

**POLITECHNIKA ŚLĄSKA**  
**WYDZIAŁ INŻYNIERII MATERIAŁOWEJ**



**Politechnika  
Śląska**

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Wpływ parametrów odlewania i obróbki cieplnej na kształtowanie  
struktury i właściwości mechanicznych odlewów ciśnieniowych bloku  
silnika samochodowego

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## Abstract

**Thesis title:** Effect of casting parameters and heat treatment on structure and mechanical properties of high pressure die casting engine block

This thesis was the result of an “Industrial PhD program” carried out in Nematik Poland Sp. z. o. o. The company specializes in high pressure die casting technology of aluminum alloys. The goal of the research was to develop technology for serial production of engine block housing from EN AC-46000 (AlSi9Cu3(Fe)) alloy. The main criterion from the customer’s side was to increase the content of internal scrap in the final product to 60-70%. Nevertheless, the castings had to meet new, more demanding requirements for mechanical properties of the engine block. The required parameter levels were  $UTS \geq 210$  MPa and  $Elongation A_5 \geq 1\%$ . The values were the highest at that time for this class of product in Nematik Poland. The investigation began with a complex analysis of archival production data from 2017-2019. The conclusion was that the required level was achievable, however, certain technological modifications were required. Three activities regarding the thesis were performed. Firstly, the effect of increased scrap content was investigated, focusing on the structure and mechanical properties of engine blocks from two alloys with minimum and maximum scrap content. The results indicated that there is no significant difference in the chemical composition, microstructure, and mechanical properties (including the influence of heat treatment). In the second stage, the influence of changing liquid alloy level in the holding furnace was checked. The results showed that, at low levels of alloy, there was a higher concentration of lead particles in the produced HPDC castings. Higher content influenced the mechanical properties by decreasing them below the requirements. Finally, the last part was dedicated to the implementation of a new innovative dosing system for HPDC. Due to the features of the system and internal improvements of the process, the influence of lead particles was reduced. The Customer’s requirements were achieved.