Brazing Cell Redesign

Miles Lewis, Ben Myers, and Jared Williamson
Client: Earl Barthel **Manager:** Dr. Stephen Hill
Technical Advisors: Dr. Laura Moody, Dr. Melinda Hollingshed, and Dr. Loren Sumner
Industrial and Mechanical Departments, School of Engineering
Mercer University, Macon, GA

INTRODUCTION

Problem Statement: Ideally, the brazing assembly cell should be space efficient, cost effective, repeatable, and high performing. However, the existing Marvair brazing process is separated into multiple cells, inaccurate jigs/stabilizers are being used, and performance is not up to expectations.

Client Description: Our client is Earl Barthel, the lean leader for Marvair. Marvair manufactures wall-mounted air conditioners.

Team Members/Responsibilities: Our team consists of three Mercer University Engineering Students. Ben Myers, a Mechanical Specialization, was in charge of jig creation and implementation, Jared Williamson, an Industrial Specialization, lead the workstation layout design and implementation, and Miles Lewis, an Industrial Specialization, ensured ergonomic standards and completed testing of the workstation while assisting Jared with the workstation layout.

PROJECT DESCRIPTION

Workstation Layout: Our group was tasked with consolidating the line 4 brazing cell into the current brazing workspace. Our goal was to improve the cell by optimizing flow, reducing labor costs, and eliminating non-value added tasks. The deliverables for the workstation layout were an updated and complete cell layout along with the necessary engineering drawings.

Jig Creation: Our group was also tasked with creating an enhanced jig for the operators. Our goals for the jig were to reduce assembly variation, improve ease of use, reduce cycle time per assembly, and eliminate unnecessary labor. The deliverables for the jig creation were fully assembled and improved jig design and the necessary documentation and testing to ensure safety.

FINAL DESIGN AND IMPLEMENTATION

Workstation Design and Implementation: Figure 1 is shown below showing the final layout that was implemented in the Marvair brazing cell. A four station layout was designed for implementation when the demand increases. Our design optimized the flow by centrally locating raw material and finished goods carts to reduce the distance traveled by the operators. Our design was implemented over the course of one work day. Changes were made over the employees lunch break to minimize downtime. Initial feedback from the brazing cell operators and our client was overwhelmingly positive. Employees adjusted to the new layout quickly.

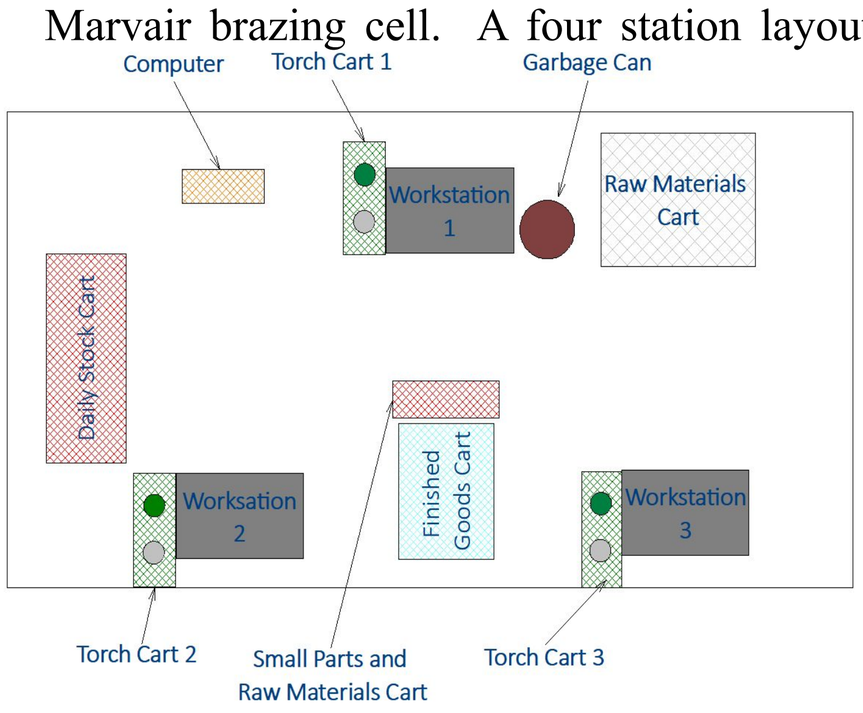

Figure 1: Final Workstation Layout

Jig Design and Creation: In constructing the jig, minimizing time, increasing stability, and allowing the operator adjustment flexibility was key. Using welding and cutting techniques, the team created a jig that satisfied all Marvair's criteria. The inner tubes of both jig arms and main jig tube were turned by 0.04 inch increments. Once the inner tubes reached 0.6 inches in diameter, the tubes were slid into their respective elements.

Coupling nuts were weld to the spring clamps to connect them to the threaded rods extending from the scaffolding clamps. Thumb bolts replaced the tightening hex bolt on the scaffolding clamps. Holes were drilled and tapped to provide securing pins and eyebolts for the jig. Lastly, a 10x10x1/4 inch steel plate was welded to provide jig stability.

Figure 2: Final Jig Design

TESTING AND CONCLUSIONS

Workstation Testing: Our team tested the final design to ensure it was effective. A spaghetti diagram was created to show the operators flow patterns through the workspace and showed the improvements made from the prior layout. A motion study was also completed, which showed a seven minute decrease in average cycle time. Illuminance and sound tests were completed to ensure the safety of the operators, which concluded that the illuminance and sound levels in the workspace are effective for the workspace.

Workstation Conclusions: The workstation layout design and implementation was a success. We achieved all goals and objectives set by our client. The operators and client are happy with the design. The design reduced cycle time per part, motion, cost, and streamlined flow through the workstation. The four station layout was delivered to the client for future expansion as the demand increases.

Jig Conclusion: The operator's feedback and jig alternate testing established that the jig minimized set up time, allowed for efficient adjustments, and provided flexibility in brazing operation without compromising jig stability.

Jig Testing: Due to COVID-19, testing did not proceed as planned, however, feedback was gathered to provide a conclusion of the jig's operational capabilities. The jig received a 9/10 and 10/10 on flexibility and stability, respectively, by the Marvair operators. The operators provided a stability test by applying their heaviest tubing configuration weighing approximately 15 pounds. Our team believed that both tests provided sufficient results to determine the success of the jig.

Acknowledgements

We would like to thank the client, technical advisors, and team members at Marvair. We would like to thank Earl Barthel and the team at Marvair for assisting us throughout the process. We would like to thank our manager and technical advisors: Dr. Stephen Hill, Dr. Laura Moody, Dr. Melinda Hollingshed, and Dr. Loren Sumner for providing technical knowledge and answering any questions we had. We would also like to thank Mr. John Mullis for assisting us in the completion of the jig.