

# Sheet Metal Cutting and Bending by Pneumatic Actuator

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**Abstract:** Sheet metal cutting and bending by pneumatic actuator is a precise and efficient manufacturing process that involves the use of compressed air or gas to power cutting and bending tools. The process is used to create a wide range of metal components and products, and it has applications in various industries, including automotive, aerospace, construction, and manufacturing. The process involves preparing the metal sheet, cutting it to the desired shape using a cutting tool driven by a pneumatic actuator, and then bending it into the desired shape using a bending tool also driven by a pneumatic actuator. The accuracy and precision of the process depend on the calibration of the tools and the control of the pneumatic actuator. The future of sheet metal cutting and bending by pneumatic actuator is likely to see continued advancements in technology, including automation, the use of advanced materials, and integration with Industry 4.0 principles. The development of sustainable materials and energy-efficient processes will also become increasingly important. Overall, sheet metal cutting and bending by pneumatic actuator is a critical process for the manufacturing industry, and its importance is likely to continue growing in the future.

**Keywords:** Pneumatic Actuator, Sheet Metals, Air Compressor, Cutting Blades, Connecting Cables, Manufacturing Technology.

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## 1. Introduction

Metal sheet cutting and bending by pneumatic actuator is a manufacturing process used to create precision cuts and bends in metal sheets. Pneumatic actuators are devices that use compressed air or gas to produce mechanical motion, which is then used to operate cutting and bending tools. This process is widely used in various industries such as automotive, aerospace, construction, and manufacturing.

In metal sheet cutting, the pneumatic actuator drives the cutting tool, which slices through the metal sheet with a high degree of accuracy and precision. This process is and it can be performed on a wide range of metal sheet thicknesses.

In metal sheet bending, the pneumatic actuator operates a bending tool that folds the metal sheet into the desired shape. This process is commonly used to create components such as brackets, enclosures, and frames, and it can also be used to create more complex shapes such as cylinders and cones. Overall, metal sheet cutting and bending by pneumatic actuator is a highly efficient and precise manufacturing process that is essential for the production of a wide range of metal components and products.

## 2. Literature Survey

A fast, accurate, and inexpensive position-controlled pneumatic actuator has been developed for use in a variety of practical positioning applications. This actuator allows for precise and rapid positioning control, which is crucial in many industrial applications was presented by Van Varseveld and Bone [1].

Arun, Rajendra, et.al. [2], A method has been developed for controlling the operations of a punching machine using Programmable Logic Controllers (PLCs), resulting in reduced manufacturing lead time and increased worker safety. PLCs are electronic devices that can be programmed to automate a wide range of industrial processes, including those involved in metal fabrication.

Frederick, Mathivanan, et.al. described pneumatic as the branch of technology, which uses air as the primary medium for various cutting operation [3]. A conventional power hacksaw machine cable replaced by automated hacksaw machine which is highly productive and it reduces labor [4]. By varying the pressure of compressed air, variable cutting forces can be obtained in sheet metal cutting equipment. This allows for greater flexibility in the cutting process, as the operator can adjust the pressure to achieve the desired level of cutting force depending on the thickness and type of material being cut [5]. The solenoid controlled pneumatic cylinder provides a way of controlling the machine by a micro controller, thus enabling automation to cutting [6].

Shirodkar, Vaidya, et.al. developed a method on the PLC application in industry of cutting machine, properties of plc, different types of hacksaw used for cutting purpose [7]. A pneumatic machine has been developed that can perform cutting and bending operations on sheet metal, resulting in reduced operational costs and increased efficiency. The use of pneumatic power allows for a high degree of control and accuracy in the cutting and bending process [8].

Quazi and Shaikh investigated the influence of punch-die clearance in the blanking process. The results showed that decreasing the clearance between the punch and die increased the required blanking force [9]. A pneumatic punching machine has been fabricated to reduce the punching cost on metallic sheets. This machine uses pneumatic power to drive the punching process, which is more efficient and cost-effective than traditional hydraulic or electric-powered machines [10-14].

### 3. Materials & Methodology

**Table 1.** Technical specification of the components used to develop Sheet Metal Cutting and Bending by Pneumatic Actuator

Sr. No.	Component	Specification/Details
1	Pneumatic Actuator	A 0.1- 0.7 MPa Pneumatic Actuator is used. (SC 50*100)
2	Air Compressor	Air compressor is used to compress the natural air and the air passes through the connecting cable.
3	Cutting Blades	Cutting Blade is used to cut the sheet metal.
4	Connecting Cables	Through connecting cable the compressed air from the compressor reaches the solenoid valve.
5	Sheet Metal	Sheet metal used for cutting and bending process.
6	Supporting Frame	The supporting frame is used to fix all the components.
7	Rivet & Screws	Rivet is used to fix the components to the supporting frame.
8	Solenoid Valve	solenoid valve is used to control the direction of pressure

Components used are represented in Fig. 1(a) to Fig. 1(h) below.



