heavy duty industrial uses to light duty spray cans or spray bottles.

Jato Nozzle

Jato nozzle is a full cone spray nozzle which is being manufactured in Spraytech Systems (India) Pvt. Ltd. Jato nozzle is generally made of brass and stainless steel SS304, SS316. Used in continuous casting machine for secondary cooling. The spray angles available are 45, 65,80,90 and also as per request.

1.1 Purpose

The existing manual pressing machine and crimping machine take additional time for assembly of the nozzle body and the disc vane. The process of assembly of the nozzle is subsequent i.e. first the disc vane is press fitted into the nozzle body using a manual press followed by crimping operation so as to lock the disc vane into the nozzle body. The whole assembly process requires at least two skilled workers. These manual machines are vertical stroke press machine, this vertical arrangement of the presses needs alignment for the assembly of the disc vane and nozzle body. If the disc vane is misaligned while press fitting the disc vane would cut through the nozzle body creating a defective assembly.

1.2 Project Scope

Provide a short description of the software being specified and its purpose, including relevant benefits, objectives, and goals. Relate the software to corporate goals or business strategies. If a separate vision and scope document is available, refer to it rather than duplicating its contents here. An SRS that specifies the next release of an evolving product should contain its own scope statement as a subset of the long-term strategic product vision.[2]

1.3 Project Goals and Objectives

1.3.1 Goals

1.3.2 Objectives

- To optimise the assembly working of the Jato Nozzle.
- To reduce the total time required for assembly process.
- To combine the two-step process into a one step process
- To design a compound die for press fitting and crimping process
- To design an automated feeding mechanism of nozzle parts for assembly.
- To assemble multiple nozzles at one stroke.

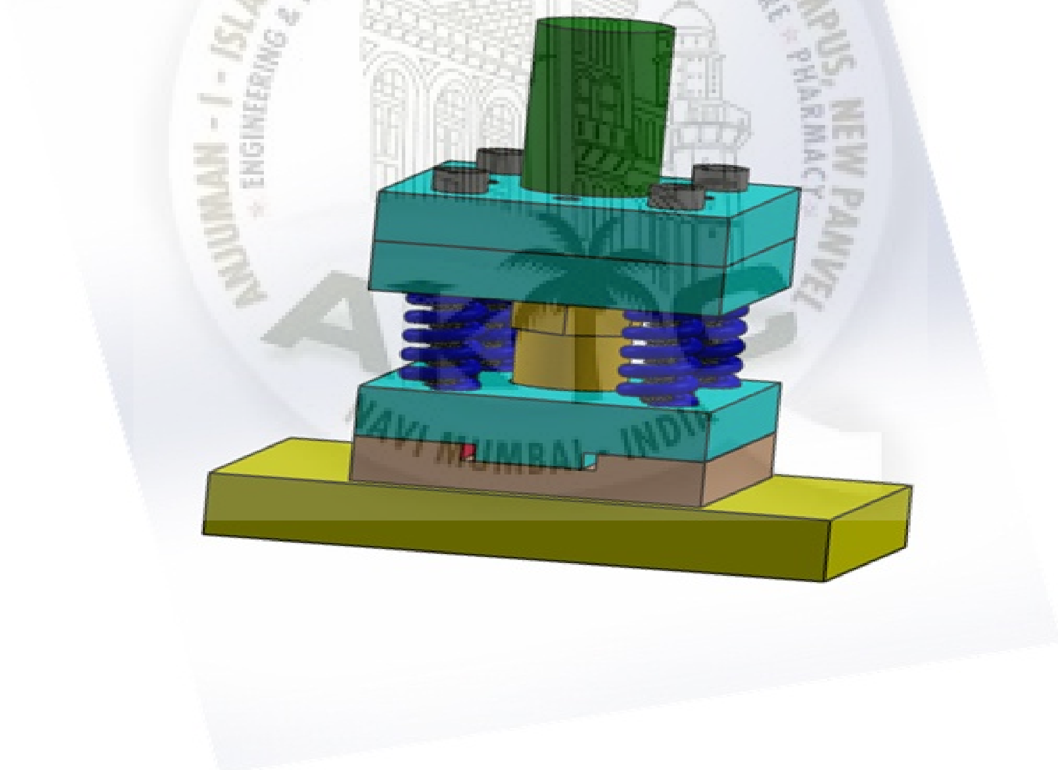


Figure 1.1: Crimping Die Machine

Chapter 2

Literature Survey

2.1 A REVIEW ON DESIGN, DEVELOPMENT, AND ANALYSIS OF COMPOUND DIE FOR AUTOMOBILE COMPONENT

Mr. Bhaskar F. Satpute, Prof. Mahesh S. Harne reviewed design, development and analysis of compound die for an automobile part. They identified that in the simple dies we can perform various operations like blanking, piercing, drawing, deep drawing, forming, notching etc. separately. And hence there will more time is required to complete the desired press operation on sheet metal. In this project they design Compound Die for an automobile body part. The part is consisting of four different operations which are Blanking, Notching, Piercing, and Bending. Currently all these operations are completed in three different stations and it required three different press machines.

2.2 COMPUTER ASSISTED COMPOUND DIE DESIGN: A CASE STUDY

Sneha S.Pawar, R.S.Dalu presented that compound die set for a blanking, drawing and punching operations are in many cases is very complex and expensive device. It is time consuming design die set by combining these three operations manually. Their paper presents a Computer assisted design method to design compound die set for downlight housing. The design calculations take account of the quality of the workpiece material and they determine the optimal size for the die punch sets. The proposed method can be used for any configuration of the parts which need to be processed. The design calculations are verified by using manual die design process Their paper presents the computer assisted die design of a compound dies for Downlight housing for Onkar Industry Nagpur. Based on workpiece dimensions and using mathematical relationships presented in the developed computer program in .net technology, tool- Visual studio, langue-C, project type-Window application which allows the determination of constructive parameters for the elements of compound dies. A windows application is an application that runs on windows desktop. Windows applications will have graphical user interface (GUI). Because of GUI, designing the application will be easy and fast.

2.3 DESIGN AND DEVELOPMENT OF COMPOUND DIE FOR BEARING CAP

Mr. B. F. Satpute1, M. S. Harne2, designed and developed a compound die set for bearing cap. The task of project is to modify the die used for the production of bearing cap used in rock crushing machine. This bearing cap was initially produced using simple dies which perform the various operations Separately that requires number of dies. This took a lot amount of time for the production of each product, thereby increasing the cost, production time and energy supplied for the production of each component/part. This problem may be compensated by using compound die in which two drawing operations and piercing operation will be performed simultaneous.

2.4 HANDBOOK OF DIE DESIGN, SECOND EDITION. by: IVANA SUCHY

1. Commercial die sets, with tolerances between guide posts and bushings from 0.0004 to 0.0008 in. (0.010 to 0.020 mm). 2. Precision die sets, where the alignment between guide posts and bushings is

further perfected by precision grinding of the bushing's inner opening, as well as its outer diameter, which is press-fitted into the die shoe. 3. Ball-bearing die sets with ball-bearing arrangement in place of plain sleeve bushings.

Chapter 3

Project Planning

3.1 Members and Capabilities

Table 3.1: Table of Capabilities

SR. No	Name of Member	Capabilities
1	MOHAMMAD SAMEER FARUQUI	Die Designing
2	KHAN AYYUB NANNEH	Analyst
3	KHAN MARUF EBNESAUD	Surveyor
4	LAD ALPESH CHANDRAKANT	Die Designing

Work Breakdown Structure

3.2 Roles and Responsibilities

Table 3.2: Table of Responsibilities

SR. No	Name of Member	Role	Responsibilities
1	MOHAMMAD SAMEER FARUQUI	Team Leader	Die Design
2	KHAN AYYUB NANNEH	Team Member	Product Analysis and Survey
3	KHAN MARUF EBNESAUD	Team Member	Product Analysis and Survey
4	LAD ALPESH CHANDRAKANT	Team Member	Die Design

3.3 Project Budget

The machine tool designer must furnish the management with an idea of how much tooling will cost, and how much money the productions methods save over a specified run. This information is generally furnished in a form of cost worksheets. By referring to the cost worksheets the final cost of machine is calculated. Cost estimation is defined as the process of forecasting expenses that are incurred to manufacture a product. These expenses take into account all expenditure involved in designing and manufacturing with all the related service facilities such as material handling, heat treatment and surface coating, as well as portion of general administrative and selling costs.

NEED OF COST ESTIMATION :

1) Determine the selling price of a product for a quotation or contract, so as to ensure a reasonable profit to the company.
2) Check the quotations supplied by the vendors.
3) Decide whether a part or assembly is economical to be manufactured in the plant or is to be purchased from outside.
4) Determine the most economical process or material to manufacture a product.
5) Initiate means of cost reduction in existing production facilities by using new materials which result in savings due to lower scrap loss and revised methods of tooling and processing.
6) To determine standards of production performance that may be used to control costs.

ELEMENTS OF COST ENCOUNTERED IN THE PROJECT :

The cost encountered in this project are material cost, labour cost, cost of standard parts, designing cost and cost of indirect expenses.

1) DESIGN COST : The designing cost is calculated by considering the amount taken by the designer (if so) and the cost of designing material.

2) MATERIAL COST :
The material cost can be calculated by finding the total volume of the material used and the weight of the material. For calculation the value and the weight, the following procedure is adopted :
a) In actual procedure, there are some holes and shapes cut. But they are considered to be solid while calculation the total volume of material used.
b) While calculation the volume the triangle shaped parts and the T shaped parts are considering as rectangular or square plates.

c) The weight of the parts is calculation by multiplying the total volume and the density of the material (M.S.) which is equal to 7.76665x10 –3 Kg/Cc.

d) The total cost can be obtained by multiplying the total weight by the rate of material.

