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# SIMPLE PRESS TOOL DESIGN AS A SUPPORTING TOOL FOR FORMING PLATES WITH A THICKNESS OF 3 MM

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***Abstract***

*The press tool is one of the combined Jig and Fixture tools that can be used to form and cut metal by means of emphasis. The working process of this tool is based on the compressive force passed on by Punch to cut or shape the workpiece according to the desired geometric and size. This research aims to design a cutting machine for sheet metal forming processes that are able to improve the production process in industry. In this study, the author designed the components of a progressive type presstool machine in the process of making clamps with a thickness of 3mm with software inventor design media. Includes components shanks (St.60), top plate (St.60), bearing locator (St.40), bottom plate (St.60), punch (SKD-11), dies (SKD-11), pillar shaft (St.40), spring (St.40). Analysis of calculations carried out in this study produces a cross-sectional area of the shear field (132mm2), shear voltage (32 kg/mm2), Formation style (4,224kg), presstool engine power (1267.2 watts/168.9688 HP). Press tools are designed to make clamps made of steel plates with a thickness of 3 mm. From the design results obtained the dimensions of the tool as follows the length of 450 x 400 x 542 mm. The results of press tool type of precision equipment used to form or cut workpiece materials according to needs and to increase production in industry.*

***Keywords:*** *Design, machine presstool*

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## Introduction

The development of science and technology encourages the creation of a product that is new and has good quality. In the manufacturing industry this is a very important problem because in the manufacturing process there are many obstacles that must be solved in order to create a high quality product.

Sheet metal forming is a process that aims to cause plates or materials to undergo plastic deformation so that components of the desired design are formed. The use of sheet metal forming is an effective forming technique because it can replace machining and welding processes. Components produced by sheet metal forming from very simple shapes to complex and small shapes as needed by the electronics industry and produce large components such as car bodies in the automotive industry. There have been several who have conducted research or designed the Press Tool.

We need a tool that functions to produce a component product on plates that is more effective, such as the process of making clamps with a thickness of 3 mm with good accuracy and can be accepted in the market so that they can be used in the community. Then a tool was designed to assist in the manufacturing process in the field of forging, namely a press tool.

## Definition of Press Tool

The press tool is a combined Jig and Fixture tool that can be used to shape and cut metal by means of pressure. The upper part of this tool is supported by the upper plate as a tool for holding and guiding the Punch which functions as a Jig, while the lower part consists of a bottom plate and Dies as a support and guide for the workpiece which functions as a Fixture. The working process of this tool is based on the compressive force that is transmitted by the Punch to cut or shape the workpiece according to the desired geometry and size. This equipment is used to make products in bulk with the same output product in a relatively short time.

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**Classification of Press Tools**

Judging from its working principle, this tool can be classified into three types, namely:

**Simple Tools**

The Simple Tool is a simple press tool designed to do only one type of work at a single work station. In operation, only one type of cutting or forming is performed, for example, only blanking or bending.

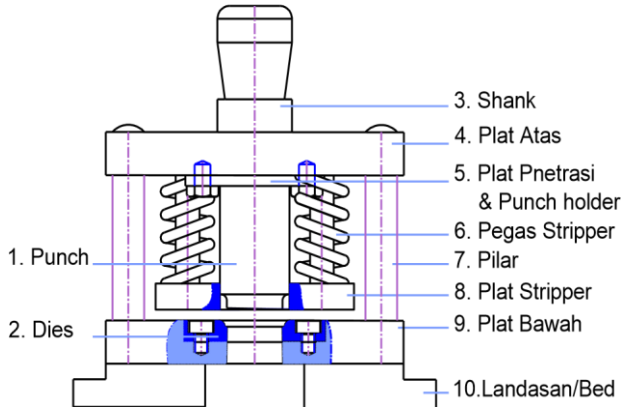
Advantages of simple tools:

1. Can carry out certain work processes in a short time.
2. The construction is relatively simple so that the manufacturing **process is easy.**
3. Produce more guaranteed product quality.
4. Easy to assemble.
5. The price of the tool is relatively cheap.

**Disadvantages of Simple Tools:**

1. Only capable of carrying out machining processes for simple products so that for complex machining types this press tool cannot be carried out.
2. only one type of processing can be done.

