

# **FABRICATION OF PNEUMATIC METAL SHEET SHEARING MACHINE**

Submitted in partial fulfillment of the requirements  
Of the degree of

**BACHELOR OF TECHNOLOGY  
IN  
MECHANICAL ENGINEERING**

By

**Tushar Saxena (1614101182)  
Arun Kumar (1614102001)  
Abhishek Tiwari (1614101013)  
Rishu Tomar (1614101145)**

Supervisor:

**ABDUL GANI**



**SCHOOL OF MECHANICAL ENGINEERING  
GALGOTIAS UNIVERSITY  
GREATER NOIDA  
2020**

# **CERTIFICATE**

This is to certify that the Research work titled **PNEUMATIC METAL SHEET SHEARING MACHINE** that is being submitted by **Tushar Saxena, Arun Kumar, Abhishek Tiwari and Rishu Tomar** is in partial fulfillment of the requirements for the award of **Bachelor of Technology**, is a record of bonafide work done under my guidance. The contents of this research work, in full or in parts, have neither been taken from any other source nor have been submitted to any other Institute or University for award of any degree or diploma.

**Supervisor**

**ABDUL GANI**

**Internal Examiner**

**External Examiner**

# Approval Sheet

This thesis/dissertation/project report entitled **PNEUMATIC METAL SHEET SHEARING MACHINE** by Tushar Saxena, Arun Kumar, Abhishek Tiwari and Rishu Tomar is approved for the degree of bachelor of technology in mechanical engineering.

**Examiners**

---

---

---

**Supervisor**

ABDUL GANI

**Dean**

---

Date: \_\_\_\_\_

Place: \_\_\_\_\_

# **Declaration**

I declare that this written submission represents my ideas in my own words and where other's 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.

TUSHAR SAXENA

ARUN KUMAR

ABHISHEK TIWARI

RISHU TOMAR

1614101182

1614102001

1614101013

1614101145

Date:

# ACKNOWLEDGEMENT

Primarily I would like to thank God for being able to complete this project with success.

Then I would like to thank my Supervisor Dr. Maniraj M and Guide Mr. Abdul Gani, whose valuable guidance has been the ones that helped me patch this project and make it full proof success their suggestions and their instructions has served as the major contributor towards the completion of the project.

Then I would like to thank my parents and friends who have helped me with their valuable suggestions and guidance has been helpful in various phases of the completion of the project.

Last but not the least I would like to thank my project team, without their contribution completion of this project was difficult.

TUSHAR SAXENA

ARUN KUMAR

ABHISHEK TIWARI

RISHU TOMAR

(Department of Mechanical engineering)

# ABSTRACT

The sheet cutting machine is the heart of sheet metal industries. In some industries, hand sheet cutter is used which is operated manually. In these machine, we are using pneumatic cylinder for sheet metal cutting. These machines will be easy to operate and maintain also. Hence, we are introducing a pneumatic sheet metal cutting machine which will reduce manufacturing cost and minimize industrial labor problems which is the biggest problem for human.

The main objective of our project is to perform job holding operation effectively with less human efforts by using a machine with the pneumatic power. This will also reduce the time required for metal cutting. By using these machine we can increase the production rate and automatically the industry will be in profit.

Automation plays an important role in mass production. Automation can be achieved through pneumatic form. The main advantage of pneumatic system is economically cheap and easy to handle. The manufacturing operation is being adopted for the following reasons.

- Less human efforts is required
- Production rate can be increased
- Industry efficiency can be increased
- Work load can be reduced
- Production time can be reduced

Generally the metal sheet shearing machine is handy operated manually for MSME Industries. This paper gives an insight about the automatic sheet metal cutting machine.

Any automatic machine aimed for economical use of man. In this paper, pneumatic cylinder is used for cutting in easy way which can be use in small scale industries at lower cost. The metal sheet shearing machine operates with the guidance of pneumatic double acting cylinder. The piston is attached to the moving cutter tool which is used to cut the metal sheet into pieces. The cutting process is operated by a direction control valve by using compressor. In manual method sheet metals goes to the scrap sometime because of wrong dimensions, improper cutting etc. Machines which are operated hydraulically are also taken in consideration for metal sheet cutting operation. But these hydraulically machines are operated for heavy metal cutting and its expense is very high.

Therefore, we are considering a pneumatic system for metal sheet shearing operation in an easy manner. The main advantage of pneumatic sheet metal cutting machine is to improve product quality, repetition of work and increasing production rate.

# TABLE OF CONTENT

	<b>Page</b>
<b>Certificate</b>	<b>II</b>
<b>Approval sheet</b>	<b>III</b>
<b>Student declaration</b>	<b>IV</b>
<b>ACKNOWLEDGEMENT</b>	<b>V</b>
<b>Abstract</b>	<b>VI</b>
<b>Table of content</b>	<b>VIII</b>
<b>List of figures</b>	<b>X</b>
<b>List of abbreviation</b>	<b>X</b>
<b>Chapter 1      Introduction</b>	<b>11</b>
<b>1.1</b> Project background	11
<b>1.2</b> Purpose of using pneumatics metal shearing machine	12
<b>1.3</b> Pneumatics transmission of energy	13
<b>1.4</b> Prior Concept	14
<b>1.5</b> Sheet Metal Cutting	15
<b>Chapter 2      Literature review</b>	<b>16</b>
<b>2.1</b> Introduction	16
<b>2.2</b> Reviews	16
<b>2.3</b> Problem Description	20
<b>2.4</b> Future Scope	20
<b>2.4.1</b> Modifications	22
<b>2.5</b> Applications	23
<b>Chapter 3      Methodology</b>	<b>24</b>
<b>3.1</b> Operations	24
<b>3.2</b> Material Used	25



<b>Chapter 4</b>	<b>Pneumatic Cylinder</b>	<b>27</b>
4.1	Single-Acting Cylinder	28
4.2	Double Acting Cylinder	29
<b>Chapter 5</b>	<b>Direction Controlled Valve</b>	<b>30</b>
5.1	Introduction	30
<b>5.2</b>	<b>2 way DC Valve</b>	<b>33</b>
<b>5.3</b>	<b>3 way DC Valve</b>	<b>34</b>
<b>5.4</b>	<b>4 way DC Valve</b>	<b>35</b>
<b>5.5</b>	<b>5 way DC Valve</b>	<b>36</b>
<b>Chapter 6</b>	<b>Compressor</b>	<b>36</b>
6.1	Types of Air compressor	36
6.2	Reciprocating Air compressor	37
6.3	Rotary Screw Compressor	38
6.4	Centrifugal Compressor	40
6.5	Lever Shear	41
<b>Chapter 7</b>	<b>Working</b>	<b>42</b>
<b>Chapter 8</b>	<b>Design Procedure</b>	<b>44</b>
<b>Chapter 9</b>	<b>Merits &amp; Demerits</b>	<b>45</b>
<b>Chapter 10</b>	<b>Conclusion</b>	<b>46</b>
<b>Chapter 11</b>	<b>Reference Used</b>	<b>47</b>
<b>Publication Details</b>		<b>48</b>

## List of abbreviations

1. TRIP- Transformation Induced Plasticity
2. LDR Sensor- Light Dependent Resistor
3. PLC- Programmable Logic Controller
4. DAC- Double Acting Cylinder
5. PET- Polyethylene terephthalate
6. FRL- Filter Regulator Lubricator
7. DC Valve- Direction Controlled Valve

## List of figures:

<b>Figure</b>	<b>title</b>	<b>page no:</b>
Figure 1	Pneumatic Cylinder	27
Figure 2	Detailed Pneumatic cylinder	28
Figure 3	DC Valve	31
Figure 4	2 Way DC Valve	32
Figure 5	Working of 2 way DC valve	32
Figure 6	Schematic symbol for 3 way dc valve	33
Figure 7	Working of 3 way dc valve	34
Figure 8	Symbol for 4 way dc valve	34
Figure 9	Reciprocating air compressor	37
Figure 10	Rotary screw compressor	38
Figure 11	Centrifugal compressor	41
Figure 12	Lever shear	42
Figure 13	Pictorial working of machine	43
Figure 14	Modelling of Pneumatic shearing machine	46
Figure 15	Drafting of pneumatic shearing machine	47

# **INTRODUCTION**

## **1.1 Project Background**

This is an industrial era and so as to possess better surface finish and acquire a high degree of flexibility within the manufacturing processes within the industries, a tons of work is done on sheet metal. To make sure the adequate demand, sheet is cut and bent into sort of shapes. This is often a review of the previous work done on the sheet metal where the cutting and bending of the sheets has been studied under various conditions.

