

# Fabrication and Review of Hydraulic Heavy Sheet Metal Cutting machine

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**ABSTRACT:** This machine is for sheet metal industry and can be made into multiple machines and should be used as circle cutting cum straight cutting machine. The machine is simple to maintain easy to operate. Hence we tried out hands on Hydraulic Shearing Machine in shearing operation as the punch descends upon the metal, the pressure exerted by the punch first cause the plastic deformation of the metal. Since the clearance between the punch and the die is very small, the plastic deformation takes place in a localized area and the metal adjacent to the cutting edges of the punch and die edges becomes highly stressed, which causes the fracture to start on both sides of the sheet as the deformation progresses. The idea of the project generated due to a manual sheet metal shearing machine in workshop of our college. In that machine sheet metal is placed in between the two shearing blades of machine and the lever is pulled down to move the upper movable blade and cut the work-piece.

**Keywords-** Hydraulic system, Solenoid Valve, Modeling in NX-CAD, Hydraulic cylinder

## 1. INTRODUCTION

Hydraulic machines are machinery and tools that use liquid fluid power to do simple work. Heavy equipment is a common example. In this type of machine, hydraulic fluid is transmitted throughout the machine to various hydraulic motors and hydraulic cylinders and which becomes pressurized according to the resistance present. The fluid is controlled directly or automatically by control valves and distributed through hoses and tubes.

The popularity of hydraulic machinery is due to the very large amount of power that can be transferred through small tubes and flexible hoses, and the high power density and wide array of actuators that can make use of this power. Hydraulic machinery is operated by the use of hydraulics, where a liquid is the powering medium.

Types of shearing Machine:

Sheet metal Cutting machines are classified according to the following:

- 1) Pneumatically operated
- 2) Hydraulically operated
- 3) Rack and pinion operated

## 2. DESIGN PROCEDURE

### 2.1 MATERIAL SELECTION

To prepare any machine part, the type of material should be properly selected, considering design, safety. The selection of material for engineering application is given by the following factors:-

- 1) Availability of materials
- 2) Suitability of the material for the required components.
- 3) Suitability of the material for the required components.
- 4) Cost of the materials.

The machine is basically made up of mild steel. The reasons for the selection are Mild steel is readily available in market. It is economical to use and is available in standard sizes. It has good mechanical properties i.e. it is easily machinable. It has moderate factor of safety, because factor of safety results in unnecessary wastage of material and heavy selection. Low factor of safety results in unnecessary risk of failure. It has high tensile strength. Low Coefficient of thermal expansion.

The materials of the sheets to be cut are taken as aluminum and plastic as they are replacing many metals in the present scenario because of their distinguished properties and features.

Table 1: Specifications

SHEET METAL MATERIAL	ALUMINIUM, MILD STEEL
THICKNESS	10 mm
LENGTH OF CUT	30 mm
Max. SHEAR STRENGTH OF ALLUMINIUM	30N/mm <sup>2</sup>

**2.2 FORCE CALCULATION**

Force required to cut the Sheet = L\*t\*Tmax

For sheet 10 mm thickness

Force required = 25×10×30= 7500N

This is the force required to cut the sheet metal, however the initial force required to cut the sheet is more and it is 140-150% than we calculated, Therefore, max force required to cut the sheet = 10500 –11250 N.

**2.3DESIGNING OF CYLINDER**

The hydraulic cylinder is a device that converts the energy of fluid into mechanical energy. The fluid is pumped into the cylinder by means of a pump and it can be used to move a load. The size of the cylinder determines the amount of load that can be handled by it Major parts of a hydraulic cylinder

1. Piston
2. Cylinder

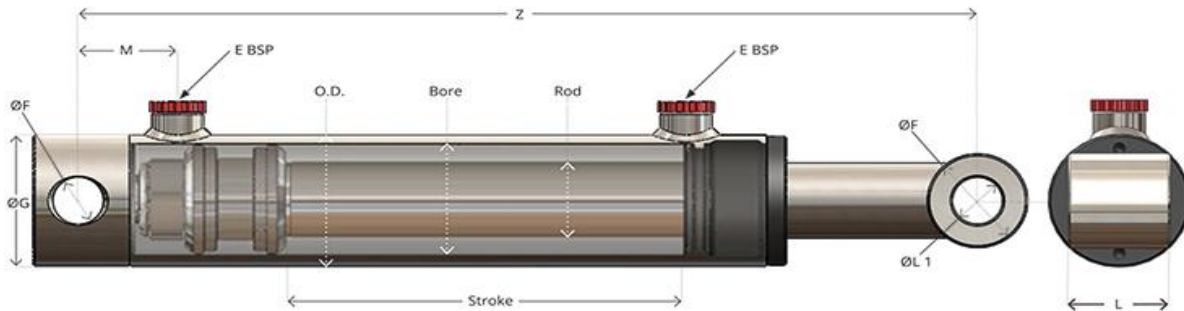


Fig 1 hydraulic cylinder

Since the max force required to cut the sheet = 11250 N

And pressure applied by gear pump =125 bar

Therefore,

Force applied by the cylinder,

$$F = (\pi/4) \times d^2 \times p$$

$$11250 = (\pi/4) \times d^2 \times (125/10)$$

$$\rightarrow d = 33.3 \text{ mm}$$

For safety, we have taken the cylinder of diameter 40 mm.

