ABSTRACT

Klop, Richard James., M.S.E, Purdue University, August, 2007. A Simulation-Based Investigation of the Influence of Valve Plate Design to Reduce noise of Compact Power-Split-Drive Transmissions. Major Professor: Dr. Monika Ivantysynova, School of Agricultural and Biological Engineering.

The aim of this research is to complete three primary objectives: (1) to demonstrate a simulation-based approach of reducing noise sources in compact hydrostatic power-split-drive transmissions while maintaining efficiency, (2) to investigate the influence of valve plate design in regards to noise sources of a pump and motor in a power-split-drive transmission, (3) to determine how transmissions with different size displacement machines affect noise sources as well as the potential for noise reduction through valve plate optimization. Two output-coupled power-split-drive transmissions of different sizes are modeled based on identical drive cycles: Transmission A with two identical 85 cc bent axis units, and Transmission B, which is linearly scaled down from transmission A, with two identical 18 cc bent axis units. The influence of valve plate design to reduce noise sources over a complete operating range is the primary focus. A valve plate optimization strategy is introduced and implemented on both the pumping and motoring units of each output-coupled transmission. Comparisons between the standard and newly designed valve plates of both transmissions indicate promising noise source reductions. Comparisons between standard valve plate designs of each transmission determine how transmissions with different size displacement machines affect noise sources. Furthermore, comparisons between newly designed valve plates of each transmission demonstrate the potential for noise reduction through valve plate optimization.

This research emphasizes the complexity of optimizing for minimum noise sources over a large operating range of a power-split transmission; numerous design factors are considered.