Direct Material Cost Sheet

Sr. No.	Name of Part	Material	Cost inRs.
1.	Shank	M.S.	2500
2.	Top Plate	M.S.	6000
3.	Punch Plate	M.S.	6500
5.	Die Plate	W.P.S.	9000
6	Base Plate	M.S.	7000
6.	Stock Guide	M.S.	4000
	TOTAL		**Rs. 35000**

TOTAL MATERIAL COST = Rs 35000 /-

COST OF STANDARD PARTS & OTHER COSTS

Sr. No.	Name of Parts	Size	Number	Rate for each	Costs
1.	Allen Bolts	M6	4	20	80
2.	Bolts	M8	1	12	24
3.	Dowel Pins	DIA 6	2	15	30
4.	Guide Pins	DIA 6	2	15	30
	TOTAL				**164**
5.	Hardening of Die Plate and Punches				200
	TOTAL				**364**

COST OF STANDARD PARTS & OTHER COSTS = Rs. 364/-

- **COST OF MACHINE TOOLS, EQUIPMENTS ETC. HIRED :**

Total hours required for manufacturing Die = 60 Hrs.
Total working days = 7.5 days
Hiring Charges = Rs, 500/- per day

TOTAL COST OF MACHINE TOOLS, EQUIPMENTS ETC. HIRED = Rs.3750/-

TOTAL COST OF COMPOUND DIE IS GIVEN BY THE EQN;
Total Material Cost + Cost of Standard parts and other costs + Cost of Machine Tools Equipments etc. Hired.

Now total material cost = Rs. 35000 /-
Cost of Standard parts and other costs = Rs. 364/-
Cost of Machine Tools, Equipments etc. hired = Rs. 3750/-

THEREFORE, TOTAL COST OF DIE = Rs. 39114/-

We shall now calculate the cost recovery of the die. Let us assume that the actual working hours in the college is to be 3 hours per day. The number of components that can be made in 1 hour = 400 components.
The cost of 1 component = 15 Paise Therefore, the cost of 400 components = Rs. 60/-
Therefore, the total hours required to recover the cost of this die
Total cost of die / Income per hour = 3284.95 / 60
Therefore Total hours required = 54.31 Hrs.
Therefore,**Days required to recover the cost of die = 54.31 / 3=18 Days**

Chapter 4

Types Of Presses

It is difficult to classify the presses according to the operations performed on them because most of them are capable of performing many similar operations. They may, however classified into the following two main groups, according to the source of power as :- (a) Manually operated /Hand press (b) Power press. Out of these, the manually operated press are generally employed in thin sheet-metal work and the power press in heavy production work.The presses are further classified as follows:-
(A) According to the type and design of frame :- 1. Inclinable 2. Gap frame 3. Straight side 4. Horning 5. Adjustable bed 6. Open end.
(B) According to the position of frame :- 1. Inclinable 2. Inclined 3. Vertical 4. Horizontal.
(C) According to the actions :- 1. Singleaction 2. Double action 3. Triple action.
(D) According to mechanism used for applying powerto ram :- 1. Crank 2. Eccentric 3. Cam 4. Toggle 5. Screw 6. Knuckle etc.
(E) According to number of drive gears :- 1. Single drive 2. Twin drive 3. Quadruple drive
(F) According to number of crankshafts used :- 1. Single crank 2. Double crank
(G) According to transmission method of power from motor to crankshaft: 1. Non geared 2. Single geared 3. Double geared 4. Multiple geared
(H) According to the purpose for which used :- 1. Shears 2. Breaks 3. Punching 4. Seaming etc.
The other criteria for press classification are shut height, stroke, clutch.

Chapter 5

Main parts of Power Press

The principle parts of the power press are as follows: 1. Bold: - It is a main supporting member. In inclinable presses, it also carries provision for holding and tilting the frame in an inclined position.
2. Frame :- It forms the main body of the press and carries the ram and driving mechanism etc.
3. Ram :- It is main operating member, which reciprocates to and fro inside suitable guides. At it's bottom end, it carries the punch.
4. Pitman :- In a press the connecting rod which connects the ram and the crankshafts is known as pitman.
5. Driving mechanism :- The cylinder and the piston in a press or crankshafts etc. are called driving mechanism. They are used for driving the ram.
6. Flywheel and clutch :- A flywheel is used for storing the energy, which is required for maintaining constant speed of ram when the punch is pressed into the work piece. Clutch is used for engaging and disengaging the drive shaft with the flywheel.
7. Brakes :- They are used to bring the drive shaft to rest after disengaging it from flywheel.
8. Bolster plate :- It is a thick plate fastened to the bed of the press. It supports and holds the die assembly over it.

Chapter 6

General Press Information

The important specifications of a press are as follows:-

- Press tonnage :- The size of a press is expressed in terms of the maximum force, it's ram can exert on the work piece, called tonnage. It is expressed in tones varies between 5 to 4000 tonnes for mechanical presses and upto 50000 tonnes for hydraulic presses.
- Stroke :- The distance traveled by it's ram from it's extreme up position to extreme down position.
- Die Space :- Total surface area of bed and ram of the press.
- Shutheight :- It is the total opening between the ram and the bed when the former is in it's extreme down position.
- Press adjustment :- It is the distance thought which the ram can be lowered below it's shut height position, by turning the adjustment screw which connects it with the connecting rod. This adjustment when made will obviously effects the closed opening of the press between it's ram the bed.
- Ram Speed :- Ram speed or strokes per minute, which vary from 5 to 5000 per minute. 'c' frame presses provide the maximum ram speed and single and double geared type, the minimum.

Chapter 7

Lubricants used in Press Working

Lubricants play an important role in press working. In general machine, the pressure being varied from zero to 5000 PCI, but in press working the pressure ranges from zero to hundred thousand PSI, in which co-efficient of friction is not more than a few thousandth. Lubricants are essential in press working because it avoids the overheating of the metals due to high pressure between two metals. They reduce the heat involved in press working and due to which deformation is avoided.

CLASSIFICATION OF PRESS WORKING LUBRICANTS :

They are classified as follows :

1) Extreme pressure lubricants :These are typically sulpharised or chlorinated fatty oils or paraffin waxes in concentrated form or diluted with mineral oil.

2) Pigment type drawing lubricants :These are of three subtypes.

3) Emulsion compound, which consist of paste, composed of ports and patty oils and water.

4) Oil compounds, which are pastes or pigments, dispersed in fatty oils, which may be sulpharised or otherwise treated.

5) Dried lubricants and pigment coating, which are widely used in tube drawing and in sheet fabrication.

6) Non - pigment type lubricant :These are of four types.

7) Emulsion drawing compounds, which are, paste composed of fats and fatty oils and their patty acids.

8) Fats, fatty oils and acids, generally used directly or sometimes mixed with mineral oil.

9) Mineral oil and greases.
10) Soluble oil.

General characteristics of the lubricants selected :
i) Handling, mixing application and removal
ii) Chemical stability
iii)Wetting property
iv) Toxicity and odour
v) Non - corrosive and non - staining properties
vi) Economy

Chapter 8

Safety in press working

Safety of dies : As die is the main constituent in the press working, we must have a safety about it. It is costly item in the press working. For safety purpose, we use safety stops, limits switches, ram blocks etc.

1. **Safety stops** : For proper protection while using a dial feed on power press, an automatic safety stop should be employed. This safety stop can either be electrical or mechanical stop. Mechanical stop can be operated on the press shaft by a cam so arrange that, when dial stops a pin drops into a hole in dial plate. As long as everything is functioning properly, this pin drops into position and a press continues to operate. If for any reason, this dial is not position properly the pin rests on the top of dial plate, playing a lever in the port of clutch releasing.

2. **Limit switches** : It is extensively used to safeguard the die in case of misdeed or buckling of stock. To avoid misfeeding, misplacement, the levers operated by limit switches are placed at the end of slug probes. This lever directly affects the start or stop of the press.

Chapter 9

Types Of Dies

1) Blanking dies :- In this type of die a strip is placed between the die and the stripper plate. On the downward stroke, the punch punches out the blank from the stock and the stock is held down by the stripper plate to prevent the lifting of upper stroke of the simultaneously. They are also called as multiple dies.

Advantages :-

1. Accuracy : The edges of blank part are accuratly retain to each other.
2. Appearance : The furnished edges of the each blank extended around it's periphery on the same side.
3. Flatness : Blank parts are flat because of even conversion of the material between punch and die cutting edges.

2) Bending dies : A typical bending die is used for bending a stock to the desired shape. The contour of the punch and die determined the final shape of the stock. The springiness of the material should be properly considered.

3) Bulging dies : It is an internal forming operation used to expand portion of drawn sheet or tubes. These are of two types :- Fluid dies and Rubber dies. Fluid dies employ water or oil as expanding medium and ram applies pressure to fluid. In rubber dies, a pad or block of rubber under pressure moves walls of work pieces to the desired portion. This is because rubber is virtually incompressible.

4) Deep drawing dies : It is meant only for shallow drawings. These drawings produce the desired shape to the work by drawing the flat piece of the metal into tabular or other form. The amount of pressure must be adjusted carefully. Excessive pressure would cause the bottom of the cup to be punched out. Insufficient pressure would allow the wrinkles to form. With the proper amount of pressure, a smooth wrinkle free cup is produced. Drawing is extensively used to produce large shell for pressure vessel, ships, aircrafts and missiles.

