

# OPINION

on the dissertation

for awarding the educational and scientific degree "Ph.D." in the

**Field of Higher Education – 5. Technical Sciences**

**Professional Field – 5.1. Mechanical Engineering**

**Doctoral Program – "Construction Mechanics, Strength of Materials"**

**Author:** Eng. Petya Hristoforova Daskalova, MSc

**Topic:** „Increasing the fatigue life of fastener holes in aluminum alloy D 16 AT using a modified split mandrel cold working method“

**Member of the Scientific Jury:** Assoc. Prof. Dr. Eng. Borislav Tsonev Stoyanov

## 1. Topic and Relevance of the Dissertation

The dissertation analyses the existing approaches and their implementing methods for increasing the fatigue life of structural elements with fastening holes and on this basis substantiates the advantages of the modified SMCW, which overcomes a key drawback of the basic method: the need for very tight tolerances of both the diameter of the pre-machined holes and the tool, which significantly complicates the technological cycle. The proposed modified MSMCW method represents a significant step towards achieving greater technological reliability and reduced production costs in the conditions of wider tolerances of the diameter of the pre-machined CO. The method is applied to a high-strength aluminum alloy, 2024-T3 (analog of D16AT), preferred in modern engineering applications for the manufacture of structural elements in the aviation industry, transport engineering and other industries, where the components are subjected to cyclic loads. This proves the relevance of the dissertation.

## 2. Research Methodology

The methodological framework of the dissertation is well-founded and consistent. To assess the effectiveness of the modified method (MSMCW) for cold expansion of CO, an experimental approach was used, including modern research techniques: microstructural analysis by optical microscopy and scanning electron microscope (SEM), microhardness measurement experiment and X-ray diffraction analysis to determine the circumferential residual stresses with evaluation of the gradient in the axial direction and pulsating cycle fatigue tests. Therefore, I believe that the obtained results are reliable.

## 3. Contributions of the Dissertation

I accept the proposed contributions and summarize them as follows:

*Scientific and Applied Contributions*

- Morphological classification scheme of the main approaches and the methods realizing them for increasing the FL of metal structural elements with FH;

- It has been proven that, under conditions of excessively large dispersion of the diameters of the pre-processed holes, the MSMCW method provides an intensive and deep zone with introduced beneficial hoop RSs on both end faces of sleeve-type samples made of 2024-T3 aluminum alloy after CEH and after final reaming of the holes;
- The effect of grain refinement near the surface of the holes in 2024-T3 aluminum alloy after CEH by the MSMCW method under conditions of different pre-processed hole diameters was established;
- It has been proven that the removal of a plastically deformed layer of appropriate thickness around the CEH during final reaming provides a homogenizing effect in the distribution of the hoop RSs in the axial direction, which improves the fatigue behaviour under pulsating cycles of sheet components made of 2024-T3 aluminum alloy.

#### *Applied Contributions*

- An experimentally validated instrumental approach for technological implementation of MSMCW has also been developed, which can be implemented in real production conditions;
- S – N fatigue curves for pulsating cycles, proving the effectiveness of the MSMCW method under conditions of excessively large dispersion of the pre-processed hole diameters for increasing the FL of 2024-T3 aluminum alloy more than six times compared to the conventional case of processing the FH.

#### **4. Publications and Citations Related to the Dissertation**

A total of 5 scientific papers have been published on the dissertation, distributed according to the place of publication, as follows:

- 1) Two scientific reports at an international scientific conference “Mechatronic, Eco- and energy saving systems and technology”;
- 2) A scientific article in a Journal of the Technical University of Gabrovo;
- 3) A scientific report at an international scientific conference Unitech 2024, Gabrovo;
- 4) One scientific publication in an international scientific journal Metals, issued by MDPI, – Impact factor 2.5 for 2024.

The number and quality of the publications fully meet the requirements for acquiring the educational and scientific degree "Doctor" (PhD).

#### **5. Authorship of the Results obtained**

The doctoral student is the sole author of one publication on the dissertation, in two she is co-authored with her scientific supervisors, two are co-authored with colleagues from the academic staff of the department in which the dissertation work is defended. I believe that Eng. Petya Hristoforova Daskalova, MSc has significantly improved her qualifications in the field of the research problem.

#### **6. Opinions, Recommendations, and Remarks on the Dissertation**

The dissertation is well-structured and written. The experimental research conducted is thorough and well-founded. I have no substantial remarks of principle.

## **7. Conclusion**

I consider that the presented dissertation meets the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria. The results achieved give me reason **to recommend** that the educational and scientific degree "Ph.D." be awarded to

Eng. Petya Hristoforova Daskalova, MSc in the

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**Date:** 26.01.2026

**Signature:** /signature/

/ Assoc. Prof. Borislav Stoyanov /