

## OPTIMIZATION OF PRODUCTION TIME AND IDEAL TIME IN LASER CUTTING MACHINE

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**Abstract** - Laser cutting process is an advanced machining process. It is working on energy based unconventional process. Laser cutting method is one of the most widely used thermal energy based non-contact type. It is advance machining process which can be applied for almost whole range of materials. A laser cutter uses a high energy focused laser beam controlled by a computer to vaporize a variety of materials. There are many problems in laser cutting machine while the machine is running time. They are filter problem, leakage problem, motor problem, control problem, etc., But we are finding the filter problem and leakage problem only. These two problems are indirectly contact to protective lens so, the protective lens is damaged. If the filter tissue can be changed due to dust particles, so the filter problem will be avoided. More dust can produce leakage and pressure problem. To fix flow regulator in cylinder pipe lines to control the flow of air. Finally the leakage problem also will be avoided.

**Key Words:** Laser cutting machine, Material, Filter tissue, Flow regulator.

### 1. HISTORY

In 1965, The first laser cutting machine was found by the Western Electric Engineering Research Centre. The first production laser cutting machine is used to drill holes in diamond dies. [2] In 1967, the British pioneered laser cutting machine-assisted oxygen jet cutting for metals. [3] In the early 1970s, this technology was introduced and then put into production to cut titanium material for aerospace applications. At the same time CO<sub>2</sub> lasers were adapted to cut non-metals, such as textiles, etc., because, at the time, CO<sub>2</sub> lasers were not powerful enough to overcome the thermal conductivity of metals.

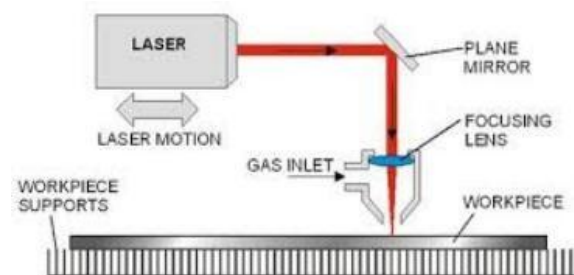
### 2. INTRODUCTION

Laser cutting is a advanced technology that uses a laser to cut the materials. A laser cutting machine can cut a variety of materials using a high powered laser beam that is controlled by CNC software that determines cutting parameters. A laser cutter uses a high energy focused laser beam controlled by a computer to vaporize a variety of materials. But it is focusing by using protective lens. The protective lens is the main component of laser cutting machine. It is used to focusing on material depth so, easily

to cut the material. It is made on fiber material. Laser cutting is incredibly precise and provides a pristine cut to clients, making it a popular choice in metal fabrication shops.

### 3. WORK THEORY OF LASER CUTTING MACHINE

Laser technology has been applied in teaching, military as well as industrial production. Laser cutting machine is one of the applications especially industrial oriented. It can be used in both metal and non-metal cutting, Melting surface material by laser beam through focused lens.



**Fig 1. Process of laser cutting machine**

Laser tube is the mainly core part of laser cutting machine. So, below is an introduction of the most popular laser tube that is CO<sub>2</sub> laser tube.

Laser tube is also a composed of hard glasses, so it is fragile material. It adopts the double layer of sleeve construction with discharge tube in the most inside layer of machine. However, the diameter of discharge tube is thicker than the laser tube, so diffraction between the thickness of discharge tube and the size of flare is in direct ratio; the length of laser tube is in proportion to output power of discharge tube. Laser tube generates a large quantity of heat power in the operation of laser cutting machine, which influences the normal work. So, cold water machine is needed to cool laser tube, maintaining and controlling the constant temperature for successful running.

### 4. LASER CUTTING

Laser cutting is a advanced technology that uses a laser to cut the different materials such as, mild steel, stainless steel, aluminium, bronze, brass, copper,

galvanized iron. While typically used for industrial applications. Laser cutting works by directing the output of a high-power laser beam strike on the material through focused lens. The laser optics and CNC (computer numerical control) are used to control the laser beam generated on the material. A commercial laser for cutting materials uses a motion control system to follow a CNC pattern to be cut onto the material. The laser beam is directed on the material by focusing of protective lens, which then either melts, burns, vaporizes away, by a jet of gas, leaving an edge with a high-quality surface finish.