5) Forming Dies : The operation of the forming is similar to the bending except that the line of the bend is curved instead of the straight. And plastic deformation in the material is more severe.

6) Piercing dies : Piercing dies pierce the hole in the stamping. There are two principle reasons for piercing holes separated operation instead of combining piercing with other operation.
i) When subsequent bending, forming or the drawing operation would distort the previously cut hole or holes.
ii) When the edge of the pierced hole is to close to edge of the blank for adequate strength in the die section. This occurs in the combined and combination dies in which piercing and blanking are done simultaneously.

7) Compound dies : These operations perform two or more operations during one stroke of the press at one station only. In these dies the holes are pierced at the same station as the part is blanked, instead of previous station as done in piercing or the blanking die. The result is greater accuracy in the blank. Whatever accuracy is built in the die will duplicate in every blanks that are too large for production blanks in more than one station. Since all the operations are performed at the same station, compound die are very compact and smaller die set can be applied.

8) Combination dies : It is a special form of the compound die. Here cutting operation is combined with a forming operation. Outer punch is used to perform the operation of cutting and holding the blank. The inner punch is drawing punch. In actual industrial practice, the cutting operation may include blanking, piercing and trimming and cut off and combined with non-cutting operations which may include bending, embossing, forming, drawing (forming) operation and finish the product.

9) Progressive dies : It performs two or more operations at different station or stages. In this die, the strip is moved in stages from station to station. Different operations are performed on it at each station except at idle ones applied to provide room for components. A complete W/P is removed from the strip at the final station. A progressive die may thus be considered as a series of the different dies placed side with the strip passing through each die successively. This analogy has some merits although it does not give a true picture of extremely closed interrelationship between various stations. These types of the dies are usually set up in automatic press. It is also kwon as follows on the die.

10) Trimming dies : Trimming dies cuts away portion of formed all drawn work pieces that have become heavy and irregular. This condition occurs because of uneven flow of the metal during forming operation. Trimming removes this unwanted portion to produce square edges and accurate contours.

11) Coining dies: It is the process of pressing material in die so that it flows into the spaces in the detailed on the die face.

12) Cut off dies : The basic operation of a cut off die consists of severing strips into short lengths to produce blank. The line of cut may be straight or curved, an hole or both may be applied in previous operation. Cut off dies are used for producing blanks having straight, parallel sides because they are less expensive to built than blanking die.

13) Shaving dies : Shaving operation of removing a small amount of metal from around edges of the blank or hole in order to improve the surface. A properly shaved blank has a straight, smooth edge and it is held to very accurate size. Many instruments, business machines and their parts are shaved to provide better functioning and longer wear.

14) Embossing die : It is a shallow forming operation in which the work piece material is stretched over a male die and caused to conform to male die surface by a mating female surface die. The finished product will have a depressed detail on one side and a raised detail on the other side.

15) Curling or wiring dies : It is a special form of bending die in which part of the stock is bent to form circular bends around the edge of draw cylinder parts. A curling die forms the material at the edge of the work piece into the circular shape or hollow ring. Flats blanks may be curled, a common application is a hinge formed at two plates, each of which is curled at one side for arrangement of hinge pin. More often curling is applied to edge of open ends of cups and shells to provide stiffness and smooth round edge. Most pans for cooking and baking foods are curled.

16) Gang dies : A gang die is one in which multiple (two or more) punches are combined in a single punching head. These dies permits reduced cost of labour and increased production. Increase in set up and maintenance costs are it's chief drawback.

17) Swaging dies : 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 cause the part to become longer than before.

18) Self CentringDies : This type of die is provided with a small conical point so that it does not require a gauge pin for location the hole punch in the stock. This die is used chiefly for punching hole. The stock must be center punched at the points where the holes are required so that the conical points register with the center punch mark on the stock when placed under the punch.

19) Assembly die : Assembly die assemble two or more parts together by press fitting, riveting, staking or other means. Components are assembled very quickly and relationship between parts can be maintained closely.

20) Cold forming dies: Cold forming dies produces work pieces by applying pressure to blank, squeezing and displaying the shape of the punch and die.

21) Extruding dies : The functions of all the dies discussed is to perform work on sheet material to cut sheet metal into blanks, to perform further operation upon the blanks, to perform operation on work piece bent. We come now to interesting classes of dies that perform secondary operations on small thick blanks called SLUGS. In these dies, the slugs are severely deformed to make parts having no resemblance to the slug from which they are made. The first class is called extruding dies. In these type of die, each slug is partly confined in a cavity and extremely high pressure is applied by a punch to cause the material in the slug to extrude or squirt out much like tooth paste is extruded, when the tube is squeezed.

22) Broaching Dies : Broaching may be considered to be a series of shaving operations performed one after another by same tool. A broach is provided with a number of teeth, each of which cuts a chip as the broach transverse the surface to be finished. Internal broaches finish holes surface or slab broaches finish outside surface. Two conditions make broaching necessary:-

1) Blanks are too thick for shaving. Considerable metal must be removed from the edge of thick blanks and a series of shaving dies would be required for a smooth finish to be produced. It is then less expensive to built a broaching die.

2) When considerable metal must be removed. This occurs when ridges or other shapes must be applied in the edge of the blank. It is often impractical to blank such shapes directly because the cutting edges would be weak and subject to breakage. The first three or four teeth of the broach are made undersized and they ordinary do not do acting except if an oversized blank is introduced in the die. The last three or four teeth are sizing teeth. Intermediate teeth are called working teeth and take the successive chips to machine the serration.

23) Horn Dies : A horn die is provided with a projecting post called a horn. Bent formed or drawn work pieces are applied over the horn for performing secondary operations. Many other operations such as piercing can be done in the horn dies.

24) Inverted Dies : Here the arrangement of conventional dies is reversed, that is punch is mounted on die shoe. The blank is removed by means of a knockout pin (that is the blank is removed mechanically or manually from the punch). In this type of die, there is little possibility of thin blank being bent. The disadvantage is it’s relatively high cost.

Chapter 10

Die Operations

Cutting operations are classified either by the purpose or the shape of cutting actions as follows :-

(A) Operations for producing blanks :

1) Blanking :- Stamping having an irregular contour must be blanked from the strip. Piercing, embossing and various other operations may be performed on the strip prior to the blanking station.

2) Cut off :- Cut off operation are those, in which strip of suitable width is cut of required length. Preliminary operation before cutting off include piercing, notching, embossing. Although they are simple, many parts may be produced by cut off dies.

3) Shearing :- In this, workpiece is cut off. The cutting action must be along a straight line.

4) Parting :- It is an operation in which two single line are made to cut blank from the strip. During parting some amount of scrap is produced.

(B) Operations for cutting holes:

1) Piercing : Piercing dies pierce a hole in previously blanked, formed or drawn parts. It is often impractical to pierce holes while forming or before forming because they would become distorted in the forming operation. In such case, they are pierced in a piercing die after forming.

2) Punching : It is a cutting operation by which various shaped holes are made in the sheet metal.

3) Perforating : This is the process operation by which multiple holes are punched.

(C) Operations for Progressive Working:

1) Notching :- This is the cutting operation by which metal pieces are cut form the edges of the sheet.
2) Lancing :- This is the cutting operation in which the hole is partially cut and then one side is bent down to form a start tab or louver. There will be no scrap.

(D) Operations for size control:

1) Trimming :- When cups and shells are drawn from the flat metal sheet the edge is left wavy and irregular, due to uneven flow of the metal. This irregular edge is trimmed in trimming die. Shown is a plunged shell as well as the trimmed ring removed from around the edge.
2) Shaving :- Shaving consist in removing a chip from around the previously blanked stamping. Straight smooth edge is provided and therefore shaving is frequently performed on instrument parts, watch and clock parts. Shaving is accomplished in shaving dies especially designed for the purpose.
3) Slitting :- It refers to the operation of making incomplete hole in a work piece.

(E) Forming operations:

1) Bending :- Bending dies apply simple bends to stampings. The simple bend is straight. One or more bends may be involved and bending dies are a large and important class of press tool.

2) Drawing :- Drawing dies transform flat sheet of metal into cups, shells or other drawn shapes by subjecting the material to severe plastic deformation.

3) Squeezing :- Under this operation the metal is caused to flow to all operation to die cavity under the action of compressive forces.

4) Embossing :- Embossing group of operations is used to deform sheet metal away from the blank or part edge or in the central region.

(F) Miscellaneous operations :

1) Extruding :- Extruding dies caused metal to be extruded or squeezed out, much like toothpaste is extruded from it's tube when pressure is applied. This shows a collapsible tube formed and extruded from a solid slug of metal.
2) Horning :- Horn dies are provided with an arbor or horn over which the parts are placed for secondary operation such as seaming. Horn dies may also be used for piercing holes in the side of shells.
3) Bulging :- Bulging dies expand the bottom of the previously drawn plates. The bulged bottom of the some types of pots are performed in bulging dies.
4) Curling :- Curling dies curl the edge of the drawn shells to provide strength and rigidity. The curl may be applied over a wire ring for increasing strength. You may have seen the tops of sheet metal pails curled in this manner. Flat parts may also be curled. A good example is a hinge in which both the members are curled to provide hole for a hinge pin.
5) Cold forming :- In cold forming operation, metal is subjected to high pressure and caused to flow in a determined form. In cold forming, the metal is caused to flow into the shape of the die cavity.
6) Progressive operation : Progressive operation are those in which progressive dies performs work at number of stations simultaneously. A complete part is cut off , at the final station, with each stroke of the press.
7) Sub-press operation : Sub press dies are used for producing tiny watch, clock and instrument components. Sub-press are special types of the die sets used only for such precision work.

