RZESZÓW UNIVERSITY OF TECHNOLOGY
Faculty of Mechanical Engineering and Aeronautics
Department of Foundry and Welding.

Rzeszow, 30.09.2024.

DIPLOMA THESIS ABSTRACT

ANALYSIS OF THE IMPACT OF TECHNOLOGICAL PARAMETERS OF WELDING THIN-WALLED COMPONENTS USED IN AIRCRAFT ENGINE CONSTRUCTION ON THE MINIMIZATION OF THEIR DEFORMATIONS

Bartłomiej Kucel
Supervisor: Dr. habil. Eng. Marek Mróz, University Professor
Key words: welding, deformations, aircraft engine, TIG.
Abstract:

The doctoral dissertation addresses issues related to the welding technology of thin-walled aircraft engine components made of 17-4 PH stainless steel and Inconel 718 nickel alloy. The main objective of the study was to analyze the impact of technological welding parameters on the deformation of these thin-walled components. The proposed solutions include both the development of innovative welding fixtures and the precise selection of technological parameters for the TIG (Tungsten Inert Gas) method.

The first part of the dissertation discusses the materials used in aircraft engine construction, with a particular focus on high-alloy steels and nickel alloys. Subsequently, an analysis of welding methods is presented. The next section of the work is dedicated to issues related to welding stresses and deformations, including their formation, prediction, and methods of reduction.

In the subsequent part of the dissertation, experimental research was conducted to verify the effectiveness of the proposed solutions. The research included the selection of process parameters, the development of fixtures, as well as the setup for semi-automatic TIG welding. Welding trials were performed, followed by measurements and analyses of the test joints. This included non-destructive testing, heat treatment, and destructive testing such as microstructure analysis, hardness measurements, and evaluation of mechanical properties.

The positive results obtained from the research confirm that the newly developed technology for semi-automatic welding of thin-walled aircraft engine components significantly reduces welding deformations. It was demonstrated that through integrated actions at all stages of the production of thin-walled welded joints, welding stresses and resulting deformations can be minimized. A crucial element of this technology, especially considering the implementation nature of the doctoral thesis, is the newly developed welding fixture, which minimizes welding deformations at the welding stage itself. Additionally, the appropriate selection of technological parameters for semi-automatic TIG welding, along with the application of heat treatment at the final stage of manufacturing thin-walled aircraft parts, significantly influences the reduction of welding deformations.

The achievement of the scientific and utilitarian objectives confirms the thesis of the dissertation: that by developing a welding technology for thin-walled components made of 17-4 PH stainless steel and Inconel 718 alloy, based on an innovative welding fixture design and selecting technological parameters for semi-automatic TIG welding, followed by post-weld heat treatment, it is possible to minimize welding deformations, reduce costs, and improve the quality of work related to aircraft engine assembly.