The Wave Disk Engine (WDE) is a revolutionary engine that utilizes principles of unsteady flow and fast combustion, taking advantage of shock waves and constant-volume heat addition. The WDE references the Atkinson cycle (also called the Humphrey cycle), which combines both confined combustion, as in the Otto cycle, and complete gas expansion, as in the Brayton cycle. This new engine concept, with few moving parts, has the potential to significantly outperform existing heat engines. Four WDE prototypes have been developed and built and two test cells have been used for testing. A working, real-size WDE prototype has been used for testing and evaluation of the performance of new parts and settings and an Optical WDE prototype has been used to optically analyze the combustion inside the WDE. The objective of the work is to enhance the understanding of the practical WDE operation for the further development of new WDEs prototypes with increased performance.

The work details practical challenges and methods to successfully overcome these. This includes a description of the developed electromechanical testing facility with computer control system, diagnostic techniques, and power measuring equipment. Power analyses of the working WDE prototype are performed on the bases of acceleration of the WDE measured on the test stand. The results are related to the Air/Fuel Ratio (A/F) and the number of return channels in the design. Further operational conclusions are drawn from a flame speed analysis of the combustion inside the Optical WDE. High Speed Imaging of combustion was used to track flame fronts inside the WDE providing data for the understanding of how Equivalence Ratio, Rotational Speed (RPM), Spark Plug Position, and Injection System relate to the flame front speed.