The pneumatic sheet cutting machines are one of the latest techniques which are used efficiently to form the sheet cutting and bending an efficient process. This work reviews the reliability, performance and therefore the possibilities of simplifying the model of the pneumatic sheet cutting machines. This work also reviews the energy lost within the pneumatic cylinder while it's made to impart the force on the cutting blade. The energy efficiency of pneumatic and compressed gas systems is a crucial element within the overall development of sustainable production.

The target of this cross-discipline review is to change production and life cycle engineering researchers on state of art in energy efficiency for pneumatic production and associated compressed gas infrastructure.

Metal sheet is normally a metal beaten into flat and thin fragments. It's one among the basic forms which is employed in metal operating and may be cut and bent into a sort of various shapes. Countless on regular basis objects are constructed of the material . Thicknesses can change remarkably, although exceedingly thin thicknesses are taken in consideration of foil or leaf, and pieces thicker than 5 mm are taken as plate.

The thickness of the sheet termed as its gauge. often used steel sheet varies from 30 gauge to about 8 gauge. The greater is the gauge number, thinner is the metal. Gauge is evaluate in metals which are ferrous while nonferrous metals similar to aluminum or copper are rated differently; i.e., Copper is calculated in thickness by Ounce.

There are variety of metals which can be made into sheets,ex. brass, copper, steel, tin, nickel, iron aluminum and titanium. For garnishing purpose uses, major sheet metals include silver, gold and platinum.

Metal sheet operations also find its importance in production of car bodies, medical tables, aircraft wings, building's roof (Architectural) and various other things. Metal Sheet of iron and other sort of materials possessing high magnetic permeability, also referred to as laminated steel cores, has usage in transformers and electrical machines. An important use of metal sheet was in armor plate worn by cavalry, and sheet continues to possess various garnishing uses, including in horse tack.

There are three primary procedures in Layout

- 1 Parallel
- 2 Radial
- 3 Triangulation

## **1.2 Purpose of using pneumatics metal shearing machine**

Pneumatic systems are used extensively in industries and are mainly powered by compressed gases. An electrically powered and centrally located compressor powers air motors, cylinders and other pneumatic devices. A pneumatic system are often either controlled through manual or automatic solenoid valves which are selected because they supply low cost, more flexibility and safer alternative to electric motors and actuators. Pneumatic systems even have applications in mining, dentistry, construction, and other areas.

This project is essentially made from mild carbon steel the rationale for the choice is mild carbon steel is quickly available in market. It's budget friendly and it's available in standard dimensions. It possesses good mechanical properties. It possess medium factor of safety, it possesses high level tensile strength, thermal expansion coefficient is low. The substance of the sheet to be sheared are considered as aluminum and plastic as they replace various metal within the present scenarios due to their distinguished properties of features.

### **1.3 Pneumatics transmission of energy**

The reason for using pneumatics, or the other sort of energy transfer in a machine, is that to carry out of task requires the appliance of K.E to a resisting object which result in the object advance through a distance. In pneumatic system, energy is kept during a potential state under the shape of compressed gas. Working energy (kinetic energy and pressure) leads to a pneumatic system when the compressed gas is permit to increase. Expansion of air possess the config of airflow. Generally a positive displacement compressor contains a movable member inside of housing. The compressor features a piston for a movable member.

### **Controlling**

Transmitting working energy pneumatically, it must be guided under full command in the least times. If not in check, important work won't happen and machine operators could be injured. major benefit of transferring energy pneumatically is that the energy can be controlled comparatively easily with the help of valves.

## **1.5 Sheet metal cutting**

Shearing processes are those during which a bit of metal sheet is segregated when an excellent enough force is put in application which causes the substance to fail.

When an quite good enough cutting force is put in application, the shear stress within the substance will increase the subsequent shear strength and therefore the material will segregate at location of cut.

This cutting force is implied by two tools, one tool is fixed below the metal sheet other tool is above the metal sheet which falls downwards.

Sides of upper and lower tools have a little clearance between them, which creates the fracture of the substance. The size of this clearance is usually 2-10% of thickness of material and depends upon several factors, like the precise shearing process, material, and sheet thickness.

The material fractures at an angle with a little burr build at the side as the shear stress was just too great. There are some factors on which height of portion of cut depends, including the tool sharpness and the clearance having among the tools.

# LITERATURE REVIEW

## 2.1 INTRODUCTION

Metal sheet shearing is one among the foremost widely applied metal sheet producing operations. The learning of the shearing mechanics is focused toward having two sorts of dominant information for industrial purpose.

The modern world is more practical and cost-conscious, therefore the shearing process for sheet-metal has got to be wiped out an accurate and more precise way with the relative economy of operation, easier implementation for mass-production, also as greater control on the technical parameters. In most of the metal sheet operations shearing operation is that the main or initial operation within the process sequence. Automating this operation leads to reduced time interval and can also reduce human effort.

## 2.2 REVIEWS

### ➤ Harold s. gaines

Examined an apparatus for implying pneumatic force on a work piece consisting of pneumatic cylinder mechanism. Devices which operates hydraulically or by pneumatic concept. In such prior art devices, it has been primarily known to employ hydraulically or pneumatically operated piston-cylinder arrangements to actuate a cutting implement, such as a knife or the like.

### ➤ Leonard C.Ross

He examined the force applying apparatus which includes a fluid actuated cylinder that incorporates a flexible diaphragm for use in severing metals, such as in punch presses, shears or the like, and for moving parts such as baffles which can be effectively used singularly or in multiple combinations. The apparatus, in one form, includes a pneumatically

actuated flexible diaphragm mechanism including a fluid pressure chamber having a resiliently biased piston rod member adapted to be vertically reciprocated in response to pneumatic actuation of the flexible diaphragm member.

➤ HEINRICH BERNS

The study aims to method of adjusting and resetting the blades in metal shearing machines. The study concludes that adjusting and resetting the blades of metal shearing machines, particularly of heavy mechanically driven sheet metal shearing machines.

➤ Vishal tambat

Designing of an efficient system which reduces the human effort and help to increase production output. It also includes pneumatic system, pneumatic component and shearing die and bending die. The shearing machine and bending machine is most vital in metal sheet industry. This machine should be used for straight cutting machine with wide application. But in some industry hand sheet cutter and hand bender are used. For that machine to operate the human effort are required.

➤ Shradha patil

Generally the sheet metal cutting machine is manually hand operated one for medium and small scale industries. This project report gives an insight into the automatic shearing and feeding of sheet metal. Roller mechanism is used to automate the feeding of sheet metal. It further gives the glimpse of possible future developments concerned with automation of shearing process.

➤ Vallance and Matlock

studied the friction behavior of zinc-based coated sheet steels and laboratory scale friction analysis techniques. Sheet sliding over cylindrical dies.



## ➤ **Types of cutting machine:**

1. Pneumatically operated
2. Hydraulically operated
3. Rack and pinion operated
4. Spring operated

### **Pneumatically operated:**

In pneumatically operated header movement is allocated within the up and down direction with the guidance of pneumatic double acting piston and arrangement of cylinder unit at the side of DC valve which is operated by foot. In this process air having high pressure is suitable for transferring of motion and power.