Bore of the cylinder 80 mm.

**2.4 SOLENOID VALVE**

A solenoid valve is an electromechanically operated valve. The valve is controlled by an electric current through a solenoid: in the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design. Besides the plunger-type actuator which is used most frequently, pivoted-armature actuators and rocker actuators are also used.

The valve body must be compatible with the fluid; common materials are brass, stainless steel, aluminum, and plastic.

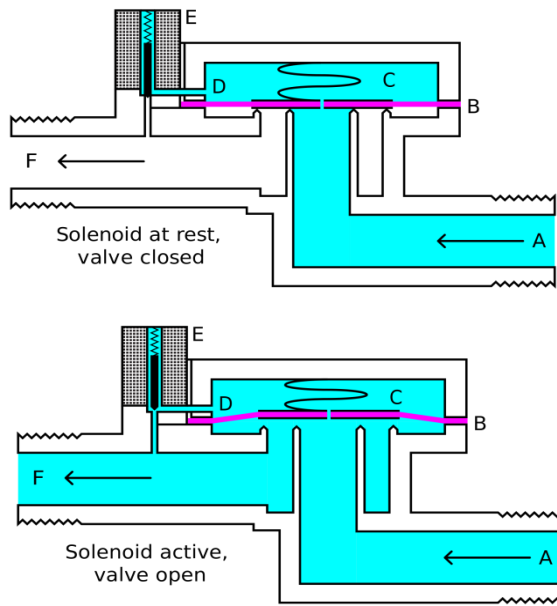


Fig 2- solenoid valve

**2.5 HYDRAULIC OIL SELECTION**

High performance hydraulic oil with optimal anti-wear properties (AW-Additives) and high load capacity of the lubrication film. Its excellent oxidation resistance delivers good performance at higher temperatures and extended operating intervals. Antioxidants and corrosion-inhibitors, high pressure absorption, good ageing and temperature resistance, no foam absorbance, good demulsification. Neutral toward ferrous metals and almost all nonferrous metals, wristbands and gasket-materials. Hydraulic systems containing gears and bearings where good anti-wear properties are required, where wide ambient temperatures are encountered, even under the influence of water.

So hydraulic oil HLP 68 suitable for given properties.

Table 2 –HLP 68 specification

Typical characteristics	value
Viscosity at 40°C	68 mm <sup>2</sup> /s
Viscosity at 100°C	8,7 mm <sup>2</sup> /s
Specific weight at 15°C	883 kg/m <sup>3</sup>
Viscosity index	100
Flash point COC	250°C
Pour point	-24°C
TAN(total acid number)	0,2 mgKOH/g

**2.6 SELECTION OF HYDRAULIC PUMP**

A hydraulic pump is a mechanical source of power that converts mechanical power into hydraulic energy (hydrostatic energy i.e. flow, pressure). It generates flow with enough power to overcome pressure induced by the load at the pump outlet. When a hydraulic pump operates, it creates a vacuum at the pump inlet, which forces liquid from the reservoir into the inlet line to the pump and by mechanical action delivers this liquid to the pump outlet and forces it into the hydraulic system.

Factor to be considered for selection of hydraulic pump is following:-

1. Pressure
2. Discharge
3. Speed
4. Volumetric efficiency

Types of pumps	Pressure	discharge	speed	Volumetric efficiency
Gear pump	35 to 200 bar	400 lit/min	1200 to 2500 rpm	85 to 95%
Vane pump	70 to 140 bar	200 lit/min	1200 to 1800 rpm	90 to 95%
Piston pump	140 to 850 bar	1000 lit/min	1200 to 3000 rpm	95 to 98%

Table .2 specification of pump

### 3. WORKING PRINCIPLE

In this machine, the hydraulic oil from the reservoir is cleaned by filter and sucked by the pump when driven by motor. The pump increases the pressure of oil high pressure oil is then passed through the pressure relief valve to drain excess press. Now oil is circulated to the direction control valve to the actuator. The pressure of 120 to 125 bar is passed through a pipe connected to the Solenoid valve with one input.