Chapter 11

Cutting Action in Punch Die operations

The cutting action that occurs in blanking or piercing is quite similar to that of chip formation ahead of a cutting tool. The punch contacts the work material supported by the die and a pressure build-up occurs. When the elastic limit of the work material is exceeded, the material being to flow plastically (plastic deformation).

The punch penetrates the work material, and the blank, or slug, is displaced into the die opening in corresponding amount. A radius is formed on the top edge of the hole and the bottom edge of the slug or blank.

The radius is often referred to as rollover, and it's magnitude depends upon the ductility of the work material. Compression of the slug material against the walls of the die opening burnishes a portion of the edge of the blank.

At the same time, the plastic flow pulls the material around the punch, causing a corresponding burnished area in the work material. Further continuation of the punching pressure then starts fractures at the cutting edge of the punch and die.

Under ideal cutting condition, the fracture will meet and the remaining portion of the slug edge will be broken away. A slight tensile burr will be formed along the top edge of the slug and the bottom edge of the work material.

The highly burnished band is the result of the materials being forced against the walls of the punch and die and rubbing during the final stage of plastic deformation.

The sum of the edge radius depth and the burnished depth is reffered to as penetration, i.e. the distance the punch penetrates into the work material before fracture occurs.

Penetration is usually expressed as a percent of material thickness, and it depends upon the properties of the work material. As the work material becomes harder, the percent of penetration decreases. For this reason, harder materials have less deformation and burnished area.

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

Chapter 12

Clearance

The die opening must be sufficiently larger then the punch to permit a clean fracture of the metal. This difference in dimensions between the mating members of the die set is called clearance.

The clearance is applied as followes :

1. When the hole has to be held to the size, i.e. the hole in the sheet metal is to be accurate (punching operation) and slug is to be discarded, the punch is made to the size of the hole and the die operating size is to be obtained by adding clearance to punch size.
2. In blanking operation, when the slug or blank is the desired part and has to be held to size , punch size is obtained by subtracting the clearance from the die opening size and die opening size is made to the size of the hole.

The clearance is applied in the above manner because the burnished area determines the diameter of the blank or the punched hole. On the blank, the walls of die produce the burnished area. Therefore, the blank size will be equal to the size of die opening.

Similarly, in punching operation the burnished area in the hole is produced by the punch, therefore the size of the hole will be same as the punch.

The clearance "C" is the function of the kind, thickness and hardness of the work material. Harder material require large clearance than soft material, the exception being Aluminum. The usual clearance per side of the die for blanking and piercing is as follow.

For Brass and soft steel C = 0.05 times t

For medium steel C = 0.06 times t

For Hard steel C = 0.07 times t
For aluminum C = 0.01 times t

The total clearance between the punch and the die size will be twice of this.

The clearance may also be calculated by following formula :-

C = 0.0032 x t x fs Where, fs = shearing strength of material in N/mm.

Punch and die clearance after considering the elastic recovery of material :

Due to elastic recovery of strip material in blanking operation after the release of blanking pressure, the blank expands slightly. The blank part is thus actually larger than the die opening. Similarly in punching operation, after the strip is stripped off the punch, the material recovers and the hole contracts thus the hole is smaller than the size of the punch.

This difference in size due to elastic recovery will depend upon,
1) Blank size
2) Stock thickness
3) Stock material

It may be taken as between 0.0125mm and 0.075mm. If the stock thickness is up to 0.25mm, this difference may be taken as zero. For t = 0.25mm to 0.75mm, difference may be taken as 0.05mm.

Angular Clearance: Angular clearance or relief is provided to enable the slug to clear the die. It is provided below the straight portion of die surface. It is usually 1/4 to 3/2 per side but occasionally as high as 2 depending on stock thickness the frequency of sharpening.

Land: It is the flat surface adjoining to the cutting edge of the die, which is grounded and rounded to keep the cutting edge of the punch sharp.

Straight: It is a surface of the cutting die between it's cutting edge and begining of the angular clearance. The straight portion gives strength to the cutting surface of the die and also provides for sharpening of the die. This straight portion is usually kept at above 3mm for all material less than 3mm thick. For thicker material it is taken to be equal to the metal thickness.

Chapter 13

Die Construction

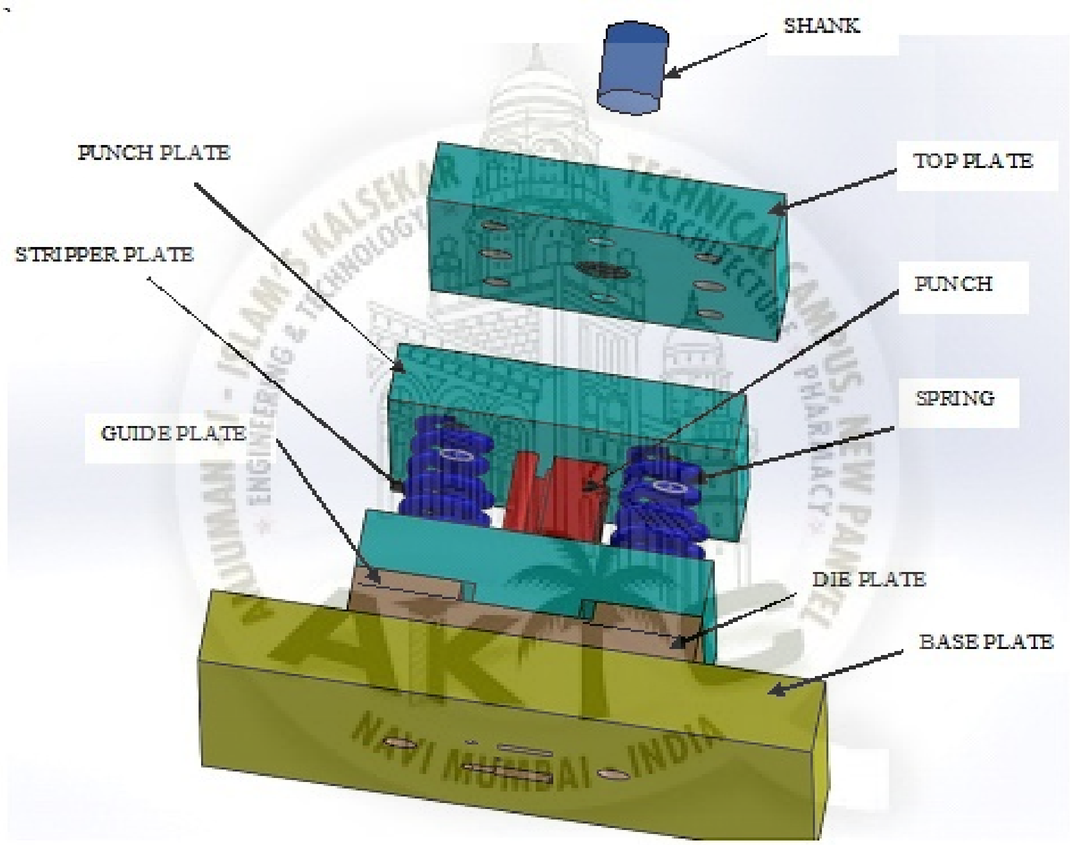


Figure 13.1: Exploded view of compound die

The information on blanking and piercing dies thus far has been general in nature. This section will deal with specific and will provide guideline for die design and construction.

Screws and dowels : The components of dies are held together by socket-head cap screw and are held in alignment by dowel pins.

The head on the cap screw is almost recessed in a counter bored hole to eliminate projecting screw heads. Cap screws used to secure die blocks are generally counter bored 1/8 in. deeper then the cap screw need to allow additional material for die sharpening.

Socket-head cap screw and dowels are commercially available in a wide range of size. Standard commercial dowels are finished to 0.0002 in. larger then the nominal diameter with a tolerance of 0.0001 in. Oversize dowels are also commercially available to replace standard size dowels in case the dowel hole becomes worn or otherwise oversize. Oversize dowels may be obtained as either 0.001 or 0.002 in. oversize.

A minimum of one cap screw and two dowels are necessary to position and hold a die component in place accurately. More cap screws may be used, but two and only two dowels should be used for positioning. Most die designer try to use at least two cap screws, but small components may allow only one because of space limitations. The diameter of screws and dowels is also determined by the size of the component. Generally 3/8-diam screws are used on die components up to 6 in.sq. Heavy die components are usually secured with 1/2 to 5/8 in diam screws.

Dowel diameter should be the same as that of the cap screws.

Dowels should be located diagonally across from each other and as far apart as possible to increase location accuracy. All screws and dowels should be located from 1 1/2 to 2 times their diameter from the component edge.

Whenever possible, screw and dowel hole should be placed nearer the outer edge of the die block and as far away as possible from the edge of the blanking contour.

Dowel holes always extend through the die components so that dowels can be easily removed. A hardened dowel pressed into a blind hole is almost impossible to remove by conventional methods. When the thickness of the component is 4 times greater then the dowel diameter, the dowel hole should be relieved. This practice is especially recommended when the dowel hole must be finished after heat treatment, as it minimize lapping and fitting time.

The effective thread depth for screws should be 1 1/2 times the screw diameter for general application and 2 times the screw diameter when the component is subjected to shock loads. Whenever possible, threading hardened components should be avoided. Die blocks, for example, should be clearance drilled and counterbored to accept the cap screw.