### **Hydraulically operated:**

In this process header is lowered and raised, that is carried over victimization the hydraulic piston and cylinder. To move the piston and cylinder, the oil is permit to enter the cylinder from front or back side of the piston. However the oil is relatively expensive and its leak may cause numerous problem.

### **Rack and pinion operated:**

Header is lowered and raised manually by victimization the rack and pinion arrangement. Manually pressure is applied in this case, victimization direct hand pressure on the rack using pinion and lever arrangement. Since the machine is strong and needed high pressure, therefore it's not appropriate.

### **Spring operated:**

Spring operating machine is very much alike to rack and pinion mechanism of pneumatics but has different construction. Therefore the raising of the heating handle are administered manually and it needed an excessive amount of pressure to work also risk of having harm to the work piece if not handled fastidiously is there. Material type should be selected properly to manufacture any machine part,

design and safety should always be considered. Material for engineering process should be selected by keeping these factors in consideration:

- 1 material availability.
2. For a specified component, suitable material should be selected.
- 3.Pricing of material.

This machine is constructed from mild carbon steel the rationale for choosing this material is quickly available in market. It has low cost and it's available in standard size. Mechanical properties are good. Moderate factor of safety.

There are many metal sheet cutting processes. Laser metal sheet shearing process is one of them. Researchers have done the investigation of the effect of different operation characteristics on the various quality in laser shearing process.

### **2.3 Problem Description**

- In manual metal sheet shearing machine large force is required which may make tire to a worker who continuously works thereon for production.
- Time loss in large scale industries.
- Less accuracy because it involves man work.
- The machine is meant by observing the factors to enhance the accuracy and time management.

### **2.4 Future Scope**

Since upgradation never stops and men always tends to develop things for their comfort and gain more luxurious. Advancement is done to develop more and more modified and new technique with the growing ascetic look and low-cost consideration,So there's always lot of scope, We have though some of the future modification which can be implied in this machine,

- It are often made hydraulically power operated by installing the oil pump at the place of gas compressor and pneumatic air arrangement.

- It can be made to operate by rack or pinion or spring method, by changing pneumatic circuit of rack and pinion with the square threaded screw and nut arrangement.
- There are many places where there is no electricity, then we can operate this machine with the help of Internal-Combustion engine.
- Accident avoiding systems by adding LDR sensors
- Improvements in pneumatic machine by adding components like timers, silencers, etc.

Hence there are number of modification which can be done on this machine.

### **2.4.1 Modifications**

Automating this operation leads to scale back time interval and also can reduce human effort. Automation may be a method during which technology involved with application of mechanical, electronic and computer-based systems to work and control production. The rationale for automating this method could also be to scale back producing time interval, to extend labour productivity or to enhance the employee safety, etc.

#### **Programmable Logical Controller:**

A Programmable logic controller (PLC) is defined as a digital electronics device that uses a programmable memory to store instructions and to implement specific functions like logic, timing, counting and arithmetic operations to control machines and processes. It are often said as associate industrial pc that incorporates a central processing unit, memory, input/output interface and a programming device. These central processing unit is that the intelligence of the controller. These central processing units accepts data, status info from varied sensing devices like limit switches, proximity switches, executes the user management program store within the memory and provides appropriate output commands to devices like solenoid valves, switches etc. In this paper the automation is achieved by interfacing the sensors and PLC system with the conventional shearing process.

Mainly 3 parts are used in this system. They're Loading Cylinder, Unloading Cylinder, and punching Cylinder. All these cylinders are operated during a sequence so as to perform the specified operation. The metal sheet that has to be sheared is stacked in a container which has an outlet which allows only one sheet metal at a time. Limit switches and proximity sensors are placed to understand the positions of the cylinders, whether in extended or retracted conditions. According to the inputs from the sensors and therefore the program written, the loading cylinder will load the work piece into the holder, then the punching cylinder will shear the work piece and eventually the unloading cylinder will unload the work piece from the work piece holder.

## **Recommendation**

When compared with hydraulic cutting or laser cutting machine, pneumatic metal sheet machine has low cost and is budget friendly. By providing a compressor which can generate a high pressure and with help of hardened blades we can easily shear those sheets which are thicker. There are many small scales and medium scale industry which couldn't able to afford the expensive machine for them this machine can be advantageous. Pneumatic metal sheet shearing machine are often utilized in various workshops or industries.

## **2.5 Application of Pneumatics metal shearing machine**

- This machine is very useful for small scale industries
- Roller sheet metal can be easily cut with this machine
- Industrial Utilization
- Bodies of cars and frame
- Wings of aircraft
- Roof s for building (architectural) and many other things
- Iron metal sheet and other material which have high magnetic permeability, also referred as laminated steel cores, has implementation in electrical machines and transformers.

## METHODOLOGY

The main objective of creating this project was to learn about pneumatic systems and how things work with it. We have learned about double acting cylinder, pneumatic valve which is hand operated, then we have learned about high speed blade and then how to fabricate pneumatic metal sheet shearing machine. After that collecting proper and suitable components. Then assembling them after machining them to a proper shape and size.

### 3.1 Operation

Applying a shear force to perform cutting operation is most commonly termed as shearing process. Shearing is a process in which a part of material is separated from its source by applying a force which causes material to fail, this force is called as shear force. This shearing force is applied by 2 tools, one tool is fixed below the metal sheet above which lies a second tool which has downward motion and it delivers a fast downward blow. There is very small clearance present between the sides of blades, which allow a material to fracture. The consequences of shearing on the material vary because the cut of sheet is visible on the sides of sheared piece of metal. The cutting of piece depends on several factors, like tool sharpness and the amount of clearance tool is having between them.

## 3.2 Material used

### ➤ Raw Material Used-

1. Mild carbon Steel bars for base frame.
2. 35C8 material for shearing blades.
3. Cylinder fittings like fork end, base plates, support links.
4. Angle section for blade fitting.
5. Connecting link.
6. Blade link.

### • Ready Items Used-

1. Pneumatic double acting cylinder.
2. Direction & flow control valves.
3. Pneumatic pipe & pipe fittings.
4. Bolts & nuts.
5. Antirust coat & paint.

### • Machines & Tools Used-

1. Cutting Machine.
2. Hacksaw Cutting Machine.
3. Sensitive Drilling Machine.
4. Horizontal Miller machine.
5. Electric Arc Welding Machine.
6. Table Grinder.
7. Hand Grinder.
8. Surface Grinding Machine.
9. Tap & Tap Holder.

## PNEUMATIC CYLINDER

Pneumatic cylinders are devices which has mechanical characteristics which runs with the help of compressed air to supply a reciprocating linear motion force.

Like hydraulic cylinders, pneumatic cylinders use the stored P.E of a fluid, during this case compressed gas, and convert it into K.E because the air expands in an effort to succeed in air pressure. When the air expands it exerts a force on a piston by which it can move in desired direction. Shape of the piston can be cylinder or disc, and therefore force it transferred by rod which piston develops to the object which has to be moved, it develops to the thing to be moved. Using pneumatics is more preferential because it is clean ,easy and take less space to operate.

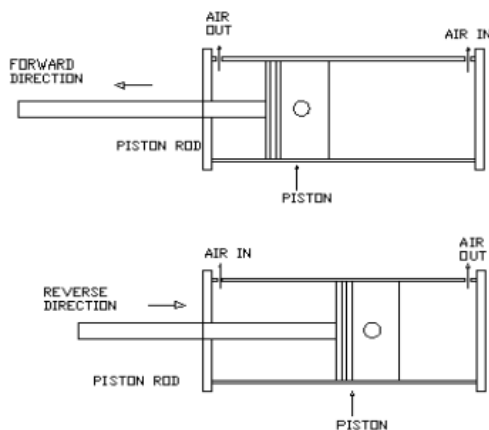


Figure 1 Pneumatic cylinder

Figure (i) as a result of the operational fluid could be a gas, discharge from a pneumatic cylinder having gas won't drip out and pollute the environment, wherever cleanliness is required there pneumatics is preferred.



