Damaged Magnet Wire Solution for Boeing 787-10 Electric Motor Pump

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Abstract

Damaged magnet wires is a problem that negatively affects the production of the 787-10 Boeing Airplane Electric Motor Pump. The major cause of damaged magnet wire during removal process is lack of adequate core protection. It was found that by implementing a plastic shim during this stage of the process, the defect was reduced by 100%, surpassing the initial goal of a reduction of 30% in PPM (Parts Per Million) and SRR (Scrap Rework and Repair) metrics.

Problem

Before the implementation of the plastic shim in the manufacturing process of electric motor stators demonstrated in figure 1, the company faced significant challenges. Rejections due to nicked magnet wires during the removal process resulted in a notable financial and customer impact. To address concerns, a project was initiated to find a viable solution. After evaluation and testing, it was determined that the implementation of a plastic shim in the manufacturing process could potentially solve the issue.

These quality issues not only affected the company's reputation but also added to the financial strain. Operator feedback highlighted the ergonomic issues and manual-intensive nature of the removal process, impacting overall productivity and operator confidence. These challenges emphasized the need for a practical solution to streamline operations and improve the manufacturing process. The plastic shim works because the stator walls now have protection during the removal process, thus reducing metal to metal contact.

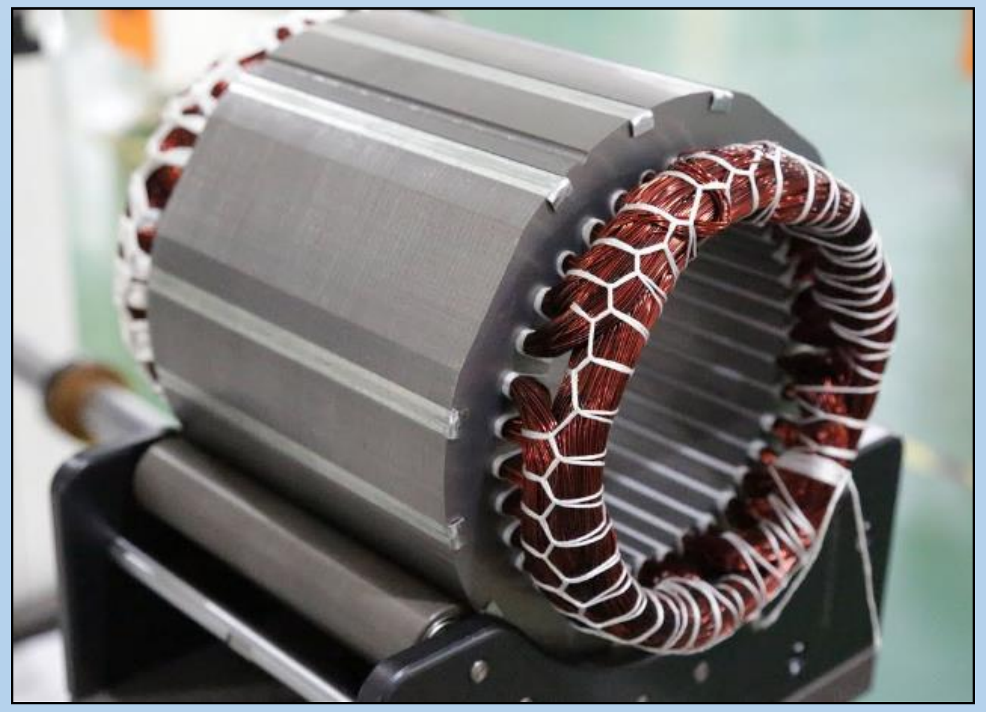

Figure 1
Finished Stator Example

Methodology

Root cause analysis (RCA) played a crucial role in analyzing rejection data and identifying opportunities for improvement in the manufacturing process. Cross-functional teams were formed to conduct a comprehensive RCA using a structured problem-solving tool known as the Core Problem Solving form demonstrated in figure 2, which uses fishbone diagrams, 5 why analysis, and a corrective action board tracker. This allowed for a systematic exploration of potential root causes contributing to the occurrence of rejections due to nicked magnet wires.

Through the RCA process, the teams discovered that the manual-intensive removal process itself was a key factor leading to the defects. This finding led to further investigation and brainstorming sessions, where the idea of protecting the magnet wires during the removal process emerged as a potential solution.

To validate this idea and trace opportunities in the manufacturing process, scatter diagrams were utilized. By analyzing the relationship between the occurrence of rejections and various process variables, the teams were able to identify a correlation between the absence of protection for the magnet wires and the occurrence of defects. This data-driven approach provided evidence supporting the need for a protective solution, leading to the concept of implementing a plastic shim.

