Scrap Minimization by Implementing Effective Nesting towards Improved Productivity

Dr. Ashok G. Matani¹, Ankush D. Bhishnurkar²

¹Associate Professor, Government College of Engineering, Amravati – 444 604 [M.S.] India,
²M.Tech. (Production Engineering), Government College of Engineering, Amravati – 444 604 [M.S.] India

Abstract— It is essential for the industry to keep production cost as low as possible. Cost of production can be minimizing by reducing amount of waste, scrap and rejection of material in the production. The amount of scrap can be reduced by efficient nesting. This study is carried for effective nesting for laser cutting operation. The laser gas is formed by the mixture of CO₂, He and N₂ in the ratio of 61%, 5% and 12% respectively. The parameters considered for the study are Common Line Cutting, Numbers of Piercing, Thickness of Materials and Length of Cutting. By effective nesting in AutoCAD 5.33% scrap is minimized, Number of components increased by 4 and loss of Rs.549.78 is minimized.

Keywords— Laser Cutting, Nesting, Piercing, Scrap, Sheet Metal.

I. INTRODUCTION

The amount of scrap to be reduced is possible by efficient nesting. The main purpose of this study is to reduce the Percentage of scrap by using the efficient nesting parameters. This study is conducted in order to minimize scrap of Sheet metal cutting done by using laser-cutting machine in medium scale organizations (MSOs). The industry manufactures agricultural equipment and it is supplied in India as well as outside India. In today's highly competitive environment, it is very important to minimize the production cost. To minimize the cost of production the amount of waste or scrap material is to be minimized. The material cost is the major portion of the cost involved in mass producing sheet metal components. Hence an efficient nesting of parts will minimize the amount of scrap material and reduces the overall production cost significantly.

A. Laser

A laser beam is generated in a glass tube with one side having perfect mirror and the other having semi reflecting mirror. One of the mirrors is full reflective, and the other is 70% reflective. The laser gas is formed by the mixture of CO₂, He and N₂ in the ratio of 61%, 5% and 12% respectively. This mixture of laser gas is commonly known as CO₂ laser because of higher quantity of CO₂.

II. DATA COLLECTION

A. Selection of Parts-

Parts that need to be analyzed are selected according to annual usage, complicated Geometry parts that were being purchased and parts with thickness in the range of 4 mm to 10 mm were selected. These parts were selected mostly by visual inspection. Suggestions from several department experts are also considered in the selection process.

1. Annual usage: Annual usage is among one of the main criteria for the part selection process. As the annual usage of these parts was high, they are considered for this study.

2. Thickness: Most of the parts that are manufactured are between 4 mm and 10 mm thick. There are parts that are more than 10 mm, but not in great quantities.

3. Geometry of Complicated parts: it is an effort of industry to standardize the product range, to minimize production cost and to maximize the productivity.

B. Scrap-

The sheet metal which remains unused after the laser cutting of the nested components is called as the scrap or wastage material. The sheet utilization ratio depends upon the percentage of wastage of scrap. The amount of scrap to be reduced is possible by efficient nesting. The main purpose of this study is to reduce the percentage of scrap by using the efficient nesting parameters. The cost price of raw material sheet is Rs.57 per kg on the other hand selling price of scrap wastage material is Rs.22 per kg. As we can see that the cost difference is very large of about Rs.35 per kg, hence the amount of scrap needs to be reduced by using proper nesting.

III. METHODOLOGY AND DISCUSSION

A. AutoCAD

AutoCAD is a commercial software application for 2D and 3D computer-aided design (CAD) and drafting available. AutoCAD was first released in December 1982, which ran on microcomputers with internal graphics controllers.
AutoCAD is used across a wide range of industries, by project managers, architects, engineers, designers, and others. AutoCAD is in its 29 generation in the year 2014, and continues to be the most widely used CAD program throughout the world. AutoCAD is a 2-D and 3-D computer-aided drafting software application used in architecture and manufacturing used in the preparation of blueprints and other engineering applications. Interact was the first form of AutoCAD. The first release of the software used only entities such as circles, lines, polygons, arcs and text to construct complex objects. The latest version of the software includes a full set of tools for solid modelling. The AutoCAD software was used by us for the nesting of the various components.

The nesting was done by importing the .dxf and .dwg files into the 2D module. The parts were nested by using the following parameters:
1. Common Line Cutting
2. Numbers of Piercing
3. Thickness of Materials
4. Length of Cutting

Original sheet of nesting is shown in figure 1 and modified sheet in figure 2.

![Figure 1: Original sheet](image1)

Dimensions of sheet = 2500 x 1500
Thickness = 10 mm

\[ Wt. of sheet = \frac{2500 \times 1500 \times 10}{1000 \times 1000} \]

![Figure 2: Modified Sheet](image2)

Dimensions of sheet = 2500 x 1500
Thickness = 10 mm

\[ Wt. of sheet = \frac{2500 \times 1500 \times 10}{1000 \times 1000} \]
IV. RESULTS

Modification has been done on sheet of same size and thickness and reduction in scrap is brought to 36.07% from 41.37%, number of components increases from 44 to 48 and loss is also reduces from Rs.4268.67 to Rs.3718.89.

Table I:
Comparison between original and modified sheet

<table>
<thead>
<tr>
<th>Factors</th>
<th>Original Sheet</th>
<th>Modified Sheet</th>
<th>Gains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plate Dimensions</td>
<td>1500 * 2500</td>
<td>1500 * 2500</td>
<td>00</td>
</tr>
<tr>
<td>Components</td>
<td>44</td>
<td>48</td>
<td>4 More Jobs</td>
</tr>
<tr>
<td>Waste %</td>
<td>41.37%</td>
<td>36.07%</td>
<td>5.33% Reduction</td>
</tr>
</tbody>
</table>

\[
\text{Wt. of sheet} = \frac{37500000}{1000000} = 37.5 \\
\text{Wt. of scrap} = 294.75 \text{ kg} \\
\text{No. of parts} = 48 \\
\text{Wt. of parts} = \frac{\text{No. of part} \times \text{wt. of part}}{	ext{Wt. of parts}} = 188.496 \text{ kg} \\
\text{Wt. of scrap} = \text{Wt. of sheet} - \text{Wt. of parts} = 294.75 - 188.496 = 106.254 \text{ kg} \\
\% \text{ of scrap} = \frac{106.254}{294.75} \times 100 = 36.04\% \\
\text{Loss} = [(\text{CP} - \text{SP}) \times \text{Wt. of scrap}] \\
\text{Loss} = [(57 - 22) \times 106.254] \\
\text{Loss} = \text{Rs.3718.89} \\

\text{IV. RESULTS}

From the above study following conclusions has been drawn:
1. Minimization in scrap is 5.33%
2. Number of components increased by 4.
3. Minimization in loss = Rs. 549.78

V. CONCLUSIONS

REFERENCES