Die-block design: The design of die block depends basically upon the work piece size and thickness, Although the contours of the work piece and type of the die may be influential at times. Die blocks for small work piece are usually constructed from a solid block of tool steel. The size of die blocks is generally based on the past experience of the designer.

The distance between the die opening and the outside edge of the die block should 1 1/2 to 2 times the die thickness for large die or when sharp corners are present in the die opening contour. Solid die blocks that are symmetrical may be incorrectly assembled after repair.

This can be prevented by intentionally placing one dowel a different distance from it's nearest screw hole, a practice often referred to as fool proofing the die block.

Substantial savings can be derived from using insert die in the construction of die blocks. Insert dies can be obtained from specially companies as off- the-shelf items in virtually any size needed.

Die blocks made in two or more sections, known as sectional die blocks, are used to conserve tool steel in the construction of large dies or when the complexity of the die contour is such that it is easier to machine in section. The die may also be sectioned when the size of the die opening is too small to permit internal machining. An added advantage of sectional die blocks is that only one component need be replaced in case of die failure.

Punch design: The design of punches largely depends upon the area to be pierced or blanked and the pressure required to penetrate the workpiece material. The area to be pierced or blanked determines the method of mounting punches. For example punch for large work piece may be constructed from a solid block of tool steel and bolted a punch block for mounting the punch to the die holder. The punch must also with stand the maximum blanking or piercing pressure. Small punches may require punch support to prevent breakage. The many types of punches are too numerous to discuss in this text. Only basic type will be considered : the plain punch, the pedestal punch, the perforator punch, and punches mounted in punch plates.

Punches mounted in punch plates: Punch plates serve to hold, position, and in some cases strengthen the punch. The perforator punch previously described is generally mounted in a punch plate. Perforator is easily mounted in punch plates because the heads and shanks are round. Mounting holes are simply made with drills reamers, counter bores, or single-point boring tools, rectangular or odd-shaped punches are not so easily mounted in punch plates.

Punch support: In general piercing should not be smaller in diameter than the thickness of the stock they are to pierce. Where a small unguided punch must pierce stock thicker than the punch diameter, the punch shank should be at least twice the hole size in diameter and the cutting face should be ground to the hole size for a distance of about twice the stock thickness. Always avoid designing punches that would have more than 4 in. of unguided length. A spacer block should be used between the punch and punch holder (or punch plate) in order to shorten punches if more than a 4 in. length is necessary.

Punch shedders: There are times during piercing or blanking operations when the slug or blank tends to cling to the punch face and follow the punch out of the die opening. This is often referred to as slug pulling. During normal operations the slug cling to the die wall because of a slight amount of springbuck in proportionate to the stock thickness and the area of the slug. Therefore small holes in thin material have very little spring back and do not expand sufficiently to cling to the die walls. Consequently, the slug may adhere to the punch face and be drawn out.

Strippers and Pressure pads:

The purpose of a stripper is to remove the stock from the punch after a blanking or piercing operation. Strippers are classed as fixed or spring operates.Fixed strippers are generally solidly attached to the die block or die shoe, while spring-operated strippers travel up and down on the shank of a punch.

Channel Strippers:

This type is often designer's first choice because of simplicity. The most common channel stripper consists of a rectangular plate mounted on the top of the die block. A channel or a groove is milled, through which the strip is passed.

The height of the channel should be 1 1/2 times the stock thickness unless the strip must be lifted over a fixed pin stop. The width must be equal to the strip with plus adequate clearance to allow for variations in the width of strip. Stripper opening clearance around the punch should be adequate to clear the punch and should not be over one half the thickness of the material. The back edge of the channel may serve as a back gauge to correctly position the strip in close tolerance work. A stock pusher is used to hold the strip against the back gauge. The stock pusher shown is a commercial item consisting of hardened steel ruler mounted on a spring-loaded lever. It is adjustable to three pressures with a standard spring.

Spring-operated strippers:

Spring-operated strippers sometimes referred to as pressure pad strippers, employ spring to apply pressure to the stock strip. An advantage of this type is that it tends to hold the strip flat during the press cycle. Spring strippers are commonly retained in suspension by socket head stripper bolt, a form of a shoulder screw available as standard items from die-specially companies. Stripper springs are sometimes mounted over rods in place of stripper bolts. The rod should be long enough to support fully the spring's ID in order to minimised bending. The recommended way of doing this is to press a dowel of proper length and diameter into one plate and to drill a clearance hole in the other plate to allow the dowel to pass through.

Chapter 14

About the product

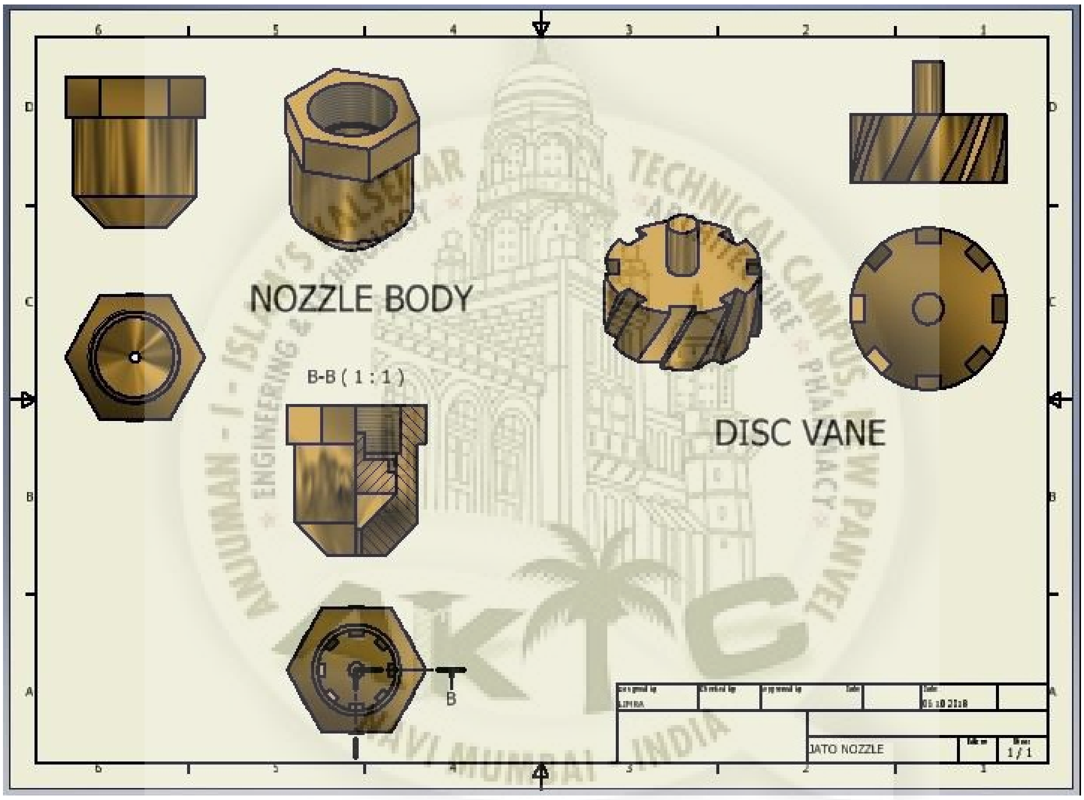


Figure 14.1: Product Assembly

Chapter 15

Working Principle of Compound Die

These operations perform two or more operations during one stroke of the press at one station only. In these dies the holes are pierced at the same station as the part is blanked, instead of previous station as done in piercing or the blanking die. The result is greater accuracy in the blank. Whatever accuracy is built in the die will duplicate in every blanks that are too large for production blanks in more than one station. Since all the operations are performed at the same station, compound die are very compact and smaller die set can be applied.

Chapter 16

Design of Die

Design considerations in die design:- The main points to be taken care of in designing a die set, i.e. , a die and a punch are :-

1) Wall thickness should be kept as uniform as possible to avoid warp age during heat treatment.
2) Fillet should be sparingly provide on all inside corners.
3) Enough space should be provided between screw and dowels holes and between them and the edges to avoid cracking.
4) Use reinforcing ribs whenever the shape of section requires them.
5) Long narrow section should, if possible be replaced by block shaped sections as to avoid warping.
6) Select a proper tool steel for die set.
7) Try to incorporate as many readymade standard components in set as possible.
8) Try to take maximum use of standard bar size as stock material.
9) Try to provide minimum machining time on parts.
10) Try to design as many parts as replaceable as possible, for ease in maintenance.
11) Try to have generous use of inserts.
12) Provide adequate clearance on cutting steel.
13) Locket the screw heads in such positions that they can be easily unscrewed for dissembling the die.
14) Provide knockout holes for all the dowels.
15) To minimize deflection, maintain a proper ratio between height and width of the set.
16) The stresses should be evenly distributed so as to provide the set

with adequate strong strength to resist cutting forces.

17) Where the die set is likely to be subjected to sever shocks, use a shock resistant tool steel.