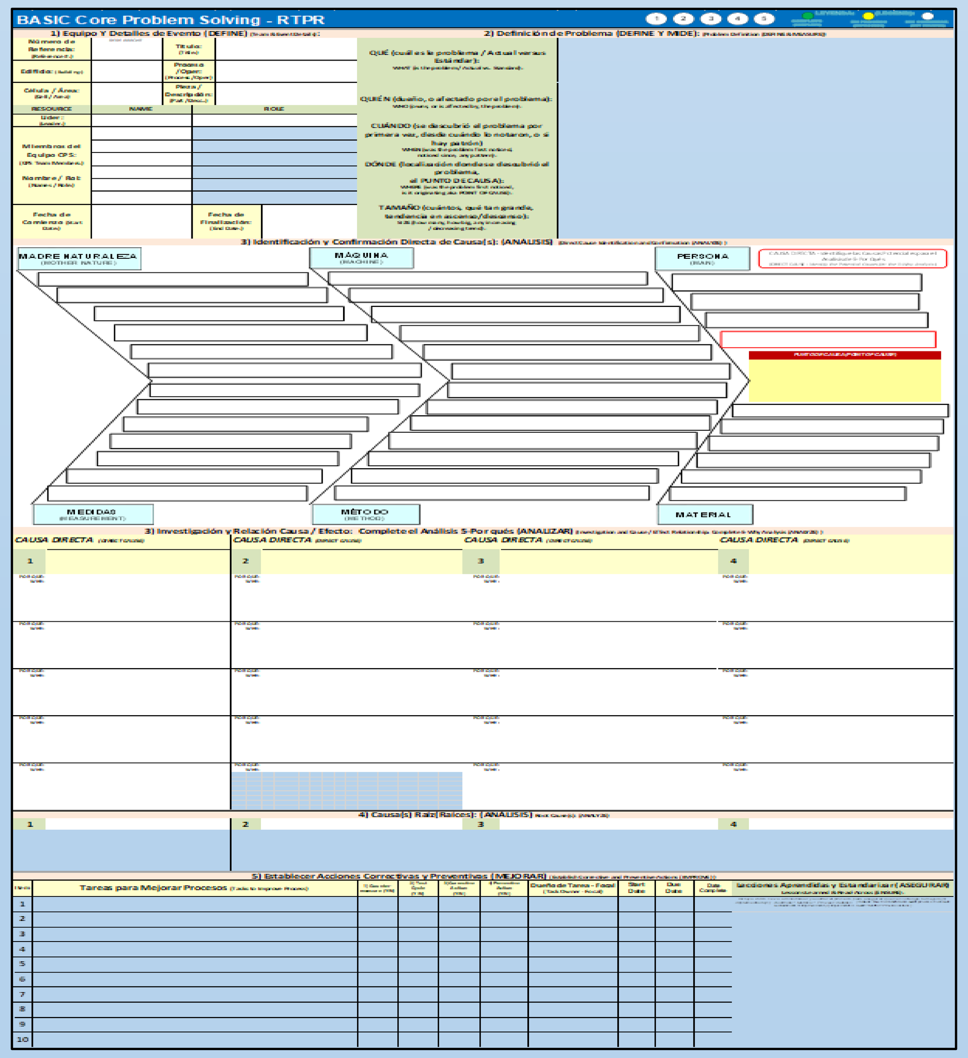

Figure 2
CPS Tool use for RCA

Results and Discussion

The implementation of the plastic shim in the manufacturing process of electric motor pumps has yielded highly positive results. The primary objective of the proposed solution was to reduce the impact on customers caused by recurring non-conformance issues related to damaged magnet wires. The data collected thus far indicates a significant improvement in the rework and Parts Per Million (PPM) metrics. In addition to the PPM improvement, the project set a secondary objective of reducing the overall rework cost by 30% in the upcoming months. The target was set at $52,700 by May 2023, with the current rework cost estimated at $62,000 if the solution was not implemented.

The implementation of the plastic shim demonstrated in figure 3, occurred after an evaluation process that determined the optimal dimensional thickness of 0.015". This thickness was selected based on the slot walls' thickness in the stator space, ensuring effective protection for the magnet wires during the removal process. Financial progress is greater than the projected 52,700$ by the end of May. Figure 4 demonstrates the actual financial progress vs the projected progress of the project.

Initially, the project scope was to reduce 30% the overall recurrence of the incidence, but after implementation of the tool proposed, no incidence was currently recorded resulting in a 100% reduction after implementation. The differential between the without tool trendline and the actual cost trendline, by the end of April is $12,915.00 or the actual savings of the project. The project initially calculated a rework cost of 70% or $9,045 by the day of this report, but project results are a 100% reduction in defect and a $12,915 in overall cost avoidance.