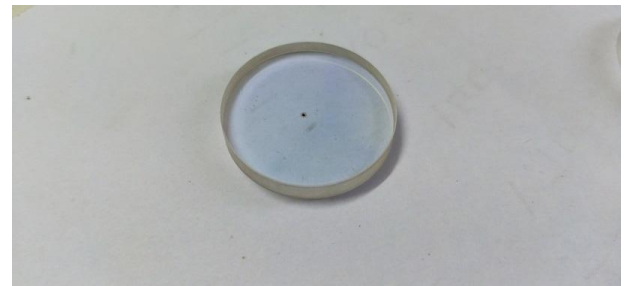
**Fig 2. Laser cutting**

### 5. FINDING THE PROBLEM DURING THE MACHINE RUNNING

There are many problems in laser cutting machine while the machine is running time. They are filter problem, leakage problem, motor problem, system problem, operator problem, etc., But we are finding the filter problem and leakage problem only. These two problems are indirectly contact to protective lens so, the protective lens is damaged. The filter problem is created to the black dots and dust particles on the protective lens because of climate change especially, in summer season the filter is going to be dry condition so, the dust particles is not filtered by filter tissue. The leakage problem is also created to the black dots and dust particles on the protective lens because the flow regulator is not fixing the cylinders pipe So, we are not control the flowing of air. Above the filter and leakage problem is created to the black dots and dust particles on the protective lens. How to solve these problem ? The filter tissue can be changed due to dust particles, so the filter problem can be avoided. More dust can produce leakage and pressure problem. To fix flow regulator in cylinder pipe lines to control the flow of air. Finally the leakage problem also can be avoided.

#### Defect of lens

The filter problem, pressure problem, leakage problem is created to the black dots and dust particles on the protective lens as shown in the figure.



**Fig 3. The breakage of protective lens**

#### How to give solution for this problem

The filter tissue can be changed due to dust particles, so the filter problem can be avoided.

More dust can produce leakage and pressure problem. So, to fix flow regulator in cylinder pipe lines to control the flow of air. Finally the leakage problem also can be avoided.

### 6. CALCULATION

#### Before changing filter tissue

Total working time	= 127 hr = 7620
mins Machine charge	= Rs.40 / mins
Labour charge	= Rs.32 / hr = RS. 0.533 / mins

Total cost of working time = (total working time\*machine charge)  
 = (7620\*40)

= Rs.304800 / mins

= Rs.5080 / hr Totally 5 protective lens damaged.

Cost of per lens = Rs.3000

Cost of 5 lens = (5\*3000) = Rs.15000

Time of changing a lens = 15 mins

Time of changing 5 lens = 75 mins (Cost of labour charge

while changing a lens) = Rs.40 (Loss of cost while changing 5 lens) = (cost of 5 lens + labour charge) = Rs.15000 + Rs.40 = Rs.15040

After changing filter tissue

Total working time = 134 hr = 8040 mins

Machine charge = Rs.40 / mins

Labour charge = Rs.32 / hr

= 0.533 Rs / mins

Cost of per lens = Rs.3000

Total cost of working time = (total working time\*machine charge) = (8040\*40)

= Rs.321600 / mins

= Rs.5360 / hr Totally 3 protective lens damaged.

Cost of 3 lens = (3\*3000) = Rs.9000

Time of changing a lens = 15 mins

Time of changing 3 lens charge = 45mins (Cost of labour charge

while changing a lens) = Rs.24 (Loss of cost while

changing 3 lens) = (cost of lens + labour charge)

= Rs.9000 + Rs.24

= Rs.9024

After fixing a flow regulator

Total working time = 80 / hr = 4800 / mins

Machine charge = Rs.40 / mins

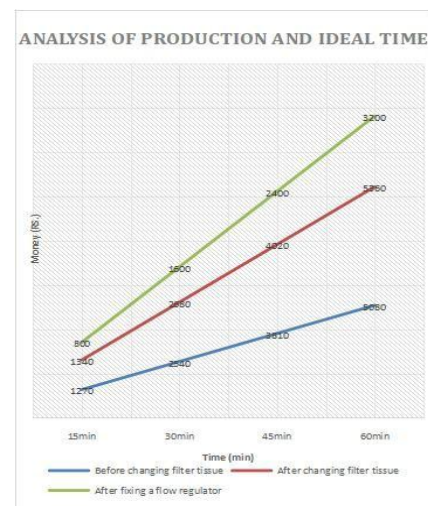
Labour charge = Rs.32/hr= 0.533/mins

Cost of per lens = Rs.3000  
 Total cost of working Time = (total working time\*machine charge) = (4800\*40) = RS.192000 / mins = Rs.3200 / hr

**Tabulation**

S.no	Process	Loss of amount
1.	Before changing filter tissue	Rs.15040
2.	After changing filter tissue	Rs.9024
3.	Before fixing a flow regulator	Rs.9024
4.	After fixing a flow regulator	No losses

**Graph**



**7. CONCLUSION**

Laser cutting machine is a advanced cutting technology of melting surface material through focused energy generated by the use of laser specialties and protective lens. It features good cutting quality, good finishing surface, high speed, various cutting material and high efficiency.

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