The example of a simple tool type machine image is in the picture




*Gambar Simple Tool [Budiarto, SST, 2001]*

**Classification of Machining Processes**

A tool that moves relative to the workpiece produces chips while the workpiece gradually shapes into the desired component. The chisel is mounted on a type of machine tool and can be one of various types of chisels/cutting tools which are adapted to the cutting method and the final product shape. Then it can be classified into 2 types of chisels, namely Single Point Cutting Tools and Multi Point Tools.

The relative motion of the chisel to the workpiece can be divided into two types of movement components, namely the cutting movement and the feeding movement. According to the type of combination of motion, cutting motion and feeding motion, the machining processes are grouped into seven types of processes

**Pneumatic system**

Pneumatic is an automation system that utilizes compressed air as an intermediary medium. The required compressed air is obtained from a compressed air storage tank produced by the compressor. Pneumatic systems are sometimes combined with other automation systems such as hydraulic, electrical and PLC automation systems to obtain control according to industrial requirements. Pneumatic devices work by utilizing compressed air. In this case the compressed air will be distributed to the existing system so that the system capacity is met. To meet the needs of compressed air we need a compressor (compressed air generator). The piston force generated by

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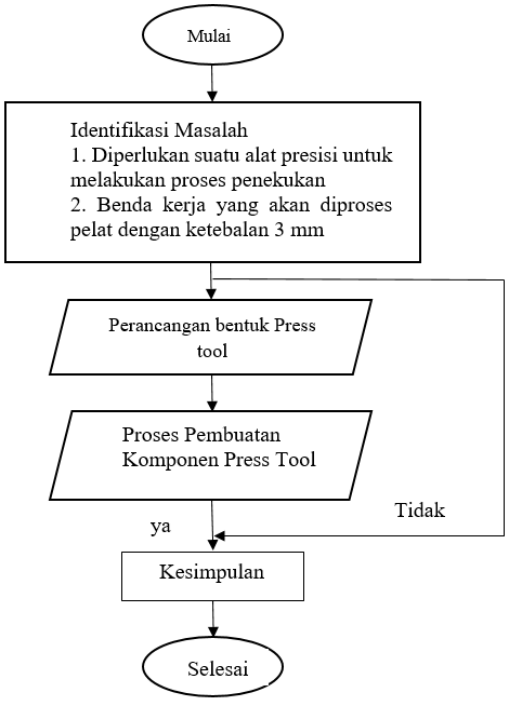
the cylinder depends on the air pressure, cylinder diameter and frictional resistance of the sealing components. The theoretical piston force is calculated according to the following formula: $F = A.\ p$
Description: F = Piston force (N)
D = Diameter of the piston (m)
d = Diameter of piston rod (m)
A = Piston cross-sectional area ($m^2$)

## Research Method

### Design flow chart

The design process is a process where the object to be made must be designed in such a way both in terms of images and in terms of dimensions so that it can be made with existing technology.




### Press Tool Design

The analysis in this study is to determine the specifications of the press tool which includes the press tool material, dimensions, cutting force, power and forming force.

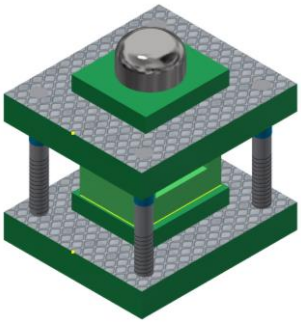


Figure Press Tool Design

**Component Design and Manufacture Criteria**

A tool designed to facilitate a job and minimize production time. The procedure for completing a design is as follows:

1. Needs. In designing a machine or tool, the need must be clear in advance so that when the machine or tool is made it can help the productivity of the product produced.
2. Mechanism, Choose a mechanism that is simple but has good reliability.
3. Force analysis, determine the action force on each part and the energy transmitted to the machine part.
4. Material selection, select the appropriate material for each part of the machine that matches the needs.
5. Design the elements, determine the shape and size of the machined parts taking into account the forces acting on the machine elements and the stress allowed for the material used.
6. Modifications. Consider the shape of the machine or tool so that it can be modified to increase the productivity of the tool.
7. Detailed drawings, Create complete and correct drawings so that others can understand them.
8. Production, machine components that are made can be processed by the machine according to the drawings.

**Results and Discussion**

The designed press tool is of a progressive type, in which some of the components are made using a machining process and some are given because there are already standards on the market.