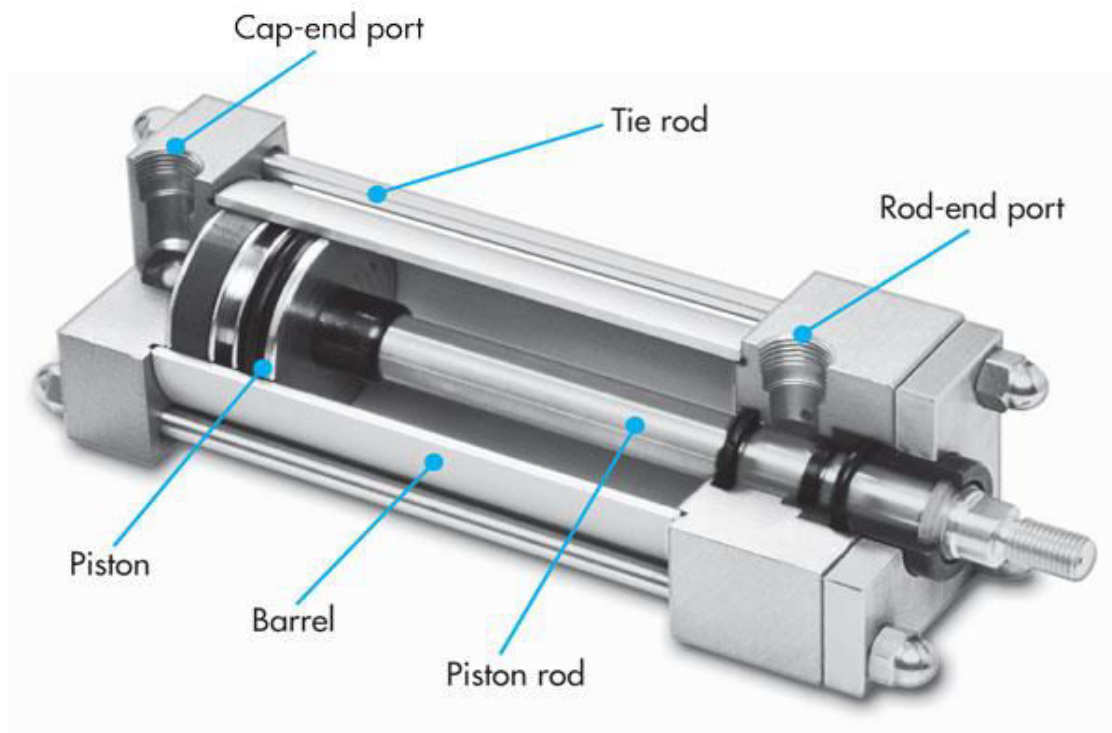


Figure 2 Detailed Pneumatic cylinder

4.1 They are two types of pneumatic sheet cutting machine

- 1) Single acting cylinder
- 2) Double acting cylinder

#### **4.1 SINGLE- ACTING CYLINDER**

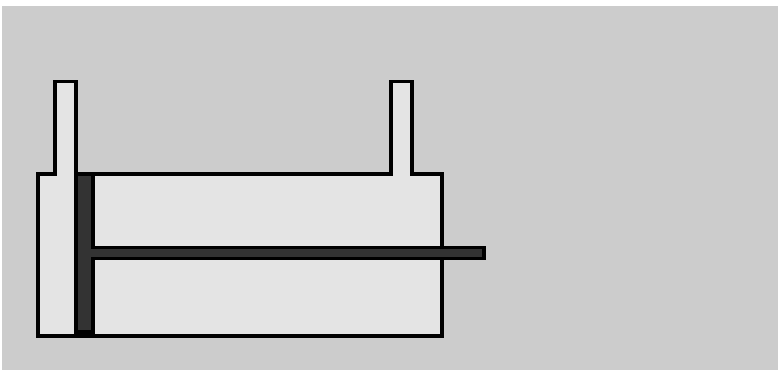
Pneumatic cylinder(s) (sometimes referred to as air cylinders) are mechanical devices which utilize the power of compressed air, which generates a force in reciprocating linear motion.

It has one connection port which can be used to fill or empty the cylinder.

## 4.2 DOUBLE-ACTING CYLINDER

(DAC)- Double-acting cylinders utilize the force of air to maneuver in both extends and retract strokes. It has two ports, one is used to permit air in and other port is used to vent. moreover, the rod of piston is more susceptible to buckling and bending.

### 2D VIEW:



5

## Direction Controlled Valve

### 5.1 Introduction

Directional control valves perform only three functions:

1. stop fluid flow
2. allow fluid flow, and
3. Change direction of fluid flow.

These three functions usually operate together.

The simplest directional control valve is that the 2-way valve. A 2-way valve stops flow or allows flow. A water tap is a good instance of a 2-way valve. A water tap permits flow or stops flow by manual control.

A single-acting cylinder needs supply to and exhaust from its port to work. This needs a three-way valve. A three-way valve allows fluid flow to an actuator in one position and exhausts the fluid from it within the other position. Some 3-way valves have a 3rd position that blocks flow in the least ports.

A double-acting actuator requires a 4-way valve. A 4-way valve pressurizes and exhausts two ports interdependently. A 3-position, 4-way valve stops an actuator or permits it to float. The 4-way function could be a common form of directional control valve for each air and hydraulic circuits. A 3-position, 4-way valve is additional common in hydraulic circuits.

The 5-way valve is found most often in air circuits. A 5-way valve performs an equivalent function as a 4-way valve. The sole difference is an additional tank or exhaust port. (Some suppliers call their 5-way valves, "5-ported 4-ways.") All spool valves are five ported, but hydraulic valves have internally connected exhaust ports getting to a standard outlet. Because oil must return to tank, it's convenient to attach the twin tank ports to a one return port. For air valves, atmosphere is that the tank, so exhaust piping is typically unimportant. Using two exhaust ports makes the valve smaller and fewer expensive. As are going to be explained later, dual exhausts used for speed-control mufflers or as dual-pressure inlets make this configuration versatile.

Following are schematic symbols for commonly used directional control valves



Figure 3 D.C VALVE

5.1 In direction control valves are so many types

- 1) **2-way directional control valves**
- 2) **3-way directional control valves**
- 3) **4-way directional control valves**
- 4) **5-way directional control valves etc...**

**In most of case we can be used the 2 way direction control valve**



Figure 4. 2 way D.C Valve

## 5.2 2 way direction control valve

A 2-way directional valve has two ports normally called *inlet and outlet*. When the inlet is blocked within the at-rest condition, as shown in Figure, it's mentioned as "normally closed" (NC). The at-rest box or the traditional condition is that the one with the flow lines getting to and from it.

The boxes or enclosures represent the valve's positions. In figure 5, the active box shows blocked ports, or a closed condition, while the upper box shows a flow path. When an operator shifts the valve, it's an equivalent as sliding the upper box right down to take the place of the lower box. within the shifted condition there's be flow from *inlet* to *outlet*. Releasing the palm button in it allows the valve spring to return to the traditional stop flow condition. A 2-way valve makes a blow-off

device or runs a fluid motor in one direction. By itself, a 2-way valve cannot cycle even a singular acting cylinder.

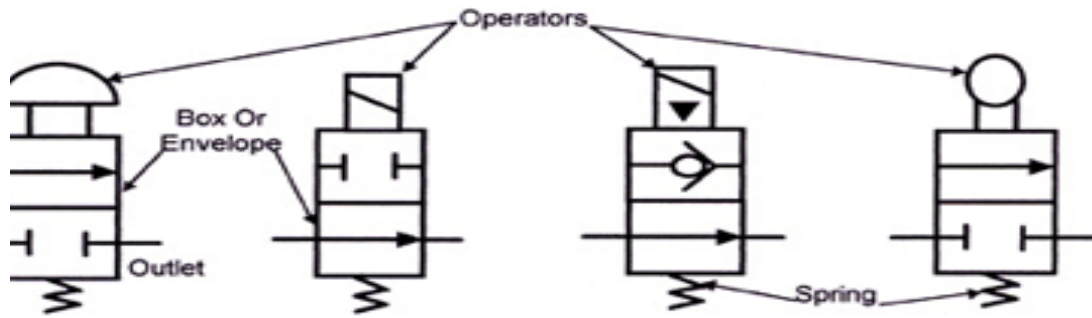


Figure 5 working of 2 Way solenoid valve

Figure shows a "normally open" (NO) 2-way directional valve. Energizing the solenoid on this valve stops fluid flow. Valve operators are available of different types. A solenoid pilot operator using solenoid-controlled pressure from the inlet port to maneuver the working directional spool cam-operated valve. A moving machine member usually operates this sort valve.