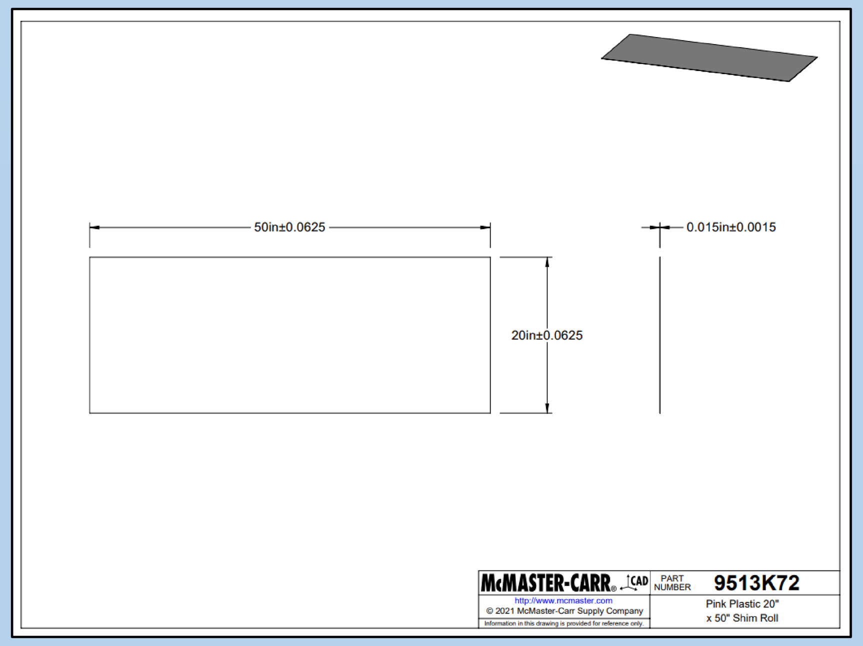

Figure 3
Plastic Shim McMaster Item

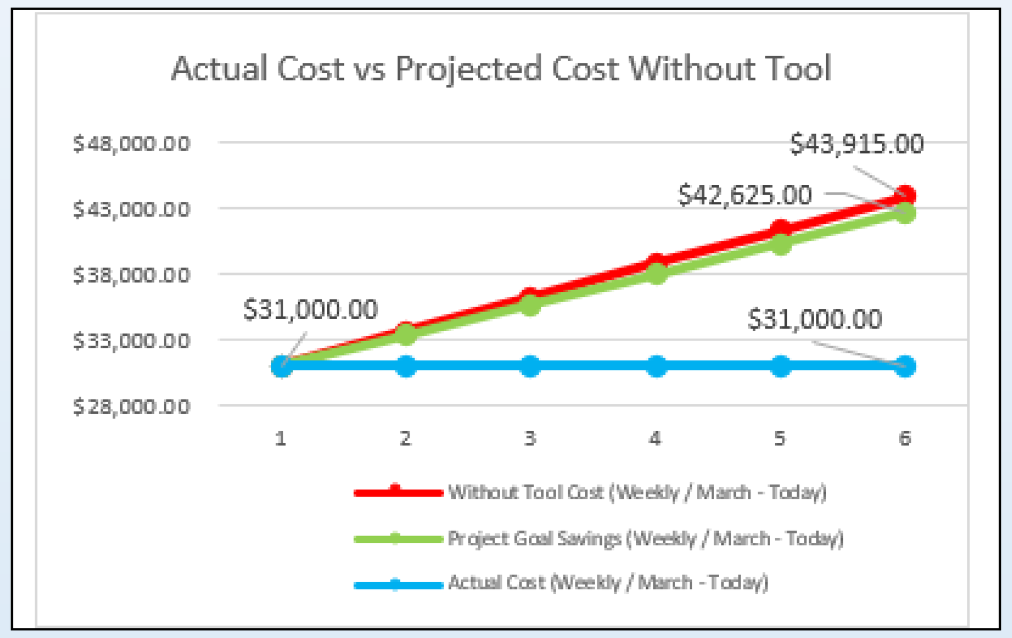

Figure 4
Actual Cost vs Projected Cost

Conclusions

The implementation of the plastic shim has successfully reduced the impact on customers caused by damaged magnet wires, leading to improved product quality and customer satisfaction. Additionally, significant improvements have been observed in rework costs and PPM metrics. The implementation of the plastic shim has successfully reduced the impact on customers caused by damaged magnet wires, leading to improved product quality and customer satisfaction. Additionally, significant improvements have been observed in rework costs and PPM metrics. The implications of these findings are twofold. Firstly, the implementation of the plastic shim has resulted in tangible benefits such as reduced defects, improved financial performance through cost savings, and enhanced customer trust. Secondly, the successful application of this solution highlights the organization's commitment to continuous improvement and adherence to quality standards.

Future Work

Moving forward, it is recommended to continue monitoring the effectiveness of the plastic shim through ongoing data collection and analysis. Further optimization opportunities within the manufacturing process should also be explored

Acknowledgments

Key players who provided essential support in all project phases of the plastic shim:

- Jose R. Ortiz (Group Leader)
- Mallie Santiago (Group Leader)
- Sheila Gonzalez (Machine Operator)
- Emmanuel Rodriguez (Sr. Manufacturing Engineer)