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SCHAEFFLER E-MOTOR

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SCHAEFFLER E-MOTOR

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Final Report for 4600:402-497 Honors Design, Spring 2022

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Abstract

This project will be focusing on the work accomplished at Schaeffler to convert an existing internal combustion engine, Ford F-250 truck, into a battery electric vehicle. This report focuses on the vehicle's integration with an emphasis on the bearing design, e-Axle housing's method for mounting, bus bar design, resolver design, differential options, wiring for low and high voltage, and oil pump and cooling system for e-Beam. The bearings for the differential as well as the power transmission system from the electric motor to the e-Axle will need to be specified. By late summer 2022, Schaeffler will have a working prototype of the electric vehicle.

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1 Introduction

Schaeffler is a leading global supplier in both “hybrid and all-electric drive systems.” (Technologies for hybrid and all-electric drive systems). Their cutting-edge technology for electric axles and hybrid drive systems constantly innovates the field of vehicle manufacturing. Throughout this project, the team will support the process of stripping an internal combustion engine Ford F-250 and converting it to an electric vehicle by integrating Schaeffler technology. This prototype will be used to showcase Schaeffler’s technology to potential customers. With the completion of this project will have effects on the automotive industry, the sustainability of the ecosystem, the economy, and the duties of engineers.

With the constant advent of new technology, all industries are changing. In every technological field, “The need to reach new customers is the primary factor pioneering technological growth in the last few years” at 46% (Bulao). Schaeffler is focusing on efficient drives, a variety of chassis applications, and new industrial equipment/machinery (Strategy: Schaeffler Group). These three focuses on technological advancements allow Schaeffler to market to everyone but will give them an advantage in virtually untouched locations, such as Asia. If companies such as Schaeffler can promote to these consumers, then that is another chance to sell their technology to a new high-demand market. Other than the rapidly changing world of technology, the pressure of politics and the impacts on the environment also need to be accounted for in this foray into the automotive industry.

Now more than ever there has been pressure to consider the environmental impacts of humans’ actions. Politicians from around the globe recently met at COP26 to tackle global climate change. However, “[c]hange is not going to come from inside,” instead it is going to

come from companies and people taking an active initiative in preserving the ecosystem (Tripathi). Schaeffler “supports the increased generation of energy from renewable sources as a partner for the energy industry” (Strategy: Schaeffler Group). They have made strides in the renewable energy sector as well as improved their drives to be more carbon efficient.

Engineers are the foundation of all these fields and must be held accountable when performing their duties. “There is widespread consensus in the codes of ethics of engineering professional societies worldwide that engineering has a primary duty to protect public safety, health, and welfare” (Bielefeldt). This project will allow the students to experience the effects in each of these fields. Achieving success will open new doors in the automotive industry allowing more efficient components in the vehicles on the road. In turn, this will affect the environment, field, and politics that are involved all while challenging the group members ethics to complete the project efficiently, effectively, and safely.

In this report a brief synopsis of relevant background material for this project is provided. The process of design and design verification is included along with the timeline necessary. The relevant costs are included as well as their prospective lead times. Finally, conclusions and references are included to wrap up the report.

**Most of the subject matter section
has been redacted due to
Schaeffler's NDA.**

2.5 Conclusion

2.5.1 Accomplishments

Throughout this project, many skills were gained. Synergizing with other groups internal to Schaeffler's Wooster campus was challenging. Coordinating time for meetings accounting for their schedule as well as students' school schedule allowed for an excellent opportunity to improve time management. The global nature of Schaeffler's company was also a challenge. Teams from Mexico and Germany were consulted for design precedence and general assistance. This emphasized the importance of clarity in communication due to the language barrier. The locational differences also raised awareness for the time especially during deadlines and meetings.

By the end of the project model of the housing was created that incorporated many of the original design goals. Due to some setbacks with the project and lead time on parts the truck could not be completed by the original date of early summer. It is now projected to be assembled in September of 2022. One of the motivations for this project was Schaeffler to find prospective new innovative engineers. All three team members were offered full time positions during their time at Schaeffler.

2.5.2 Uncertainties

Throughout the project there were several direction changes that delayed the project which made having an assembled truck by the end not possible. Some of the problems were more in the control of this senior design group than compared to others. During the project there were several shifts in the design intent of the production model Schaeffler's full time engineers were making. The intention of the project was to build a model that would reasonably reflect what would be

used for production. Because they kept shifting the design intent it made progress on the demo truck slower. The delay in finalizing the housing means that all the design details are not finalized and some of the components can still be subject to change after the project is completed. The truck has also been delayed for other reasons such as long lead times for components unrelated to the housing. These delays have pushed the expected date of an assembled truck to September 2022 from June 2022.

2.5.3 Ethical considerations

There are many ethical considerations to be made in the manufacturing of this demonstration E-axle. With many components being sourced from various manufacturers or custom made in-house or from other sources, it is important to consider and verify that all the manufacturers use ethical labor practices.

2.5.4 Future work

The knowledge gained from this demonstrator vehicle will be useful for Schaeffler's production beam axle that will be used in Ford trucks. The E-axle offers a design that can be easily converted to work in various vehicles that utilize a beam axle. Beam axles are commonly used in trucks. For this reason, the lessons learned on this project are not only applicable to Schaeffler's production project with Ford, but also to other future projects with other manufacturers.

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