### 5.3 3-way directional control valves

A 3-way valve has three working ports. These ports are: *inlet*, *outlet*, and *exhaust* a 3-way valve not only supplies fluid to an actuator, but allows fluid to return from it also. Schematic symbols for 3-way directional control valves.

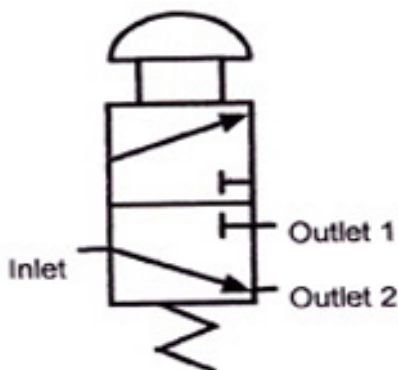


Figure 6 schematic symbol for 3-way DC Valve

In all-ports-blocked, 3-way, 3-position valve. A valve of this sort connected to a single-acting, weight- or spring-returned cylinder could extend, retract, or stop at anywhere within the stroke.

Some 3-way valves select fluid flow paths as in Figure. Use a spool-type valve for this operation. Another flow condition is that the diverter valve a diverter valve sends fluid to either of two paths.

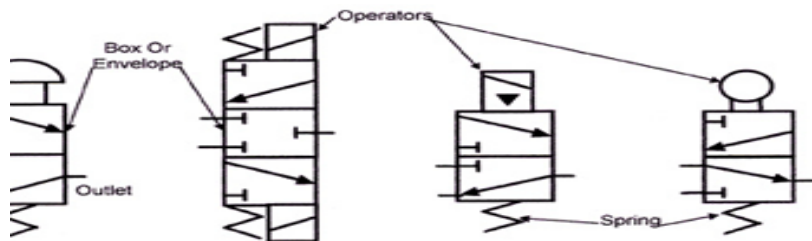
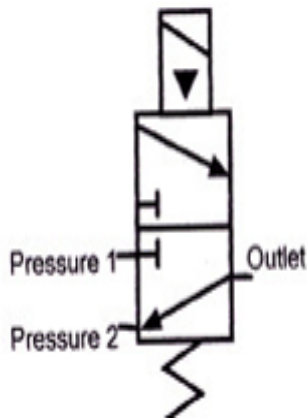


Figure 7 working of 3 Way DC valve



### 5.4 4-way directional control valves

It show different configurations available in 4-way directional control valves. They vary from the straightforward simple, two-position, single, direct solenoid, spring-return valve to the more complex three-position, double solenoid, pilot-operated, spring-centered, external-pilot supply.

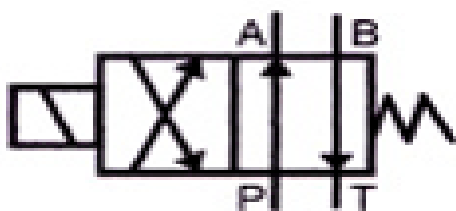


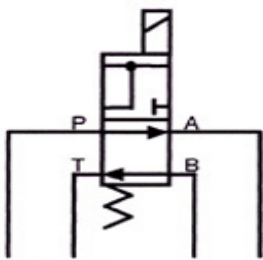
Figure 8 Symbol for 4 Way DC Valve

Lines to the boxes show flow to and from the valve, while lines with arrows within the boxes show direction of flow. The amount of boxes tells what percentage positions the valve has. Shows a single solenoid, spring-centered valve. This valve

features a third position but there's no operator for it. Use this spring-centered, single solenoid valve in control circuit. In the past, to urge this configuration, you simply had to wire one solenoid of a double-solenoid, three-position valve.

## 5.5 5-way directional control valves

Most spool-type air valves are available in a 5-way configuration. Because air usually exhausts to atmosphere, the additional exhaust port is not any problem. Many valves use the 2 exhaust ports for speed control mufflers. Mufflers not only make the exhaust quieter, but throttle the exhaust, which in turn controls cylinder speed during a meter-out circuit.



# 6

## COMPRESSORS

An **air compressor** is defined as a device that converts power into PE by using an electrical motor, diesel or internal-combustion engine, etc. The energy are often used for the variability of applications. Usually by utilizing the KE of the air it's depressurized

### 6.1 SORTS OF AIR COMPRESSOR

- 1) Reciprocating
- 2) Rotary screw
- 3) Centrifugal

#### 6.1.1 These types are future specified by:

- The number of compression stages

- Cooling method (air, water, oil)
- Drive method (motor, engine, steam, other)
- Lubricating (oil, oil-free where oil free means no lubricating oil contact the compressed air)
- Packed or custom -built

## 6.2 RECIPROCATING COMPRESSOR

A compressor which is generally a reciprocating compressor which is also known as positive displacement compressor and it is used to deliver gases which is produced by pistons that are driven by a crankshaft. The gas enters in suction manifold and then passes to compression cylinder where it gets compressed with the piston which is operating during a reciprocating motion. It is used in chemical plants, refrigeration plants Major field of application is that the blowing of plastic bottles made from polyethylene terephthalate (PET).

In the ionic liquid piston compressor many seals and bearings were removed within the design because the ionic liquid doesn't mix with the gas. Service life is about 10 times longer than a daily diaphragm compressor with reduced maintenance during use, energy costs are reduced by the maximum amount as 20%. The exchangers(heat exchangers) that are utilized in a traditional piston compressor are removed because the heat is removed within the cylinder itself where it's generated. Almost 100% of the energy going into the method is getting used with little energy wasted as reject heat

The compressor in single and double stage reciprocating compressor are commercially available

- Single stage compressor are generally used for the pressure within the range of 70 N/mm<sup>2</sup> to 100 N/mm<sup>2</sup>
- Double stage compressor are generally used for higher pressure within the range of 100 N/mm<sup>2</sup> to 250N/mm<sup>2</sup>



The reciprocating compressor is single acting when the compressing is accomplished using just one side of the piston. A compressor using each sides of the piston is taken into account double acting.

Load reduction is achieved by unloading individual cylinder typically this is often accomplished by throttling the suction pressure to the cylinder or by passing air either within or outside the compressor. Capacity control is achieved by varying the speed in engine-driven unit through fuel flow control.

Reciprocating compressor are available either as air cooled or water cooled in lubricated and non-lubrication configuration and supply a good range of pressure capacity selection



Figure 9 Reciprocating Air Compressor

### 6.3 ROTARY SCREW COMPRESSOR

A **rotary-screw compressor** is defined as a sort of gas compressor that uses a rotary-type positive-displacement mechanism. They're commonly want to replace piston compressors where large volumes of high-pressure air are needed,

either for giant industrial applications or to work high-power air tools like jackhammers

The gas compression process of a rotary screw is a continuous sweeping motion, so there's a very little pulsation or surging of flow, as occurs with piston compressors.

