CHAPTER – 4

Implementation of Bush Boring Chamfer to avoid manual De-burring in connecting rod: A Kaizen Approach

4.1 Introduction

Numerous organizations have adopted the practice of Kaizen as a mean for obtaining the alternatives for continuous improvement. Many articles have addressed the implementation of Kaizen in different industries.

The purpose of the present work is to identify and outline the application of Kaizen approach on the shop floor of connecting manufacturing operations. After the bush boring operation, in Small End of connecting rod, pillar drill is used to eliminate dent marks and burrs, as a replacement for manual de-burring operation. It reduces manual work with better concentricity of small end and improves the quality of product up to a considerable extent.

Assembly of gudgeon pin in the small end of connecting rod becomes easier as compared to the previous method due to chamfered end. The efforts made by teamwork to employ kaizen concept is documented and discussed in details. Future scope of present work and supplementary improvement potential is stated which is highly significant for the people involved in connecting rod manufacturing.

4.2 Literature Review
Kaizen in one of the most important methodologies used to manage continuous improvement in maquiladora industry located in Ciudad Juarez, Chihuahua, Mexico; however, it is frequently implemented without obtaining the expected results. The survey was validated using a rational validation, judge validation, and statistical validation using the Cronbach alpha index. The result indicated that seven factors are the most important: education and training in operators, communication process, documentation and evaluation of projects results, human resources integration, management commitment and customer focus [37]. Management commitment and education are the main factors that guarantee the success of kaizen implementation programs, but that is moderated by a good communication for having good operational process performance for better workers and customer satisfaction [38].

Kaizen is a way of thinking and managing. Its essence is the continuous improvement of processes in an enterprise through small steps performed by all employees. Processes of implementing new ideas are more efficient when it is supported with kaizen activities. It is a slower but permanent improvement of things, starting from simple improvements of tools and working methods, finishing with the improvement of whole processes performed by all employees achieved with small steps in a way that does not require considerable investments.

A continuous improvement is a tool used by Toyota production system (TPS) and is also called kaizen. It is not only the process of fostering creativity, raising the spirit and forming energy, but it is also the best tool for creating value problems quickly. However, the most effective way to achieve the above is to improve endlessly and train employees to improve the enterprise and make it the culture of the enterprise. Continuous improvement needs to form across function groups to improve certain areas and identify the process or problem. Its operation includes educational training, understanding problems, evaluating problems, brainstorming, execution, standardization, achievement record, post event handling and reporting [39].

Improving individual operation yield is an important way to increase the system yield. Studies in this field try to stabilize the process either by finding root causes of variation and eliminating them or by making the process insensitive to external agitations [18].
4.3 Research Methodology

The aim of present work is to implement the new idea to replace manual operation with drilling machine for better concentricity and consistency. Hence, it is an *Applied Research* used for a solution of an immediate problem facing an industry. The observations were taken according to definite pre-arranged plans and involve experimental procedure. The controlled observations data is collected and documented for analysis. Such observations have a tendency to supply formalized data upon which generalizations can be built with some degree of assurance [1].

In machining, the objects in quality control are geometrical dimension, tolerance, surface finish, and relative tolerances on individual part. In mechanical assembly, the quality control is oriented to confirm the correct relations between a group of parts or components and the precisions with multi-dimensions, shapes, or relative position tolerances [19].

The methodology employed in present work is purely shop floor base activity. The case study discussed for implementation, cannot be generalized for other work as it is completely *Tailor-Made Solution* (TMS). It has focused on a practical description of Kaizen approach in the production line.

4.4 Problem Statement

The product, connecting rod faced the problem of dent marks in the small end after manual deburring operation (Fig. 4.1) and uneasiness to insert the gudgeon pin on the small end at the time of assembly. The solution of the problem is taken for the present case study. The scope for improvement potential is studied and necessary corrective measures are to be taken with the help of a kaizen approach. The present approach is checked for continuous improvement in the ongoing process with the help of cost-benefit analysis (CBA).

The brainstorming exercise was conducted by an interdisciplinary team of engineers at the company in order to identify potential factors that could influence the problem. The team assessed a number of factors and proposed to add bush bore chamfering operation with pillar
drilling machine as shown in Fig. 4.2. It eliminates manual de-burring operations. The proposed solution needs to analyze various factors like cost analysis of new machine, fixture design, manpower, space, measuring instrument, gauge, tooling requirements; etc. The analysis is made for the feasibility of proposed solution in detail and concluded for necessary actions.

### 4.5 **Kaizen Sheet**

<table>
<thead>
<tr>
<th>Part Name : 2.2 L Hino Con Rod</th>
<th>Level-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kaizen Idea : Avoid Manual process</td>
<td></td>
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<tr>
<td><strong>Counter Measure:</strong> The small end bush bore chamfering on pillar drilling machine is started in place of the manual de-burring done after bush boring. It gives better concentricity, easy insertion of the pin in small end, no dent marks and avoids manual work.</td>
<td></td>
</tr>
<tr>
<td><strong>Analysis</strong></td>
<td><strong>+</strong> Sharpe edges removed by Small End Bush Chamfer on pillar drill machine.</td>
</tr>
<tr>
<td>- Sharpe edges generated after the bush boring operation.</td>
<td>+ Better quality of edge.</td>
</tr>
<tr>
<td>- Burrs are removed by manual de-burring operation.</td>
<td>+ No dent marks.</td>
</tr>
<tr>
<td>- A possibility of dent marks on inner bore.</td>
<td>+ Reduces manual work.</td>
</tr>
<tr>
<td>- Irregularity may possible on the edge.</td>
<td>+ Easy insertion of gudgeon pin in the small end at the time of assembly.</td>
</tr>
<tr>
<td>- Uneasiness to insert the gudgeon pin in the small end of connecting rod at the time of assembly.</td>
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</tbody>
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**FIGURE 4.1 : Manual De-burring operation (Before implementation)**

**FIGURE 4.2 : Small End Bush Chamfering with Pillar Drill (After Implementation)**

### 4.6 Feasibility of proposed solution
Future Scope

The introduction of small end bush bore chamfering process by pillar drilling machine (Fig. 4.3) in production line results in numbers of other factors. It disturbs many aspects including costing. The initial investment in terms of machine cost and fixture cost, tool cost, manpower cost, space utilization, measuring instrument, etc are justified to the management. The fixture is prepared for the proposed action plan as shown in Fig. 4.4. The implemented action shows improvement in the quality of small end bush bore. It shows the reduction in customer complaint due to easy insertion of gudgeon pin in the small end at the time of assembly of the piston and connecting rod at the customer end. The assembly line also reported the reduction in assembly time due to implemented action.

FIGURE 4.3 : Pillar Drilling machine

FIGURE 4.4 : Fixture for implemented action
4.7 Concluding Remarks

The purpose of this chapter is to describe the implementation of continuous improvement in connecting rod manufacturing operation. The kaizen approach presented shows improvement in quality in terms of many aspects. The dent marks in the small end are eliminated and assembly of pin becomes faster and easier as compared to the previous method. Further research in this area will need to focus on the practical experience of other aspects of other manufacturing operations.

Indeed, the concept of kaizen is outstanding road-maps, which could be used in order to strengthen the practices within an organization. Even if some of the other concepts have been accused of being management trends, it is the authors’ interpretation that organizations continuously need to work with customer-orientated activities in order to survive; irrespective of how these activities are labeled today and in the future.