CAPSTONE EXPERIENCE 2015

Dixie Chopper Noise Reduction

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Background & Problem Statement

Dixie Chopper asked Purdue University's Agricultural and Biological Engineering department to evaluate the noise produced by the company's new line of Jacobsen ZT PRO commercial mowers. The company is currently in the process of designing a mower that will be sold in Europe and needs to ensure that the current design meets the standards for acceptable noise levels.

Figure 1. Jacobsen ZT PRO 60 inch mower.

The goal of the project was to evaluate the current noise level of the mower illustrated in Figure 1 and develop a design to reduce the operator noise of the Jacobsen ZT PRO. Results and final recommendations will then be presented to Dixie Chopper's line of engineers.

Design Process

In order to define the scope of the project, the team traveled to Coatesville, IN to meet with Matt Jackson, the project sponsor, at Dixie Chopper headquarters. His insight, along with the team's findings during and after significant testing, made possible the identification of key noise reduction focus points. A proposed solution to noise reduction is detailed in Figure 2 as well as in the Final Recommendations section of this poster. The testing protocol is illustrated by Figure 3 shown below. Once the problem area had been identified and potential solutions selected, the team used a precision data logging sound level meter to collect and summarize decibel level readings around the mower detailed in Figure 4.

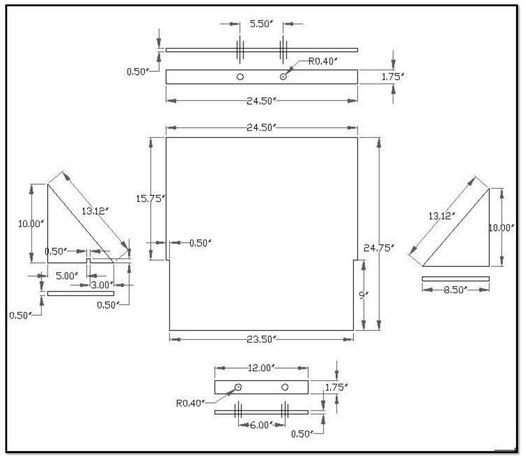

Figure 2. Technical Drawing of suggested shield design.

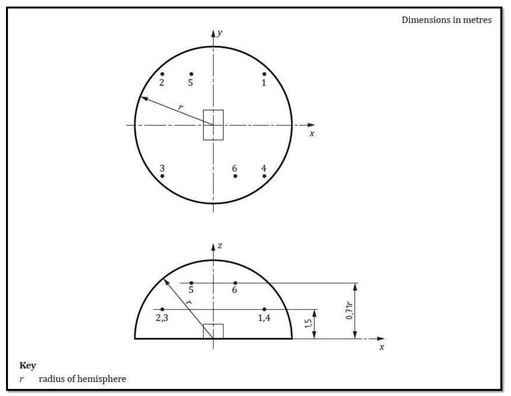

Figure 3. Sound level meter positions on the hemisphere (see Table 1).

Figure 4. Graph of sound level data.

Recommended Model

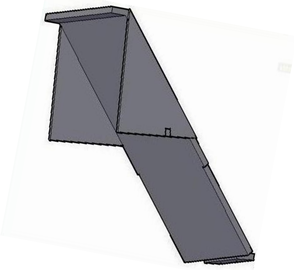

Figure 5. Isometric AutoCAD view.

Figure 6. Mower mock-up.

Criteria and Constraints

- Follow ISO 5395 testing protocol and standardization level (Refer to Figure 3)
- Modifications must hold mower under 103 dB
- Existing cut quality should not be compromised
- Modifications should be practical and not hinder routine maintenance

Impact

The data analysis graph shown in Figure 4 concludes that implementing an absorbent shield design to cover the mowers engine had the greatest impact on reducing sound levels for the operator. While sounds levels without the shield design were recorded to be well under the 103 dB mark, this additional design when added to the ZT PRO mower would aid in preserving and increasing the longevity of the operators hearing.

Final Recommendations

- The recommendation is based on empirical data collected by the team when comparing shield designs
- A bolt-on, absorbent shield design should be used to combine practicality with ease of maintenance while simultaneously having the greatest impact of noise reduction to the operator

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Technical Advisor: Dr. Daniel Ess, Professor, Agricultural and Biological Engineering
Course Instructors: Dr. Bernie Engel, Department Head, Agricultural and Biological Engineering
Dr. Bob Stwalley, Professor, Agricultural and Biological Engineering