Since the cooling happens right inside compressor the working part never experience extreme operation temperature. The rotary compressor, therefore maybe a continuous duty part air is cooled or water cooled compressor package

Rotary screw compressor are easy to take care of and operation. Capacity control for these compressors is accomplished by varies speed and variable compressor displacement. For the latter control technique, a valve opens bypassing some of the compressed gas back to the suction. Advantage of the rotary screw compressor include smooth pulse-free air output during a compact size with high output volume over an extended life



Figure 10 Rotary Screw Compressor

Oil free rotary screw compressor utilizes special design air ends to compress air without oil within the compression chamber yielding true oil free air. Oil free rotating screw compressor are available air cooled and water cooled and supply the pliability as oil flooded rotaries when oil free air is required

## **Size**

Rotary-screw compressors tend to be compact and smoothly running with limited vibration, thus not requiring spring suspension. Many rotary-screw compressors are, however, mounted using rubber vibration-isolating mounts to soak up high-frequency vibrations, especially in rotary-screw compressors that operate at high rotational speeds. Rotary-screw compressors are produced in sizes that lies in pumping speeds from 10 cubic feet per minute to many thousand CFM. Rotary-screw compressors are typically utilized in applications requiring more airflow than is produced by small reciprocating compressors but is produced by centrifugal compressor

## **6.4 CENTRIFUGAL COMPRESSOR**

During a centrifugal compressor, energy is transferred from a group of rotating impeller blades to the gas. The designation “centrifugal” implies that the gas flow is radial, and therefore the energy transfer is caused from a change within the centrifugal forces working on the gas. Centrifugal compressors deliver high flow capacity per unit of installed space and weight, have good reliability, and need significantly less maintenance than reciprocating compressors. However, the performance characteristic of centrifugal compressors is more easily suffering from changes in gas conditions than is that the performance of reciprocating compressors. On this page, the performance characteristic function is presented with emphasis on process control of capacity by speed variation, suction throttling, or variable inlet guide vanes. Process control to avoid operation during a damaging surge condition is additionally addressed.

The physical size (diameter) of a centrifugal compressor is decided by the volumetric flow at the inlet. The compression ratio (or head) determines the amount of stages (length). The rotating speed of a centrifugal compressor is an inverse function of diameter to take care of a desired peripheral speed at the outer diameters of the impellers no matter the physical size of the compressor. Very

large (i.e., high-volume) flow compressors may operate at speeds as low as 3,000 rpm. Conversely, low-volume flow compressors may operate accelerates to 30,000 rpm. Power requirement is said to mass flow, head, and efficiency. Counting on the actual application, centrifugal compressor powers can range from as low as 500 hp (400 kW) to quite than 50,000 hp (40 MW).

At low volume flow rates, the width of the gas passages during a centrifugal compressor becomes narrow, and therefore the effects of friction become significant, leading to reduced efficiency. For this reason reciprocating compressors often are more appropriate for low-volume flow applications. For further discussion of this subject, see the section below on compressor selection

The API has produced an industry standard, API Standard 617, which is usually wants to govern the planning and manufacture of centrifugal compressors. A typical centrifugal compressor package is shown in **Fig. 1**. The compressor shown is mounted on a one base plate and is driven by an electrical motor.

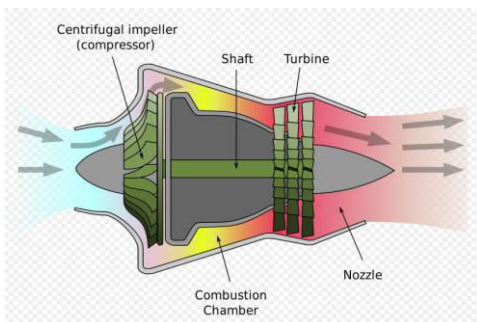


Figure 11 Centrifugal Compressor

## 6.5 LEVER SHEAR

A *bench shear*, also referred to as a *lever shear*, maybe a bench mounted shear with a compound mechanism to extend the mechanical advantage. It's usually used for cutting rough shapes out of medium sized pieces of metal sheet, but cannot do delicate work For the tiny shear, it mostly designed for a good field of applications. Light weight and easy efficient operation, yet very sturdy in construction. The cutting blades fitted are carefully and accurately ground to offer easy, clean quick cuts, and freed from burrs. These special features help the operators save a excellent deal of their energy. But some shearing machines can cut sheet bar and flat bar up to 10mm. It's electrically welded together to form it a sturdy stable unit capable to face upto highest stresses thanks to heavy duty usage. The footplates are reinforced with bracing angles in order that they provide firm stability to the shear. The machine is given with section knives with sliding blades which maybe be adjusted by hand to form 90 cuts on angles and T-sections of various sizes also with openings for cutting round and square bars.



Figure 12 Lever shear

## Working

The following figure shows general layout for the machine.

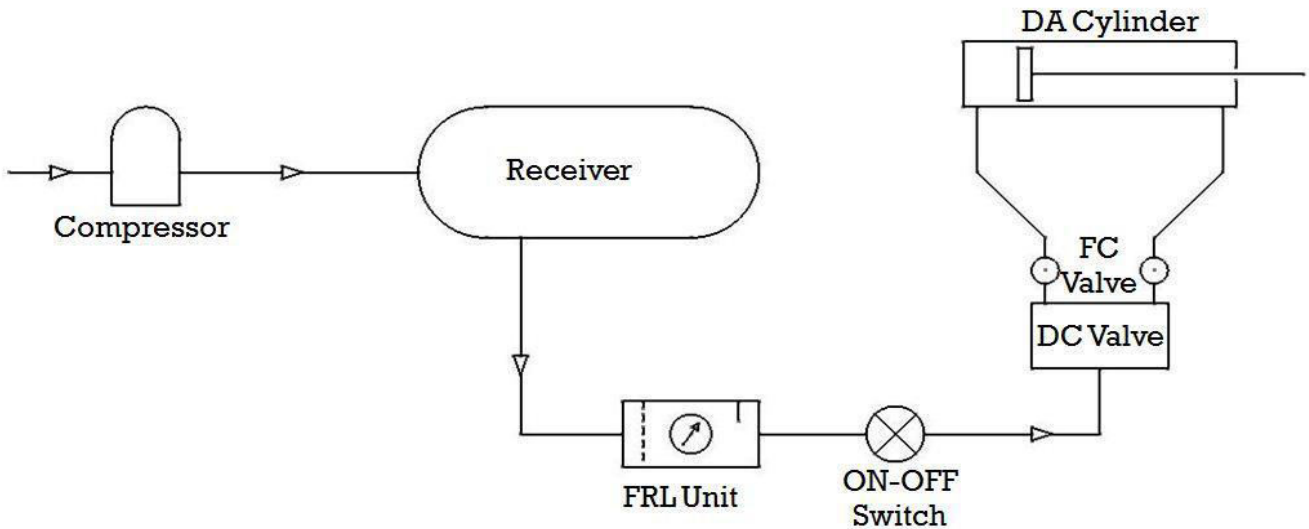
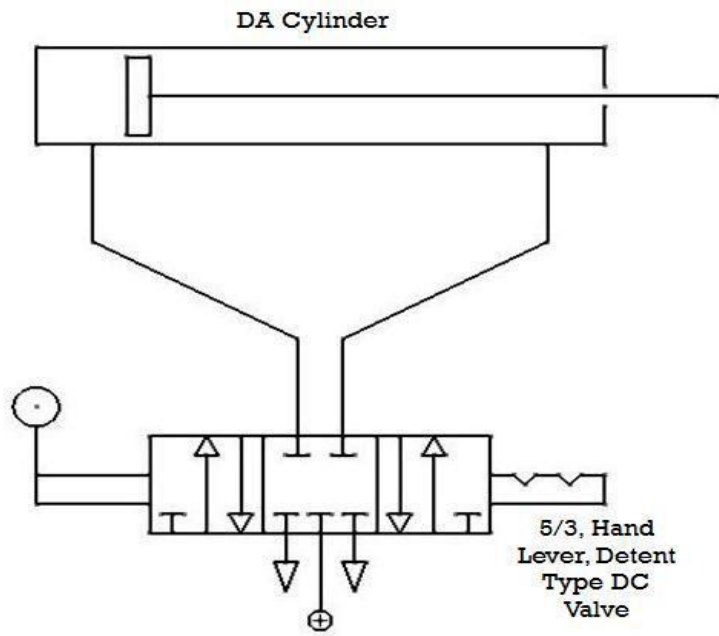