Figure 16.1: Noozle Body

Figure 16.2: Disc Vane

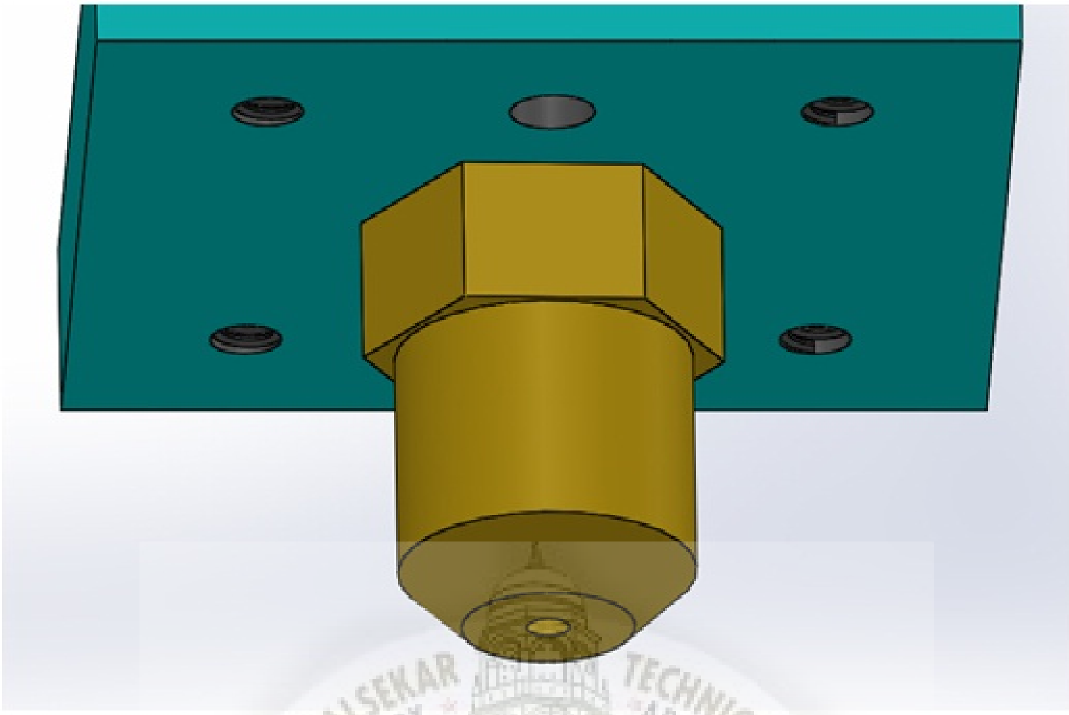


Figure 16.3: Nozzle Assembly

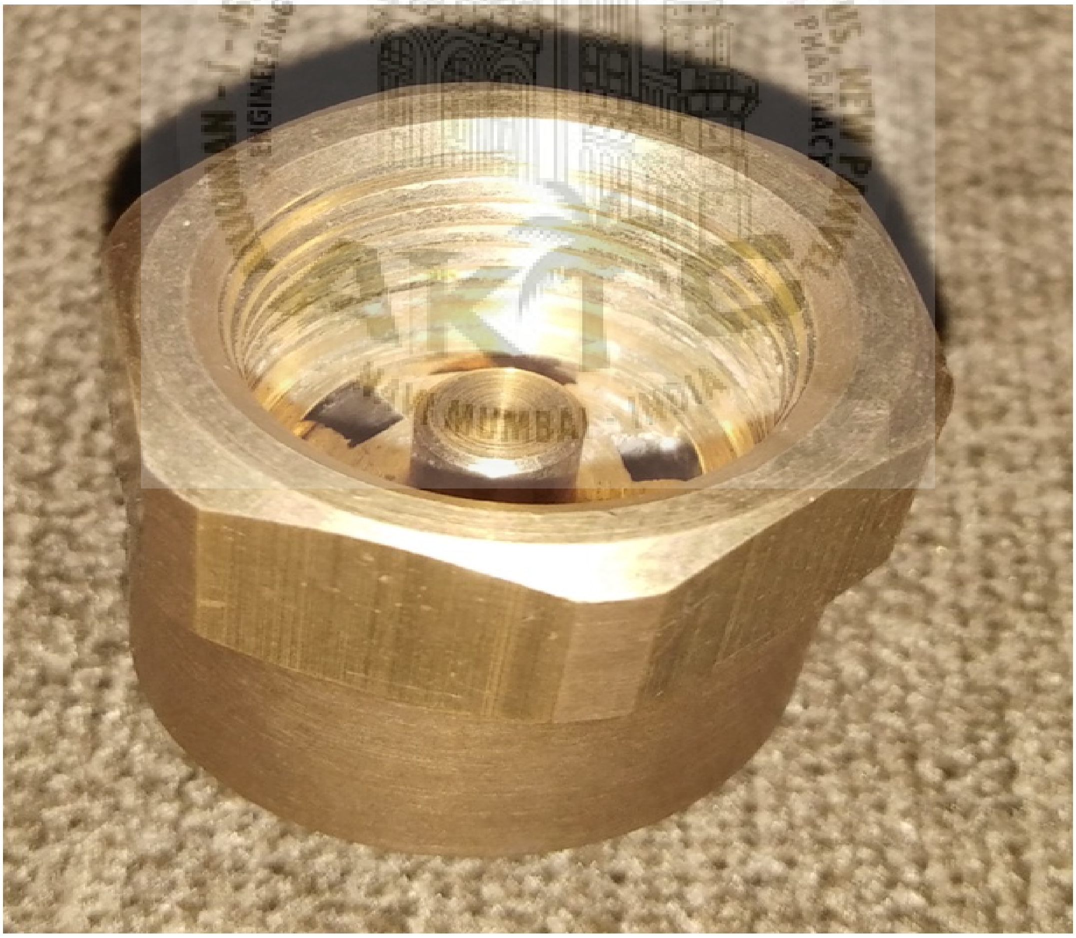


Figure 16.4: Actual Nozzle Assembly

Chapter 17

Force Calculation

Force F = perimeter x thickness x fs
For brass fs = 65 N /sq mm

PRESSING FORCE = 3.14 x 12 x 5 x 65
FB = 12246 N
FB = 1.24 Tonne

COLLER DEFORMATION FORCE
=3.14 x 12.5 x 0.5 x 65 = 1275 N
= 0.13 Tonne

TOTAL TONNAGE = 1.24 + 0.13 = 1.37 Tonne
Actual capacity of press with friction loss of 0.20 times
Total capacity of press =1.37 + (1.37 x 20 / 100) Tonne =1.644 = 1.75 Tonne.

TONNAGE OF PRESS = 1.75 Tonne

CALCULATION OF STRIPPING FORCE

Stripping force is 0.02 to 0.10 times of the actual tonnage of the press.

1.75 x 10/100 = 0.175Tonne i.e. 0.10 times

STRIPPING FORCE = 0.175 Tonne

DESIGN OF FASTNERS

The fasteners are required to fasten the punch to the upper die shoe and the stripper plate to the lower die shoe.

Allowable stress of fastener

Yield stress = 330 N/mm^2

Ft (allowable) = Yield stress/FOS = 330/2.5 = 132 N/mm^2

Now let us selecting M6 Allen screw
Area resisting tension = 3.14 (dc x dc/4)
Force acting on bolts are stripping force
By empirical relation
SF = 3.14(dc x dc /4) x ft x n
1000 X 9.8 = 3.14 x (6 x 0.84) x (6 x 0.84) x 320 x n /4
n = 1.5 = 2
Taking factor of safety as 2
n = 2 x 2 = 4 Nos

DESIGN OF DIE BLOCK

Material of Die is WPS (HcHcr) [c=0.015 times, cr =0.12 times, Mo = 0.01 times, v = 0.0025 times]
Thickness of Die plate =cube root of 0.936= 0.978 cm = 9.78 mm
CALCULATION OF CLEARANCE ON DIE AND PUNCH
Clearance = c = 0.0032 x 0.4 xs
= 0.0032 x 0.4 x 235
= 0.0196 mm
In pressing operation clearance is added to die cavity.

DESIGN OF STRIPPER PLATE

Total thickness of stripper plate + guide plate = 17 mm
Where guide plate thickness = 5 mm
Thickness stripper plate = 17-5 =12 mm
ts = 12mm

Chapter 18

Design of different components

1)**SHANK**
MATERIAL = Mild Steel
QTY = 1

The die of shank is depends upon the press selection. It aligned with top plate and get fixed with ram to move up and down the punch. The dimension of thank is directly taken from the base of ram and position of tightening bolt.
Length = 35mm
Diameter = 25 mm

2)**TOP PLATE**
MATERIAL = Mild Steel
QTY = 1

The design of top plate is depends upon the design of die Block and thickness is taken 8 to 10 mm too than die plate thickness
Top plate size = 65x 65 x 10 mm

3)**PUNCH HOLDER**
MATERIAL = Mild Steel
QTY = 1
The design of punch plate is same as the design of top plate and dimension is also same as top plate.
Size of punch holder = 65x 65 x 10 mm

4)**STOCK GUIDE**

MATERIAL = Mild Steel

QTY = 2

The thickness of stock guide is calculated at design of stripper plate. The distance between two spaces are 55.6 mm.

Size of stock guide = 65 x 20 x 5mm

5)**BASE PLATE**

MATERIAL = Mild Steel

QTY = 1

There is no standard design of base plate for length and breath. Generally the thickness of base plate is equal or greater than cutting die plate. We select thickness of base plate 15mm and length is depends upon the slot provided on press bed so we select the length of base plate equal to 115mm and width is taken as 75 mm.

