Summary

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„ Increasing the operating range of the mobile platform for motor vehicles while maintaining the curb weight"

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The introduction of exhaust emission standards in motor vehicles forced vehicle manufacturers and constructors to find solutions that would meet the restrictions resulting from the above-mentioned standards. For this purpose, motor vehicles have been introduced, inter alia, particulate filters, exhaust gas catalysts and a number of other elements of exhaust systems, which reduce the level of exhaust emissions to the atmosphere. As a result of introducing structural elements with new functions, the curb weight of the vehicles increased significantly. As a result, manufacturers are currently looking for technological solutions that would make it possible to reduce the weight of the structure while maintaining or increasing the functionality of a given type of vehicle. In the case of mobile platforms, efforts are made to expand their operational range and load capacity, while ensuring compliance with safety requirements.

The increasing demand for high-strength materials has led to the development of martensitic AHSS (Advanced High-Strength Steel) steels with an immediate tensile strength of 1700 MPa. However, these steels are characterized by unsatisfactory plastic properties, the registered relative elongation in these steels is at the level of 4-5%. A set of features resulting from the dominant martensitic structure of these materials make AHSS steels difficult to weld. During the welding process of structures made of these steels, despite the use of preheating, cracks in the joints are observed both in the heat-affected zone and in the weld. A significant disadvantage of these steels is that after the welding process, the joint strength is at a level twice lower than that of the parent material. Therefore, the aim of the work was to develop a method of manufacturing a welded structure made of AHSS steel, characterized by appropriate high strength properties of joints. Docol 1200M steel was selected as the research material. The analysis of the literature as well as the preliminary tests performed allowed for the selection of the MAG method and micro-jet cooling as the most advantageous, innovative welding method and the appropriate selection of process

parameters, enabling the execution of joints without welding defects for this group of steels. The analysis of the obtained results made it possible to formulate the thesis that "modification of the welding process of high-strength steel from the AHSS group in the construction of mobile mobile platforms mounted on motor vehicles, through the use of micro-jet cooling and a copper pad, will allow for better mechanical properties of the joint, and by this will enable a significant extension of the operating range of the platform, without increasing the total weight of the structure and while maintaining compliance with safety requirements ".

In order to prove the thesis, basic tests were carried out, which included: modification of the MAG welding process with micro-jet cooling through the additional use of a copper washer, forming the root of the weld and enabling heat dissipation from the side of the root; selecting the parameters of the modified process; execution of a welded structure made of AHSS steel, characterized by a 20 % higher work range; carrying out structural and strength tests of joints of the welded structure. The analysis of the results of the tests (tensile strength, fatigue strength, hardness, bending tests) and non-destructive tests (visual, magnetic-particle, radiographic) as well as the microstructure of the welded joint allowed to prove that the manufactured joints are characterized by the desired, high mechanical properties, are without welding defects, and the obtained results are repeatable. Moreover, by obtaining the WPQR Welding Procedure Qualification Record certificate, it was proved that the developed innovative method of manufacturing mobile landing structures made of non-weldable AHSS steels meets the requirements of EN ISO 15613 "Approval of Welding Technology". The results of laboratory tests and on the real object allowed to confirm that the developed and implemented method enables the production of a durable joint of the mobile landing while maintaining the rigidity of the structure without increasing the weight of the vehicle, and the resulting structure meets the safety conditions. The thesis of the work has been proven. The developed, verified and then validated welding process was the basis for the patent application no. P429818.