

## **Abstract of the doctoral thesis**

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### **Title:**

**The impact of the structure of polymer gears with a reduced mass on the durability of gears manufactured using the FFF method**

The aim of the doctoral thesis entitled: "The impact of the structure of polymer gears with a reduced mass on the durability of gears manufactured using the FFF method" was to carry out the title analysis of gears with a modified disk geometry, taking into account the possibilities of additive technologies in the production of complex geometric structures.

The doctoral thesis contains an analysis of the literature, which includes, among others: the development of CAD systems and additive technologies, the increasing share of the use of AM technology in industry, and the increasing importance of the use of polymer materials and their composites. The theoretical part included the design characteristics of gears, modifications of gear geometry taking into account weight reduction, methods and materials used in producing of gears (including AM technology), and CAD modeling methodology. Based on the literature review and the adopted topic of the doctoral dissertation, a research plan was developed.

As part of the practical part, the geometry of cooperating pairs of gears with reduced mass was developed, based on gears without modification of the rim in Autodesk Inventor software. Before performing research on the developed gear structures, tests were carried out to analyze the influence of the prototype material and the density of the internal structure used on the tensile and torsional strength of standardized samples. Their goal was to select a material for producing the gears in question and to determine the internal structure ensuring the highest mechanical strength. Based on them, ABS material was selected. Non-linear analysis of gear pairs was performed in the Autodesk Inventor Nastran 2021 environment.

Then, a static test stand was adapted to test the static strength of a series of polymer gears, analyzing the maximum loading moment and torsional angle. The paper describes representative samples and the most common damage to gear pairs.

The station for durability testing of gear transmissions was also adapted. A research program was developed experimentally. Several parameters were recorded during the tests. The developed design solutions of gears were analyzed, allowing their use, taking into

account the reduction of production costs while maintaining the greatest possible durability and strength. After completing a series of tests, the obtained results were analyzed and described.

**Keywords:** *polymer gears, FFF technology, reduced mass, modification in the design of gear discs, MEX technology, durability of polymer gears*