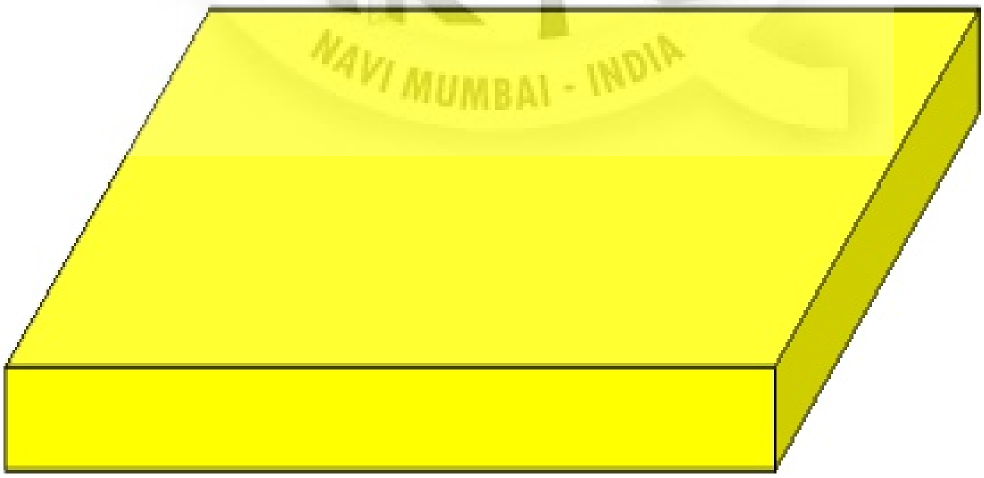


Figure 18.1: Base Plate

Chapter 19

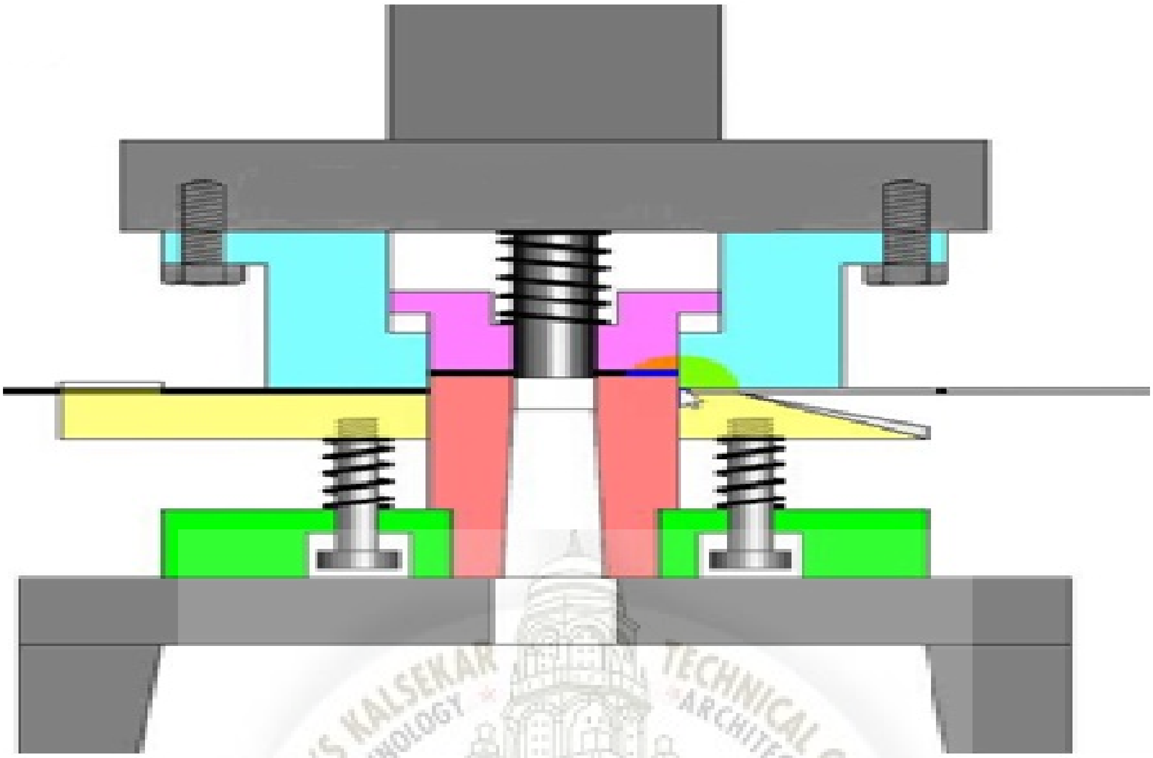
Design of dowel pin

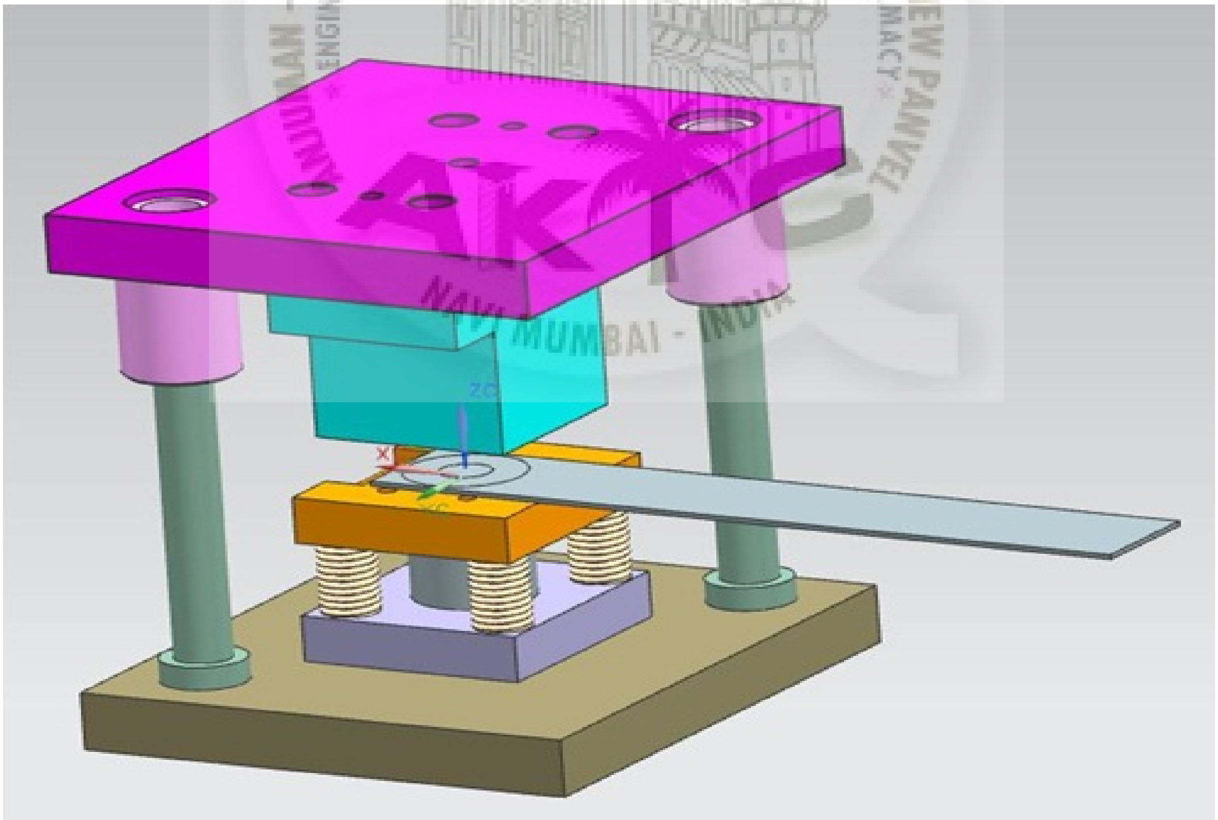
Selecting dia of dowel pin 8mm
Pressing force = (clearance x pressing force) / (Collar thickness – penetration)
= (0.02 x 132521)/(5 - (0.5))
= 588 N
Allowable shear stress in dowel is fs = 275 N/mm
No of dowel required N = 2
Fs = Vertical Force / shear Area
= V.F / (N x 3.14 x d2/4)
= 588 / (2 x 3.14 x 62)
= 10.40 N/mm2
As induced shear stress is less than allowable shear stress,
Design is safe

CALCULATION OF LENGTH OF DOWEL AND GUIDE PIN

a)Length dowel pin = stripper plate thickness + stock guide thickness + cutting pate thickness + base plate thickness
Length of dowel pin = 34 mm

b) Length guide pin = upper shoe thickness + lower shoe thickness + stroke length
Length guide pin = 65





Chapter 20

Manufacturing Process

As our project is punch and die for a Nozzle, the parts which are manufactured are as follows :

1. Base Plate
2. Die Plate
3. Stock Guide
4. Stripper Plate
5. Punch Plate
6. Top Plate
7. Shank
8. pressing punch

1.**Base Plate**: - Base plate is the plate, which is at the bottom of the die set. This plate is made of mild steel. Firstly according to the design, the size required is cut from the raw M. S. Plate. This plate is then held in chuck of lathe m/c and true by it's corners. The facing is done on all the sides of the plate by single point cutting tool. Then the plate is held on the vice and all the edges are chamfered by file. Then the marking of holes is done according to design. The holes are drilled and counter drilled for fitting of Allen screw head. This is done on drilling m/c. Then the punch shape is marked on the plate. The maximum material is removed by drilling holes at the periphery of marking and then cutting it by wire blade. The large amount of material is removed from the cavity by this process and exact shape is given with the help of different types of files. Then finishing is done on the surface grinding m/c. Then it is hardened.

2. **Die Plate**: - The die plate is the plate, which gives shearing action on the uncut stock. This plate is fitted above base plate. This plate is made from W. P. S. material. The manufacturing process for die plate is same as base plate.

3. **Stock Guide**: - These are two narrow strips, which are at the two sides of the die block. This plate is fitted over the die plate. It's function is to guide the stock. It is also made from M.S. The manufacturing process for stock guide is same as base plate.

