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The Faculty of Mechanical Engineering and Aeronautics

**Abstract of doctorate thesis**

**Title:** *Analysis of the plasticizing effect of thin sheets of aluminum and magnesium alloys in the Friction Stir Welding process for use in aviation and automotive constructions*

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Abstract: The dissertation analyzes the problem of joining light metal elements of various structures, especially in the aviation and automotive sectors. We are constantly looking for better solutions that guarantee lightness of the structure, it’s durability, tightness, and safe operation under difficult operating conditions. The presented research concerns the joining of thin-walled elements made of light alloys of aluminum and magnesium, without additional joining material, in the process of friction stir welding (FSW - *Friction Stir Welding*). Based on the presented analysis of the state of the art regarding scientific research on solid-state joining technology, the concept of a targeted research program for joining aluminum and magnesium alloys using FSW technology was presented. The influence of selected technological and geometrical parameters of the process on the phenomenon of plasticization of joined materials was presented. The analysis of the results was developed on the basis of tests of the mechanical properties of the obtained joints (static strength, fatigue strength, microhardness,) macro and microstructure tests in the area of the weld and parent material, and the measurement of the forces acting on the tool as a material response to the load resulting from the adopted process conditions. The paper presents the results of a detailed analysis of the phenomenon of plasticization of joined materials in the welding zone of thin sheets of aluminum and magnesium alloys, in the field of structural and mechanical tests, aimed at recognizing the specific features and effects of the phenomena occurring during the implementation of the process, the results of which not only have a cognitive aspect but also an application one. The paper also presents the effects of the implementation of the FSW technology to make a demonstrator of the structural elements of the M28 aircraft, eliminating the existing riveted joints. The following connections were tested: - butt welding of AZ31 magnesium alloy sheets of 0.5 mm in thickness, - butt welding of AA2024-T3 aluminum alloy sheets of 0.5 mm in thickness, - lap joints of AA2024-T3 aluminum alloy sheets with 1 mm and 3 mm in thickness and joining elements of the FSW technology demonstrator. It has been shown that joining metallic materials using the friction stir welding technology allows for the creation of high-quality, durable, defect-free joints with high mechanical properties (static and dynamic) of AA2024-T3 and AZ31B sheets of various thicknesses and types of joints (butt and lap joints). The identified specific material and mechanical properties of joining thin sheets allow for the proper selection of the type of joint and parameters of the FSW process, providing the basis for enriching the state of knowledge and creating new solutions in this field in various industries, including aircraft and automotive structures.