C-7 Production Line Cylinder Head Handling System

Jaime Boutillier, Luke Harris, and Ed Delay

Abstract. Linamar Corporation has hired Titan Consulting to design a solution to an ergonomics issue at the CAMTAC facility in Guelph, Ontario. A fixed mechanical rotator has been proposed, including engineering drawings, a bill of materials, and a written report documenting the design process and results. The design process and solution is summarized and recommendations for implementation are given.

Key words: Mechanical handling system, rotational motion, ergonomic improvements

1 Introduction

During a tour of the CAMTAC facility, it was observed that the process of rotating 250 pound cylinder heads in between machines is currently performed manually by an operator, using a large metal bar to rotate the cylinder head. Given the weight of the part, this task is not only very dangerous to the individual performing it, but is also potentially damaging to the head itself. It is for these reasons that Titan Consulting is recommending a design that will eliminate the ergonomic burden associated with this operation at the 40A to 40B process on the C-7 production line, given the following main criteria and constraints:

Criteria
1. The cost of the prototype, implementation, and maintenance should be less than the cost of the lost man hours due to ergonomic stress.
2. The ergonomic burden on the team member must be reduced by the design.

Constraints
1. The front and rear faces on the cylinder head must be accessible to the team member while in the gauging process.
2. The team member must be able to complete the process using the new design in 2 minutes and 40 seconds (the allotted time for the process).
3. The design must be safe in accordance with the Ontario Health and Safety Act.

2 Current Process

Moving from position 40A to 40B on the C-7 production line, a cylinder head is taken out of the 40A machine by an operator using an overhead hoist and is placed on a table of rollers. The cylinder head is pushed down the table until it is in front of a display of various tools. It is at this location that another team member uses several different taps to gauge the holes made during the machining processes. They gauge the holes on the face of the cylinder head that is facing them first. Then they heave the cylinder head backwards away from them so that the face is now at a 45 degree angle in order to gauge holes that are lower on the face. After setting the cylinder head back down so that the initial front face is back at a 90 degree angle to the table, the team member must twist the cylinder head internally so they can access and gauge the face opposite the initial front face. Upon twisting the cylinder head back to its original position, a large metal bar is used to rotate the head by shoving one end into one of the machined holes on the initial top face. The team member must then forcefully pull the bar towards them in order to rotate the cylinder head such that the initial rear face is now facing the ceiling. At this point, the team member pushes the cylinder head down the rollers to be loaded into the 40B machine.

2.1 Issues Pertaining to the Current Process

The manual rotating of the cylinder heads puts repetitive stress on the team members shoulders, lower back, and knees. These stresses result in injuries that render team members unable to perform regular duties. The injured team member then performs modified duties, such as cleaning or doing quality checks, in order to give them time to recover from their injury. An average of one person per eight hour day performs modified duties as a result of this process.

3 The Design: Fixed Mechanical Rotator

The structure of the fixed mechanical rotator can be seen below in Figure 1. It consists of vertical stabilizing posts made of low carbon square steel tubing that is lagged to the concrete floor and filled with concrete. Two electric chain motor and chain combinations are located on the sides of this tubing to provide lateral movement of the unit. Mobile grappling arms with internal stabilizers extend out from the steel structure to clamp onto the ends of a cylinder head. Hydraulic pistons and cylinders are located in these arms to provide for the horizontal motion. Rotating electric servo motor units are located at the ends of the grappling arms to provide the rotational movement of a cylinder head.
3.1 Design Implementation and Operation Procedure

When using the fixed mechanical rotator, the process for the team member would be modified significantly. Upon removing the cylinder head from the machine at 40A, the operator will use the hoist to place it on a pallet that will be located on the table of rollers. The pallet will allow the cylinder head to be slightly raised so that the sides will be accessible. The pallet will be pushed down the rollers so that it is in front of the fixed mechanical rotator. A fixed stop will ensure that the cylinder head is in the proper location to be picked up by the rotator. The team member will push a button to close the rotator clamps, bringing them in to surround each end of the cylinder head. The team member will push another button to raise the cylinder head off of the pallet. At this point, other buttons will be pushed to rotate cylinder head as required. Upon completion of gauging the cylinder head, the team member will push a button to lower the cylinder head back onto the pallet. Another push of a button will release the clamps, and the pallet will be pushed down the rollers to where it will be picked up to be machined at 40B. When the cylinder head is taken off of the pallet, the pallet will be moved to another set of rollers on the table underneath the top set where they will roll to the other end of the table for reuse at 40A.

4 Conclusions and Recommendations

Titan Consulting is recommending to CAMTAC Limited that they manufacture the fixed mechanical rotator and implement it at the 40A to 40B process on the C-7 production line. By lessening the ergonomic burden on the line operator, there will be fewer team members that will have to perform modified duties as a result of an injury. Upon implementation, CAMTAC can expect a return on investment of 15 weeks.

5 Acknowledgement

Titan Consulting would like to acknowledge the assistance given by Mike Minogue, an engineer at CAMTAC Limited in Guelph, Ontario.