4. **Stripper Plate**: - It is above stock guide. It's function is to strip the material. This plate is made from M.S. This plate does not have free holes as base plate but have tapped holes. The manufacturing process for stripper plate is same as base plate.

5. **Punch Plate**: - This plate is made up of M.S. This plate holds both the punch. The manufacturing process for punch plate is same as base plate.

6. **Shank Plate**: - It is located over the punch plate and made from M.S. It has tapped hole in the center for holding the shank. The manufacturing process for punch plate is same as base plate.

7. **Pressing Punch**: - The pressing punch is made from W.P.S. For this punch, we have taken a rectangular bar. It is then cut according to length given in design. Then it is held in lathe chuck. The maximum material is removed and it is brought near to it's dimension by single point cutting tool on Lathe m/c. Then finishing is done on surface grinder.

8. **Hardening**: - The pressing punch are oil hardened. In this process the material is firstly heated in furnace to a sufficient temp. required and then it is quenched in oil.

Chapter 21

Fabrication And Operation Sheet

1. Name : Base plate

Specification : 168 x60 x12 mm.
Material : Mild Steel
Time require : 10 Hrs.

Sr. No.	Operation	Jigs & Fixture	Machine used	Tool
1.	Facing	Four jaw chuck	Lathe m/c	Single point cutting tool
2.	Marking	----	----	Marker & scriber scale
3.	Drilling	Clamps	Drilling m/c	Drill bits
4.	Counter Drilling	Clamps	Drilling m/c	Drill bits
5.	Cutting die cavity	Vice	Drilling m/c & milling m/c	Drill bits & milling cutter
6.	Finishing	Magnetic chuck	Surface grinder	Soft grinding wheel
7.	Filing	Vice	----	File

2. Name : Die plate

Specification : 90 x 60 x 9.5 mm
Material : W. P. S.
Time require : 8 Hrs

Sr. No.	Operation	Jigs & Fixture	Machine used	Tool
1.	Facing	Four jaw chuck	Lathe m/c	Single point cutting tool
2.	Marking	----	----	Marker & scriber scale
3.	Drilling	Clamps	Drilling m/c	Drill bits
4.	Cutting die cavity	Vice	Drilling m/c & milling m/c	Drill bits & milling cutter
5.	Finishing	Clamps	Drilling m/c	Drill bits
6.	Filing	Magnetic chuck	Surface grinder	Soft grinding wheel

3. Name : Stripper plate

Specification : 90 x 60 x 10 mm

Material : Mild steel

Time require : 8 Hrs

Sr. No.	Operatio n	Jigs & Fixture	Machine used	Tool
1.	Facing	Four jaw chuck	Lathe m/c	Single point cutting tool
2.	Marking	----	----	Marker & scriber scale
3.	Drilling	Clamps	Drilling m/c	Drill bits
4.	Cutting die cavity	Vice	Drilling m/c & milling m/c	Drill bits & milling cutter
5.	Finishing	Clamps	Drilling m/c	Drill bits
6.	Filing	Magnetic chuck	Surface grinder	Soft grinding wheel
7.	Tapping	Vice	----	Taps

4. Name : Punch Holder
Specification : 90 x 60 x 10 mm
Material : Mild Steel
Time require : 8 Hrs

Sr. No.	Operatio n	Jigs & Fixture	Machine used	Tool
1.	Facing	Four jaw chuck	Lathe m/c	Single point cutting tool
2.	Marking	----	----	Marker & scriber scale
3.	Drilling	Clamps	Drilling m/c	Drill bits
4.	Finishing	Clamps	Drilling m/c	Drill bits
5.	Filing	Magnetic chuck	Surface grinder	Soft grinding wheel
6.	Tapping	Vice	----	Taps

5. Name : Top plate
Specification : 90 x 60 x 10 mm
Material : Mild Steel
Time require : 8 Hrs

Sr. No.	Operatio n	Jigs & Fixture	Machine used	Tool
1.	Facing	Four jaw chuck	Lathe m/c	Single point cutting tool
2.	Marking	----	----	Marker & scriber scale
3.	Drilling	Clamps	Drilling m/c	Drill bits
4.	Counter Drilling	Clamps	Drilling m/c	Drill bits
5.	Finishing	Magnetic chuck	Surface grinder	Soft grinding wheel
6.	Filing	Vice	----	File

6. Name : PRESSING Punch
Specification : dia 12 x length 20 mm
Material : W.P.S.
Time require : 10 Hrs

Sr. No.	Operation	Jigs & Fixture	Machine used	Tool
1.	Facing	Four jaw chuck	Shaper m/c	Single point cutting tool
2.	Finishing	Magnetic chuck	Surface grinder	Soft grinding wheel
3.	Curved Portion	Magnetic chuck	Surface grinder	Formed grinding wheel
4.	Concave and convex shapes	Magnetic chuck	Surface grinder	Formed grinding wheel
5.	Filing	Vice	----	File

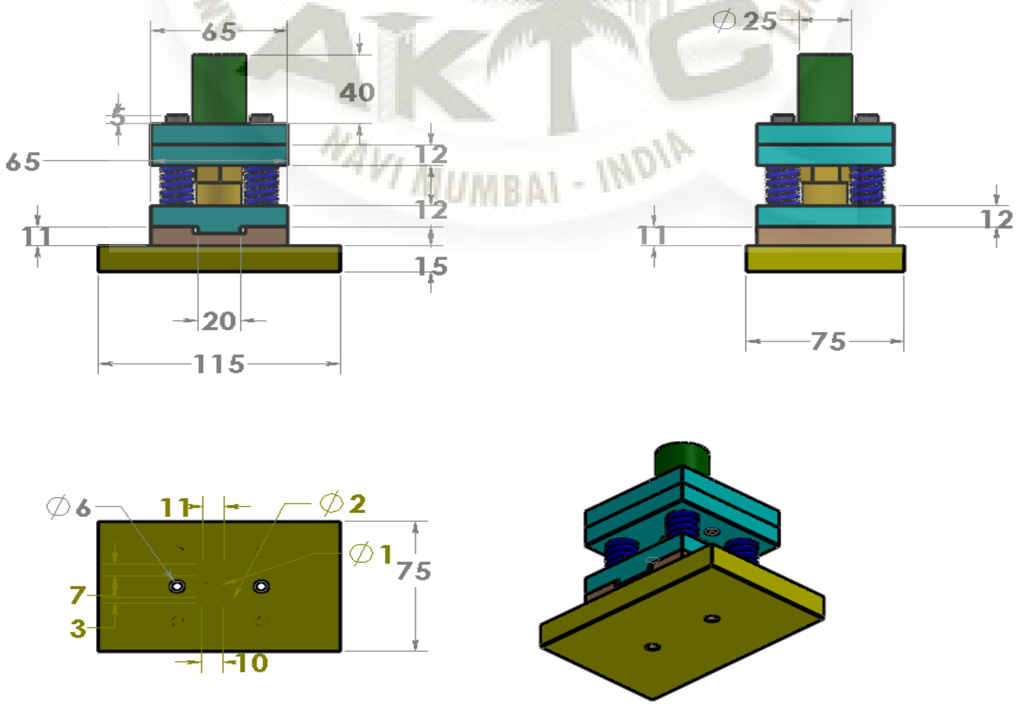
7. Name : Shank
Specification :Dia 25 x 35mm.
Material : Mild Steel
Time require : 2 Hrs

Sr. No.	Operation	Jigs & Fixture	Machine used	Tool
1.	Facing	Four jaw chuck	Lathe m/c	Single point cutting tool
2.	Step turning	Four jaw chuck	Lathe m/c	Single point cutting tool
3.	Threading	Four jaw chuck	Lathe m/c	Single point cutting tool

Chapter 22

Conclusion

The benefits of the project to be carried out at the Undergraduate level are to accrue us through an improved understanding of the Thermal and Mechanical design of compound die for automation of the crimping machine. Areas of research emphasis are the impacts of changes in production rate, cost, and quality attributes of Jato Nozzle assembly. The procedures for the validation of results emphasize understanding of the operation of assembly of the Jato nozzle. Analysis of the Mechanical designs the keystone of the Project. An important organizing principle and end goal of this work is to provide the company with their requirements and better rate of production.



Chapter 23

Future Scope

1. This crimping machine can be used for other nozzle assemblies with variant size and requirement.
2. The compound crimping die and die block are detachable this allows to replace the die for nozzles for different sizes.
3. Since the size of the nozzle is quite small, the disc vane can be fed into the die using a feeder mechanism.
4. The design of the machine will be provided to the Spratech systems Pvt. Ltd. so as for further reference to implement the project in the upcoming Plant of the company.

References

[1] *A REVIEW ON DESIGN, DEVELOPMENT, AND ANALYSIS OF COMPOUND DIE FOR AUTOMOBILE COMPONENT*; Mr.Bhaskar F. Satpute, Prof. Mahesh S.Harne, IARJSET , March 2016

[2] *COMPUTER ASSISTED COMPOUND DIE DESIGN: A CASE STUDY*; Sneha S.Pawar, R.S.Dalu, IJRET, May 2014

[3] *DESIGN AND DEVELOPMENT OF COMPOUND DIE FOR BEARING CAP*; Mr. B.F.Satpute, M.S.Harne, IJRERD, June 2016

[4] *HANDBOOK OF DIE DESIGN*;Ivana Suchy, June 2006

[5] *Overview of Press Tool Design used for Sheet Metal Processes with Design Considerations*;Nilesh N. Patil, IJSR