**Data and Discussion**

The components of the presstool machine that are designed include the following components:

1. Shanks
2. Punches
3. Pillar shaft
4. Spring
5. Topplate
6. Bearing locator
7. Dies/moulds
8. Bottom plate
9. Materials resulting from the forming process

Forming process material (St 37)

The material resulting from the forming process is in the form of pipe clamps, with a forming length of 18mm, width of 12mm.

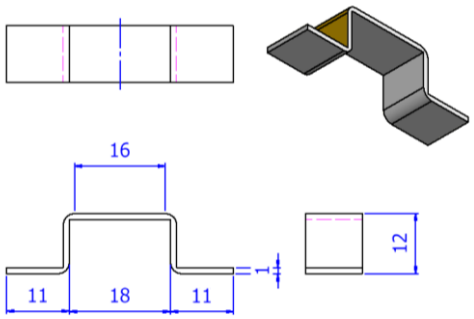



Figure The material resulting from the forming process is in the form of clamps

**Calculation Analysis**

In planning this Press Tool machine the material to be used is AISI 1025. The cutting force needed to form a component like the shape above and made of steel material with σu = 37 kg/mm2 and having a thickness of 1 mm is as follows:

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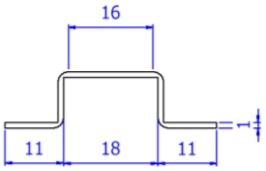


The maximum size of the forming process is:
t=1 mm
The cross-sectional area of the shear plane is:
A = p x l
= 11. 12
= 132 $mm^2$
The plate material is made of AISI 1025 material with a tensile stress of 37 kg/mm2 so that the allowable shear stress is:
τ = 0.8 x σu
= 0.8 x 37 kg/mm2
= 29.6 kg/mm2
The force required for shaping is
F = τ x A
= 29.6 x 132 mm2
= 3907.2 kg
= 38316 N
The power required to drive the cutting force is
P = F x V
P = Press Machine Power, (watts)
F = Forming Force, (N)
V = Punch Down Speed (m/s)
P = 38316 N x 0.003 m/s
= 1267.2 watts
= 1.26 kW
= 114,948 HP
This applied force will create a "shear stress" in the shear area, and if the shear stress exceeds the magnitude of the "shear strength" of the material or the shear fracture limit, then the cut occurs.
The material used for the Punch is SKD 11 (σu = 77.3 kg/mm2). So that the Punch strength against shear stress is

τ = 0.8 x σu
= 0.8 x 77.3 kg/mm2
= 61.84 kg/mm2
The shear stresses that occur during the plate forming process are:
τ=F/A
In this case :
F = blanking process force = 3,907.2 kg
A = Cross-sectional area of shear = 132 mm2
So : τ=3907.2/132=29.6 kg/〖mm〗^
Check: τ (61.84 kg/mm2) > τ (29.6 kg/mm2)
So the material for Punch is safe to use.
Piston effect force
The pneumatic system on the plate bending machine can work as needed, by using pneumatic cylinders with a diameter of 25mm and 35mm.

The theoretical piston force generated by the cylinder is:

$$F = A.\ p$$

where: F = Piston force (N)
A = Piston cross-sectional area (m2) = ( п/4 (0.025) 2) = 0.000491 $m^2$
p = Working pressure (Pa) = 6 bar = 600000 Pa
D = Piston diameter (m) = 25 mm = 0.025 m
Then the theoretical piston force is: F = 0.000491 x 600000 = 294.4 N

**Conclusion**

Press Tool Is a type of precision equipment used to shape or cut the workpiece material as needed. The designed press tool is used to make clamps made of steel plates with a thickness of 3 mm. From the design results, the dimensions of the press tool are obtained as follows: 450 x 400 x 542 mm in length. Materials for making components of the designed press tool are:
1.Shank St 60
2. SKD Punch 11

3. St 40 Pillar Axle
4. St 40 spring
5. Top Plate St 60
6. Bearing Locator St 60
7. Anniversary of SKD 11
8. Bottom Plate St 60
9. Material resulting from the St 37 forming process

This design process uses a tool that is software inventor used to draw. The manufacturing process for this tool uses machining processes such as turning processes, milling processes, drilling and welding processes. The calculation results obtained are a shear stress of 29.6 kg/mm2, a blanking force of 38316 N (Newtons), and a presstool engine power of 114.948 HP.

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