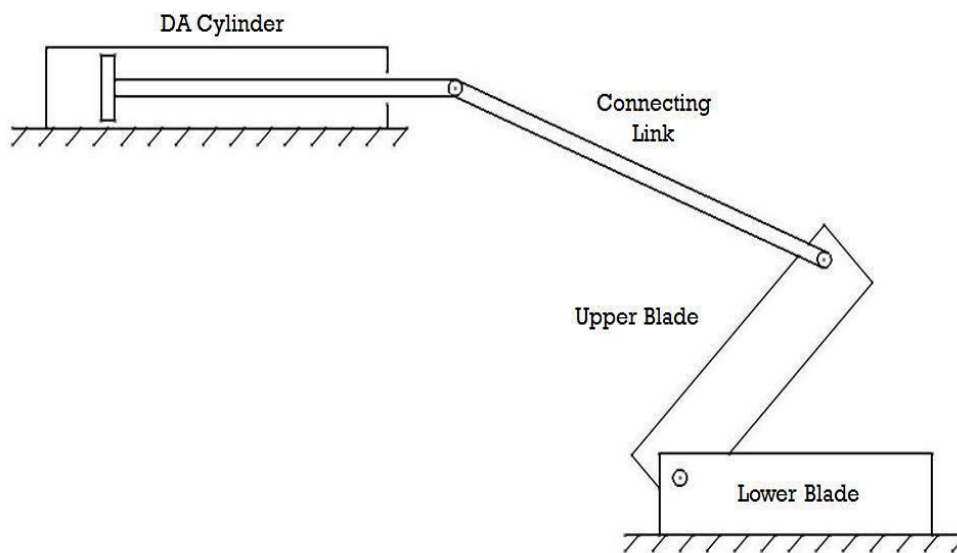
Figure 13 Pictorial Working of machine

When the air compressor is allowed to start and receiver tank pressure reaches to 8 bar. Then air is passed to the manifold via Filter regulator lubricator(FRL) which filters the gas and collects the impurities and it checks whether the air is suitable for industrial use or not. A separate supply is taken from the manifold to the machine and was provided with a ON/OFF switch, so that machine can be operated without interfering the working of compressor. Then the compressed air is transferred to direction control valve.

Position “A” depicts the non-actuated circuit diagram. In this position all ports are closed.



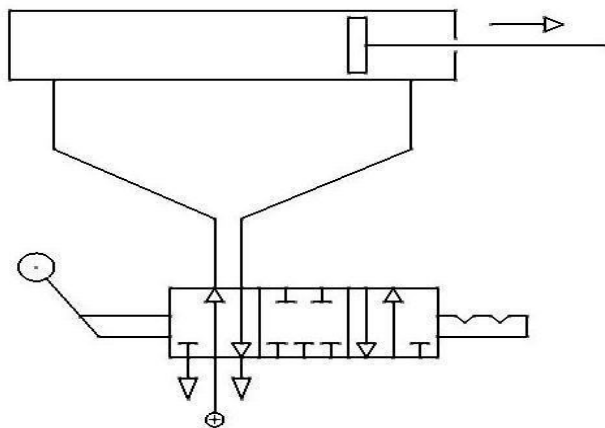
DC valve at position A



Initial position of piston in pneumatic cylinder

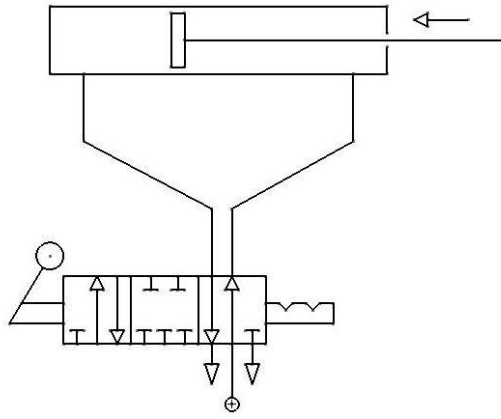
The Direction control valve is positioned at left hand side as shown in position “B” .In this condition cap port and pressure port get attached to each other and rod end port gets attached to exhaust port. Then the piston is pushed outwards as the compressed air enters in cap end port of the cylinder. The upper blade moves downwards because of the impact of force which is transmitted by the connecting link as piston moves outward.

When upper blade falls downward it generates stress between the metal sheet and this stress is beyond ultimate shear strength of metal.by which plastic deformation occurs and shearing of metal take place. Now direction control valve operates at “C”. rod end port and pressure port gets attached to each other and cap end port gets attached to exhaust port by which piston moves inward and blade moves upwards. In this time duration sheet metal is inserted again for further shearing operation. Both small and large pieces of sheet can be cut with this operation.

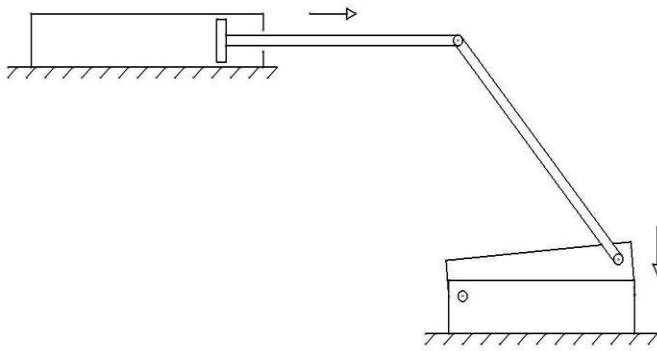


At position B, the DC valve is at left side





DC Valve at position C



Final Position of piston and blade



Figure 14 Modelling of pneumatic shearing machine

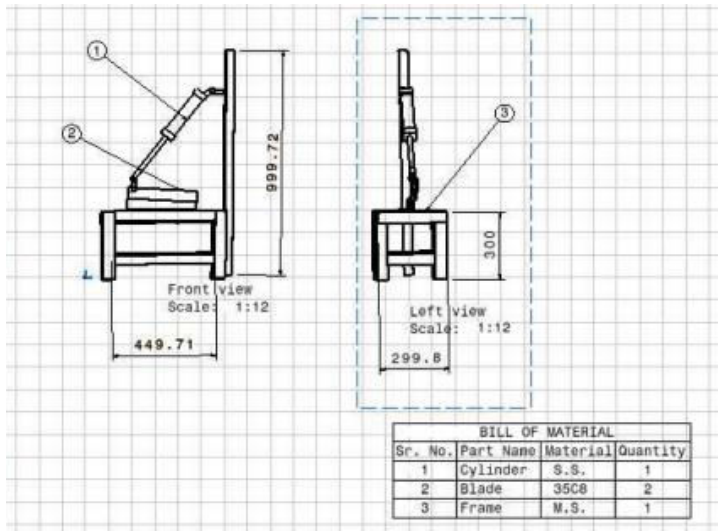


Figure 15 Drafting of pneumatic shearing machine

## Design Procedure

### 8.1 Material Selection

**To** construct or manufacture and machine component, material should be selected properly and should be studied thoroughly. All factors like design and safety should be considered. materials are selected on some of the basis which are:

Checking material availability

Whether material is suitable for the required component

Costing of material

Specification:

<b>METAL SHEET MATERIAL</b>	<b>ALUMINIUM</b>
<b>Thickness(T)</b>	0.6mm
<b>Length of cut(l)</b>	30mm
<b>Max. Shear Strength of Aluminum</b>	30 N/mm <sup>2</sup>

## 8.2 METAL SHEET CUTTING FORCE

Force required for shearing operation =  $l \times T \times z_{max}$

Stripping force = 10% - 20% of cutting force

$l$  = Length of edges to be cut in mm

$T$  = thickness of sheet in mm

$z_{max}$  = maximum Shear strength in  $\text{N/mm}^2$

$z_{max}$  = 80% of tensile strength

After substituting the following values we will get the required force for shearing operation:

Required force =  $30 \times 30 \times 0.6 = 540 \text{ N}$

## Merits and Demerits

- **Merits-**

1. Pneumatic is more preferred in this situation even when hydraulics system has more advantages, pneumatic is used in industry where there is usage of compressed air.
2. Oil and lubricants can be used to remove corrosiveness and friction can be reduced.
3. In some of cases compressed carbon dioxide is employed as compressed air in machine for shearing operations.
4. shearing operation is rapid.
5. Bending does not occur.