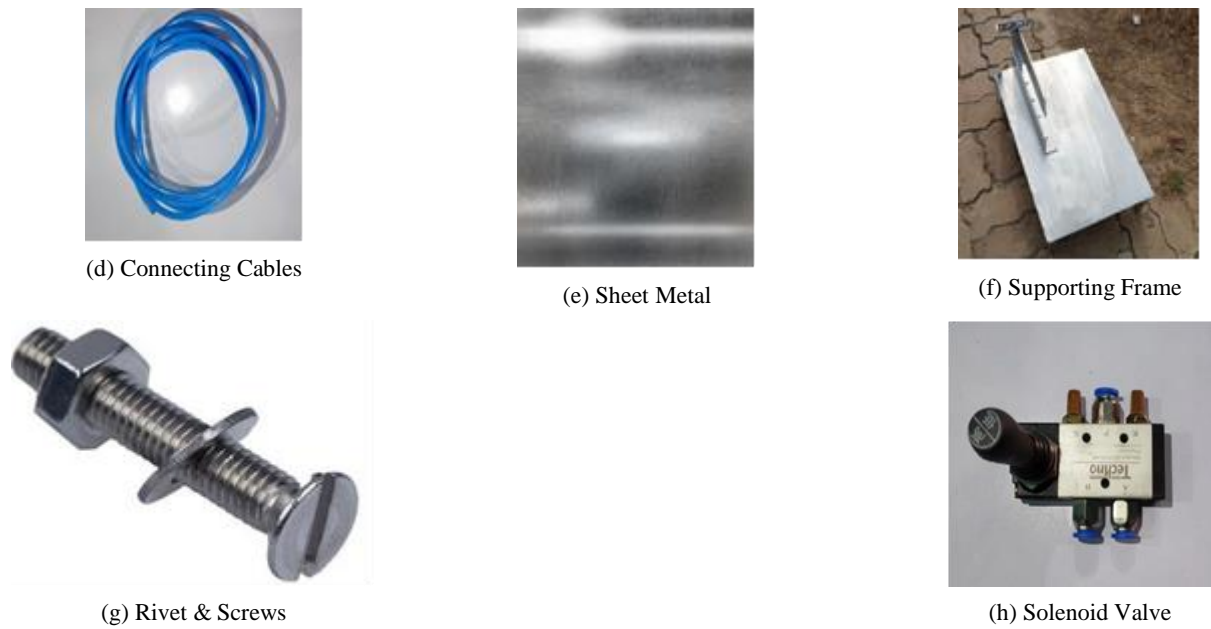
(a) Pneumatic Actuator



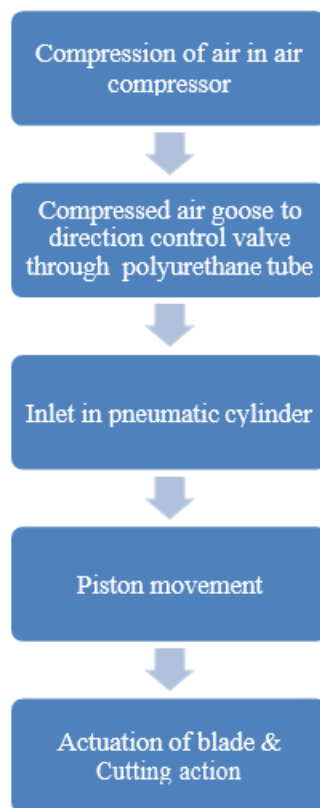
(b) Air Compressor



(c) Cutting Blades



**Figure 1.** Components used for development of machine



**Figure 2.** Methodology for fabrication of sheet metal cutting and bending machine



**Figure 3.** Working model of the sheet metal cutting and bending machine

### **3. Working of Sheet metal cutting and bending**

Sheet metal cutting and bending by pneumatic actuator involves the use of a variety of tools and equipment to achieve precise cuts and bends in metal sheets.

(a) **Cutting:** The cutting process is performed using a pneumatic actuator-driven cutting tool, such as cutting blade. The cutting tool is positioned over the metal sheet and the pneumatic actuator is activated, causing the cutting tool to move and slice through the metal sheet.

(b) **Bending:** Once the metal sheet has been cut to the desired size and shape, the bending process can begin. A bending tool, typically a hydraulic or pneumatic press brake, is used to apply pressure to the metal sheet and fold it into the desired shape.

The pneumatic actuator plays a crucial role in both the cutting and bending processes, providing the mechanical force necessary to move the cutting and bending tools. The compressed air or gas used to power the actuator is controlled by a control system that regulates the speed and force of the actuator to ensure precise and consistent cuts and bends. Additionally, the cutting and bending tools themselves are carefully designed and calibrated to achieve the desired results, with factors such as blade sharpness and tool positioning playing critical roles in the final product.

Advantages

- Air is available free of cost in the environment, So no money required for working fluid.
- No working fluid leakage risk.
- Easy to operate.
- Easy maintenance.
- High cutting accuracy.
- Fast cutting speed.
- Minimal waste.
- Cost effective and high output.
- Continuous operation is possible.

### **4. Conclusion**

In conclusion, sheet metal cutting and bending by pneumatic actuator is a highly efficient and precise manufacturing process that is essential for the production of a wide range of metal components and products. The use of pneumatic actuators to power cutting and bending tools allows for a high degree of control and accuracy, resulting in products with tight tolerances and complex shapes. The process has been used in a variety of industries such as automotive, aerospace, construction, and manufacturing. However, with advancements in technology, the future of sheet metal cutting and bending by pneumatic actuator is likely to see continued improvements in efficiency, precision, sustainability, and automation. Integration with Industry 4.0 principles, the use of sustainable materials, and the development of new cutting and bending techniques for advanced materials are among the potential areas of development.

Overall, sheet metal cutting and bending by pneumatic actuator is a vital process for the manufacturing industry, and its importance is likely to continue growing in the future. The future scope of the machine is as follows.

- It can be automated by use of sensor.

- The use of robotics and artificial intelligence to automate the cutting and bending process could help increase production speed and reduce the need for manual labor.
- The use of new materials, such as lightweight alloys or composites, may require the development of new cutting and bending techniques that can handle their unique properties.
- As demand for high-precision metal components continues to grow, there will likely be a need for improved cutting and bending techniques that can produce increasingly complex and precise shapes.

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