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ABSTRACT OF DOCTORAL DISSERTATION

Title: *Methodology of designing and manufacturing welding fixture systems using additive manufacturing techniques for the aerospace industry*

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The subject of this dissertation concerns the use of additive manufacturing technologies, particularly 3D printing, in the design and production of welding fixtures. The main objective of the research was to develop innovative welding fixtures equipped with internal cooling channels, which can shorten cooling time and reduce wear caused by elevated temperatures.

The analysis of the current state of knowledge highlighted the growing importance of additive manufacturing technologies in the industry and identified a research gap regarding their application in welding fixtures. Most existing studies focus on injection molds, underscoring the need for further research on cooling channels in the context of welding.

The research process included 3D-CAD computer modeling of the fixtures, computer simulations of heat distribution and fixture strength using the ANSYS program, the creation of technological prototypes using the PBF method with AlSi10Mg aluminum, and laboratory and production tests. The results showed that fixtures with internal cooling channels outperform traditional solutions in terms of cooling efficiency. The new designs significantly reduce cooling time and decrease wear caused by high temperatures, demonstrating better thermal properties than conventional solutions with copper inserts.

The summary contains a synthesis of conclusions and observations regarding the application of additive technologies in welding tooling, along with proposals for future research.

The work may represent a significant contribution to the development of additive technologies and their application in the industry, offering valuable insights and recommendations for further research and implementations, particularly in the context of optimizing cooling channels and the use of new materials and technologies.