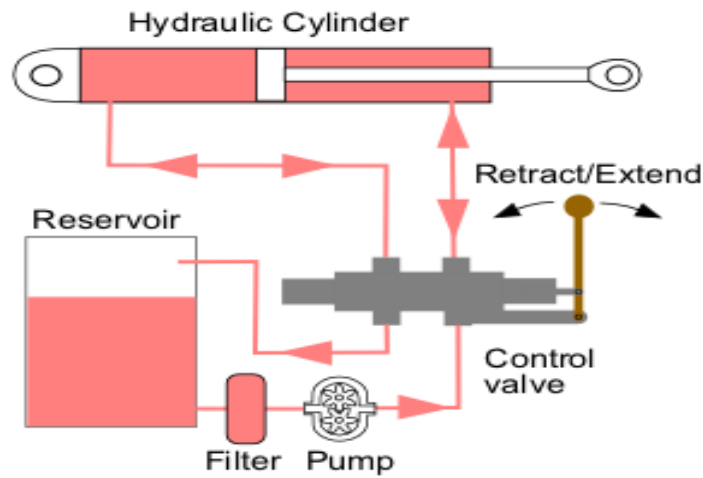


Fig 3-Hydraulic system working circuit

The oil moves to piston and rod to give output required force. The actuator connected to blade or high strength cutter which utilizes the force to performing the cutting work. The oil from relief valve and outlet of the actuator is transferred to the reservoir through drain line and recirculate in hydraulic system.

Hydraulic system using the on-off type or logic control device to its control objective is to maintain the stability of value to be transferred or simple changes of direction, also called the order of valuation and control components.

Hydraulic control system using the servo-control components, with the feedback structure, and control of electrical devices, a higher control accuracy and response speed, the constant pressure and flow control of continuous change. Output power can be enlarged.

Hydraulic circuit is the basic hydraulic components and accessories by some posed by a specific function to complete the loop.

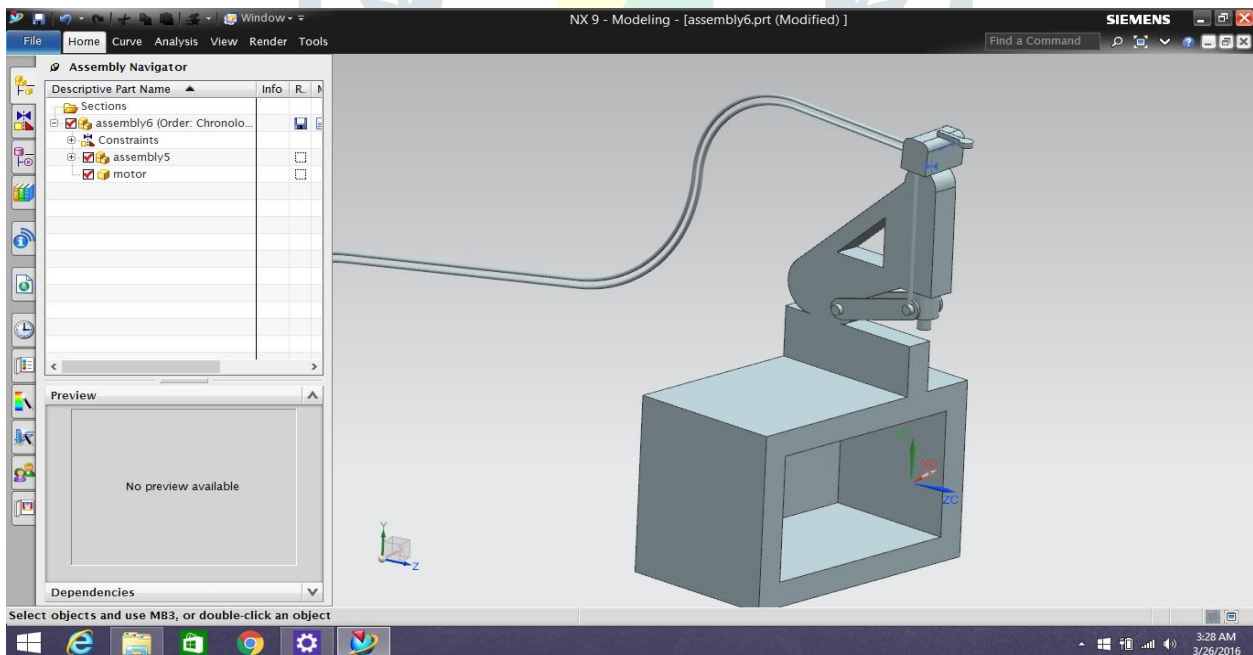


Fig 4- Drawing in NX cad

#### 4. WORKING MODEL OF PNUMATIC AUTO SHEET METAL CUTTING MACHINE



#### 5. CONCLUSION

Now we know that hydraulic Shearing machine is very cheap as compared to other shearing machine. The range of the cutting thickness can be increased by arranging a high capacity cylinder and this machine is advantageous to small sheet metal cutting industries. Hence it gives accurate cut to sheet metal as compared to conventional metal cutting machine. Thus it can be easily replaceable to conventional one.

#### 6. FUTURE SCOPE

In this machine, we develop more and more modified technique with increasing the aesthetic look and economic consideration. But being the degree Engineers and having the ability to think and plan. But due to some time constraints, and also due to lack of funds, we only have thought and put in the report the following future modifications:-

It can be made to run has bottle cap sealing machine. The stationary platform can be made auto swiveling type by installing the timer and heat sensor arrangement on the platform. It can be done such that when the bottle mouth is sealed up to the desired temperature the electrical heater circuit gets cut off. At the same time the motor installed on the reduction gear box starts operating the bevel gearing and the platform starts rotating thus it can be made auto rotating type.

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