DESIGN OF PROGRESSIVE TOOL FOR EXHAUST MANIFOLD GASKET

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Abstract -

The design of a progressive tool developed for the efficient installation of exhaust manifold gaskets. The progressive tool aims to enhance the assembly process by reducing production time and improving overall product quality. Exhaust manifold gaskets are crucial components in automotive engines, ensuring airtight sealing between the engine block and the exhaust manifold. Traditional methods of installing these gaskets involve manual handling, which can be time-consuming and prone to human error. To address these challenges, a progressive tool has been designed to automate and streamline the installation process. The progressive tool incorporates a combination of mechanical and pneumatic mechanisms to achieve efficient gasket installation. It consists of multiple stages, each designed to perform a specific task in the assembly process. The tool is equipped with adjustable clamping mechanisms, ensuring proper alignment and secure positioning of the gasket during installation. The design of the progressive tool focuses on ease of use, reliability, and precision. It utilizes ergonomic features to facilitate operator comfort and minimize fatigue during prolonged use. Additionally, the tool incorporates safety mechanisms to prevent accidents or damage to the gasket or surrounding components.

Key Words:

1. INTRODUCTION

Press tools are specialized equipment used to make many identical parts out of thin sheets of metal. The specific design and configuration of a press tool determine the type of operations it can perform, such as blanking, bending, piercing, forming, drawing, cutting off, and more. These operations are used to shape the metal sheets into various components for different industries like food processing, packaging, defense, textiles, automobiles, and aircraft.

When the metal thickness is less than 6mm, it is typically referred to as a strip. Blanking is one of the operations where a flat component of a specific shape is produced. In blanking, the outer shape of the desired component is cut out, and the cut-out piece is called a blank. The press tool used for blanking is called a blanking tool. Similarly, there are piercing tools for piercing operations and other types of tools for different operations.

Press operations find wide applications in manufacturing industries. In this context, the design, materials, manufacturing processes, and calculations involved in press tool design are important to learn. In a practical example, a simple blanking press tool is designed and a prototype is manufactured. The desired output in this case is a circular piece with a diameter of 20mm. The press machine used for this purpose is of the mechanical type.

The design of the progressive tool focuses on ease of use, reliability, and precision. It utilizes ergonomic features to facilitate operator comfort and minimize fatigue during prolonged use. Additionally, the tool incorporates safety mechanisms to prevent accidents or damage to the gasket or surrounding components.

Extensive testing and validation have been conducted to verify the effectiveness of the progressive tool. The tool demonstrated improved productivity by reducing assembly time, minimizing errors, and enhancing overall product quality. Furthermore, it exhibited compatibility with various exhaust manifold gasket sizes and designs, making it versatile for different automotive applications.

2. CALCULATION

Design Calculations: -

Acceptable economy factor is greater than 60%.

Economy factor (E) in %

= Area of the blank x number of rows(N) x100

= W x P

Where,

W= Width of strip

Pitch= Distance between two successive

Area of blank =2132.4sq.mm

First Developed strip layout for Exhaust Manifold.

Wide Run:

P=27, W=100, N=1

Economy factor (E) in % = 78.97%

Economy factor (E) in % = 2132.4x 1 x100

= 27x100

=78.97%

Cutting Clearance and Sizes for Punch and Die

Cutting clearance = $C \times t \times \sqrt{cmax}$ 10

C=constant

= (.01 for precision and 0.005 for accurate) t

= thickness of sheet

= 1mm

Tmax = Ultimate shearing stress =400N/sq.mm

Steel grade 304 stainless steel is used for product having ultimate shearing stress is 400 N/sq.mm.

Cutting clearance = 0.01 × 2 × √400 10

Cutting clearance = 0.1264mm which nearly equal to .13 mm.

Cutting clearance for component will be.1264mm.

1. **For Piercing Operation**

   Size of Punch = Size of Hole

   Size of Die = Size Of punch + 2c

2. **For Blanking Operation.**

   Size of Die = Size of Blank Size of

   Punch = Size Of die –2c

Calculating Cutting/ Shearing Force:

Shearing Force, = L x t x τ_{max}

Where,

L=Perimeter of component in mm

t=Thickness of strip in mm

Tmax= Ultimate shearing stress

Perimeter = 388.04mm

L = 111mm

t = 2mm

Tmax = 400N/sq.mm

Shearing Force=388.04*400mm

= 155216N N

= 15.52Tonne

For blanking and piercing of l plate and washer from strip 15.52tonne of force required. On which press will be selected by adding factor of safety.

Press Tonnage:

=1.2*15.52

=18.624 Tons

For performing cutting operation on strip by using progressive tool 18.624tonnage of press tool required but in market standard press tool are available.

Selection of press tool will be selected by the above value of calculated value. 20Tonne of press machine suitable for this cutting operation on progressive tool.

Press Tonnage will be 20 tons by adding factor of safety

Step Fasteners Selection

Assuming stripping force = 10% of Fsh

= 0.1 × Fsh

=3880.4N

Strength of Bolts/Fasteners=Stripping force / No of Bolts

=3880.4/4

=4050N

(No. of bolt =4, for performing cutting operation on the tool die length will be larger for that selection of bolt will beM 10)

Check this strength value of bolt in standard bolt selection chart, on which bolt size will be defined M10=4050N which is less than calculated value that is 3880.4N Bolt will be selected as per value of selected bolt will greater than calculated value. Total no. of bolt is 4 for the assembly

Selection of Dowels

Size dowel will be equal to size of

Bolt Die of dowel=10mm

Length of bolt = 2*2D

=10*4

=40mm

Step: Die Plate Thickness

Die Plate Thickness:

D = 3√Fsh

= $3\sqrt{Fsh}$(max)

=3√15.52

=2.49 cm

=24.9 mm

= 25mm

Thickness of die is 25mm

Step other plate thickness

Other Plate Thickness:

Top/ bottom plate thickness

= 1.5X TD

=1.5 X 25

=37.5mm

Stripper/ punch holder plate thickness

=0.8 × TD

=0.8 × 25

= 20mm

Thrust plate thickness= 6-8 mm

=6mm

3. CONCLUSION

- By the implementation of computer in design field accuracy of design is improved and design field accuracy of design is improved and design process time is reduced drastically than by traditional method.
- In the process of creating the documentation for the product design much of required data base to manufacture the product is also created.
- Many design problems which are complicated to estimate by traditional methods are eliminated by using CAD system, as the designs have more standardization they can be imported to any other software and also CAD provide better functional analysis to reduce prototype testing Regarding progressive die design of progressive die is simple.

4. ADVANTAGES

- Low cost of the component.
- Mass production is suitable.
- High accuracy.
- No further operations are required.
- No need of skilled manpower.

5. DISADVANTAGES

- Tool cost is high.
- Only limited to sheet metal components.
- Floor space requirement is more.

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