- **Demerits-**

1. To cut sheet having thickness more than 5mm is little difficult.
2. This system depends on compressed air only.
3. Safety major is concerned in this operation.

## **CONCLUSION**

We have created this project in order to reduce human work, increase cutting efficiency and to save time. Pneumatic shearing machine is cheaper as compared to other big machines. There are many industries which can't afford expensive hydraulic machines for them this is suitable option. This machine cuts metal sheet very efficiently and without any bending. We can cut sheet of more thickness by providing a compressor which can generate a high pressure and by providing hardened blades. We hope this project will have more contribution in mechanical world.

## REFERENCE USED:

- Lucien Diolot , Neuilly sur Seine “Shearing machine for continuous metal sheet” Socitie Nouvelle spidem, paris france march 11,1966
- Abhishek Gaonkar, Sahil Kerkar, NandanShirodkar, Vikesh Hadfadkar, “Design and fabrication of a shearing machine for glass fibre sleeves”, International Journal of Research in Engineering and Technology, 2015, eISSN: 2319-7308
- Mr. Rahul Ranjan, Mr. S. S. Solanki,“Automatic Sheet Metal Cutting Machine” Researchgate, 2016, International Journal of Advanced Engineering Applications, vol.1, Iss.4,pp.1-2
- M. Sorli, L. Gastaldi, E. Codina, S. Heras, Dynamic analysis of pneumatic actuators, Simulation Practice and Theory, 7, 1999,589-602
- Qiao Dongkai, Yang Xiangyu, Jia Jinxin, “The Application of PLC to CNC Machine Tools Development” Digital Manufacturing and Automation (ICDMA), 2011 Second International Conference on DOI: 10.1109/ICDMA.2011.299 Publication Year: 2011

❖ Manufacturing Process by Khanna and Lal.

### Internet Sites:

- a. <http://www.engineersedge.com/>
- b. <http://www.efunda.com/>
- c. <http://www.mechanicalengineeringblog.com/>

# Publication Details

Journal: IJSRD - International Journal for Scientific Research & Development

Vol. 8, Issue 1, 2020 | ISSN (online): 2321-0613

Paper name: Fabrication of Pneumatic Metal Sheet Cutting Machine

*IJSRD - International Journal for Scientific Research & Development* | Vol. 8, Issue 1, 2020 | ISSN (online): 2321-0613

## Fabrication of Pneumatic Metal Sheet Cutting Machine

Tushar Saxena<sup>1</sup> Arun Kumar<sup>2</sup> Abhishek Tiwari<sup>3</sup> Rishu Tomar<sup>4</sup> Abdul Gani<sup>5</sup>

<sup>1,2,3,4</sup>Student <sup>5</sup>Assistant Professor

<sup>1,2,3,4,5</sup>Department of Mechanical Engineering

<sup>1,2,3,4,5</sup>Galgotias University, Gr Noida, India

**Abstract**— The main objective of this work is to tell the importance of Pneumatics in our world. So we have proposed a machine which can cut sheets of metal (Aluminium) of different width with the help of Pneumatic. The main objective of this project is to fabricate a machine which can reduce human effort, achieve good surface finish, reduce process time and is cost efficient.

**Keywords:** Pneumatic Metal Sheet Cutting Machine, Fabrication

### I. INTRODUCTION

When it comes to Industry then sheet metal is the most important part of it. This machine should be used for straight cutting machine with wide application, though some other industries also use hand cutter which is operated manually, to use hand sheet cutter man work is required and accuracy is less, so we have developed a machine which can cut pieces of sheet with the help of pneumatics, this increases the accuracy and reduce the man work in operation. Sheet metal operations are generally performed in every mechanical industry, hence this machine is a good alternate to those hand cutters.

In shearing operation, as the upper blade decline downwards upon the metal, the pressure developed and exerted by the blade first causes the plastic deformation of the metal. Since the clearance between the blade and the die is very small, the plastic deformation takes place in a local area and the metal is cut along the cutting edge of blade.

### II. LITERATURE REVIEW

Sheet metal shearing is one among the foremost wide applied sheet metal operations. The understanding of the bending mechanics is aimed towards obtaining two forms of data vital for industrial applications. The primary one is that the spring back prediction for die style and shape management. The second is an estimation of the bend force for selection of press capacity, strength analysis and design of dies. Vallance and Matlock (1992) studied the friction behavior of zinc-based coated sheet steels and laboratory scale friction analysis techniques that involve sheet slipperiness over cylindrical dies. Wenzloff et al (1992) introduced a new check procedure for the bending beneath tension friction check. Mai Huang and Gardeen (1994) bestowed a literature review of the spring back of doubly curved developable sheet metal surfaces and provided a bibliography on the spring back in sheet metal forming. Reviewing the literature, it is found that researchers have been studying the phenomenon of spring back for nearly six decades. There have been diverse efforts to evaluate and/or decrease spring back in the sheet metal forming industry for a long time. Perduijn and Hoogenboom (1995) derived an simple specific bending couple curvature relation for small and larger curvatures and they verified the model with

experimental results. A simple approach for calculating bendability and spring back in bending based on the normal anisotropic value, strain hardening exponent and sheet thickness has been presented as delineate elsewhere by Daw Kwei Leu (1997).

You-Min Hang and Daw-Kwei leu (1998) showed the affects of process variables like punch radius, die radius, punch speed, friction coefficient, strain hardening exponent, normal anisotropy on V-die bending process of steel sheet. Sanchez (1999) focused on a systematic analysis of testing equipment as a measurement system of the friction phenomena on sheet metal under plane strain. It describes experimental references in order to optimize the usage of lubricants and sheet metal. Weilong Hu (2000) describes anisotropy hardening models with simple loading conditions that include exponential hardening model, linear hardening model and multi linear hardening model. Samuel (2000) studied the spring back in axisymmetric U-bending processes with a finite element program and discussed the effect of tool geometry and blank holder force on the final shape after spring back.

Aleksy et al (2001) conducted experiments on spring back for dual phase steel and conventional high strength steel for a hat channel section with varying cross sections. They delineate the methodology of experiments and mentioned spring back related results. Livatyali and Altan (2001) presented experimental investigation to determine the effect of die corner radius, punch radius, punch-die clearance, pad force and sheet material on spring back in straight flanging. Leo De Vin (2001) described the problems related to an oversimplification of the air bending process and explained the consequences of applying models, standards or thumb rules. Streppel et al (2001) performed the experiments on air bending that address the required punch displacement and the sheet length correction. Draw bend test for various die radii, friction coefficients and tensile forces was conducted by Cardeen (2002).

Zafer Tekiner (2004) examined the springback of sheet metals with various thicknesses and properties in bending dies. Carlos Gomes et al (2005) investigated the variation of spring back in high strength steels based on experimental and numerical analysis. Ihab Ragai et al (2005) discussed the effect of sheet anisotropy on the spring back of stainless steel 410 draw bend specimens and lubrication. Ozgur Tekaslan et al (2006) carried out the experiment to determine spring back of steel sheet with Vshaped die. Dongye Fei and Peter Hodgson (2006) investigated the spring back behavior of cold rolled transformation induced plasticity (TRIP) steels in air vbending process.

In shearing or cutting operation as or blade falls downwards upon the metal, the pressure produced by the blade first cause the plastic deformation of the metal. Since the clearance between the two blades is very small, the plastic deformation takes place in a localized area and the