The future of the electrical machine?

A summery of the project:
Analytical approach to understanding the tooth height variations of the stator in an axial flux machine and its impact on the airgap

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***Höganäs AB* is designing what they think is the product that will be the future of electrical machines - at least for some applications. Since we are going towards a future where the cars will run on electricity instead of petrol, is the need for small electrical motors within the cars increasing. This project highlights challenges and possible solutions regarding the manufacturing of the stator component and if machining of the component is a possible option to achieve better results.**

The market of electrical machines is dominated by designs where parts are manufactured by laminated steel. This laminate consists of layers of metal altered with an insulating layer. *Höganäs'* idea is to use a newer technique, where components made of powder metal is used instead of the laminate. This powder is special because each powder grain is coated with an insulating layer, just like in the laminate, but in much smaller scale. The insulated particles gives an advantage towards the laminate, because it generates lower losses. With powder material is it also possible to design a motor with less components and low scrap rate in the production.

On important parameter when building an electrical motor is the distance between the rotating part and the stationary part. This distance is known as the *airgap*. To build an efficient motor, with minimum of losses, vibrations and noise is it important that this airgap is even. The component that is believed to have the biggest impact on the airgap is the stator component in the motor. A picture of the stator is shown in figure 1.

The recently preformed project tries to optimize the production of the stator, to make the impact is has on the airgap less significant. The results from thees experiments were successful regarding one out of two properties that where addressed. The project also highlights areas around the production that could be investigated further to achieve an even better result.

To improve the stator even further, the machining method grinding were investigated. This test showed that it is possible to grind a component, but this may affect the material property called *resistivity* negatively.
According to the results the impact on the property is depending on the fineness of the grinding wheel. However, the *resistivity* can somewhat be restored by using a technique where the grinded surface is treated with an acid.

To build a motor, the stator component needs to be attached in the motor housing in some way. One possible solution that the company *Höganäs* consider is a method called crimping. Crimping is a method that is using heat to assemble two pieces that does not fit together in room temperature. A metal starts to expand when it is heated, and this is used to attach the stator into the motor housing. However, this project shows indications of that the stator is deformed due to the force the crimping generates, and that the possible deformation or the stresses in the material leads to bigger losses regarding a material parameter called *magnetic coercivity*.

This report adds a few pieces to the big puzzle of understanding and designing the new electrical motor. The design shows great promise, even though there are more pieces to add before this will revolution the world.

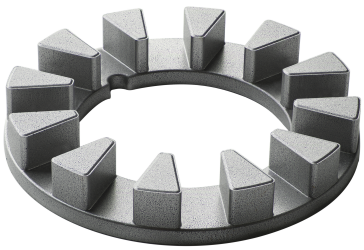

Figure 1: The stator component