From Petrol To Current Creating design guidelines for road-legal motorcycle electrification

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Topic or subject

The topic of the thesis is that of road-legal motorcycle electrification through a set of guidelines. The guidelines consider the design of an electric motor mounting, a battery compartment and a driveshaft coupling and apply to any type of motorcycle. These guidelines were applied to the electric conversion of a Ural sidecar motorcycle, as part of the Ural Electric project of start-up company Twentlantis.

Background information and practical relevance

Twentlantis is a company situated on the Technology Base of Airport Twente in the premises of JFD Ortega. The owner of Twentlantis (From now on referred to as 'the client') is motorcycle enthusiast Filip Jonker, who is specialized in developing electric submarines at JFD Ortega. During the thesis assignment, the author was working on site at Twentlantis, where a Ural CT sidecar motorcycle was at the disposal of the author. The selection of components and the development of a style guide for the Ural Electric project had already been outsourced to another IDE student at the University Of Twente, however, the practical realization of the Ural Electric project should follow from the author's bachelor thesis. Hence, the practical relevance considers completion of the road-legal motorcycle electrification of the Ural CT motorcycle through the design and production of its electric motor mounting, battery compartment and driveshaft coupling.

Main research questions and assignment objective

The thesis is divided in a general part and a case study. Together they would provide a Proof Of Concept (POC). The main research question stated: How to develop, expressed in design guidelines, a design of a battery compartment, electromotor mounting, and driveshaft coupling that facilitate a road legal electric motorcycle conversion? The POC research question stated: To what extent does fulfilling the design guidelines from the General Research result in a road-legal electric conversion of a Ural-CT sidecar motorcycle?

The objective of the thesis consisted of providing the POC, aimed at developing an electrification package through the guidelines as provided in the thesis. This electrification package was applied to convert a regular Ural CT sidecar motorcycle into an electric sidecar motorcycle.

Approach (with intermediate results)

The general research consisted of evaluating the system architectures of different types of motorcycles to get insight into the changes that occur from electric conversion of a motorcycle. Besides this, the available components were evaluated for previous and/or regular use, the influence of changes in the Center Of Gravity (COG) on motorcycle

handling were evaluated, after which all relevant testing requirements for receiving an Individual Certificate of Approval (road-legal status in The Netherlands) were evaluated.

From this general research, the final requirements including the client's design brief were formulated, after which the design guidelines for the electric motor mounting, battery compartment and driveshaft coupling were created. Next, these guidelines were applied during the Case Study, where the electrification package for the Ural CT sidecar motorcycle was designed and produced.

Results

The practical results of the thesis, or the Case Study results, were a fully functional driveshaft coupling and a fully functional electric motor mounting. The battery compartment design included several design- and production flaws, meaning it was not satisfactory. The battery compartment design did give the client a good general direction to follow for further development, which in the end did deliver a satisfactory battery compartment, however not part of the thesis.

Conclusions and recommendations

The main research question concerned the development of the design guidelines. For the battery compartment, this question does not have a clear answer, as unfortunately the guidelines were not followed as intended during the Case Study. For the electric motor mounting, it can be stated with confidence that the guidelines answer the research question, as they were followed during the Case Study and resulted in the desired component. For the driveshaft coupling, the research question answer is unsure, as the thesis does not give a definite answer on whether they function as intended, since they were not applied as intended but did provide the desired result.

The recommendations for the client consisted of some component optimization possibilities. Besides this, it was recommended to conduct further research considering testing and optimizing the guidelines. This was recommended because not all guidelines were tested thoroughly and the sample size of a single motorcycle conversion is rather small.