**TECHNICAL UNIVERSITY OF VARNA**
**DEPARTMENT OF TRANSPORT ENGINEERING AND TECHNOLOGIES**

# STANDPOINT

by Assoc. Prof. PhD. Eng. Radostin Dimitrov Dimitrov
Technical University of Varna

on the dissertation for obtaining the educational and scientific degree of "Doctor" of
Mag. Eng. Plamen Ivanov Stoyanov

**Topic of the dissertation**: "**INFLUENCE OF DEEP CRYOGENIC TREATMENT ON THE STRUCTURE AND PROPERTIES OF THERMALLY HARDENED AND THERMALLY NON-HARDENABLE ALUMINUM ALLOYS**"

***1. Actuality of the problem in the dissertation***

Aluminum alloys are one of the most used non-ferrous metal construction materials, applied in various fields such as: automotive industry, mechanical engineering, chemical industry and other fields. Compared with traditional heat treatment, deep cryogenic treatment (DCT) has its advantages in improving the performance of aluminum alloys. The DCT process is environmentally friendly and inexpensive and can significantly improve the microstructures and characteristics of metals with small deviations in their dimensions and shapes.

The dissertation contains 186 pages. This includes 120 figures, 51 tables and 15 formulas. The material covers four chapters, an introduction, general conclusions, contributions, a list of publications on the topic of the dissertation, and references.

***2. Knowing the status of the problem***

The literature review made by the PhD student shows a thorough approach used to solve the given problem. With the analysis carried out, the PhD student shows that he knows the scientific achievements in the field of methods for strengthening the alloys used in research, the different modes of heat treatment and surface plastic deformation.

The conclusions made at the end of the first chapter correctly reflect the state of the problem and help to correctly formulate the purpose and objectives of the study.

***3. Assessment of the credibility of the material on which the contributions are based***

The reliability of the material on which the PhD student draws his conclusions and claims contributions is based on the comprehensive and in-depth scientific approach to conducting the research. The description of the methods of processing and analysis shows that the PhD student has a very good command and knowledge of the devices with which he works and also has an active participation in conducting experimental research. The data obtained are determined correctly and correctly, which determines that the analysis of the results is correct and accurate.

***4. Contributions of the dissertation***

The dissertation presents a study on the influence of DCT on four types of aluminum alloys - AlSi7Mg, AlSiMgMn, AlMg4.5 and AlMg6. Conducted experimental studies, which include: Conducting deep cryogenic treatment; Conducting

surface plastic deformation; Microstructural analysis; X-ray structural phase analysis; Determination of Vickers Microhardness; Determination of tensile strength; Determination of the degree of electrochemical corrosion; Determination of roughness.

A regression model has been made to analyze the relationship between the mechanical and operational characteristics of aluminum alloys, thus it is possible to achieve optimization of the technological parameters and properties of the alloys used with high predictive ability.

After conducting the experimental studies and processing the results obtained, the main conclusions and conclusions were made. Contributions to the dissertation are separated, and they are divided into three groups: scientific, applied and applied. Scientific contribution – it is accepted when a new, previously non-existent scientific result or previously unapplied theory and technology of research in a particular field of great significance has been achieved. The proposed scientific contributions can be attributed to the scientific and applied ones. I consider the rest of the contributions to be adequate, properly defined and credible.

***5. Assessment of the degree of participation of the PhD student in the development of the dissertation and contributions***

I believe that the doctoral dissertation and contributions are the personal work of the doctoral student Plamen Ivanov Stoyanov, which is confirmed by the above publications to the dissertation. Of the four publications mentioned, one is independent and the other three are co-authored with one of the supervisors.

I definitely believe that only a PhD student who is actively involved in the conduct of scientific research is able to report and answer with confidence the questions posed.

***6. Implementation of the research results***

The results of the dissertation are useful and are subject to direct use and implementation in practice, giving a direct link in the choice of a method for strengthening aluminum alloys containing various alloying elements. Their implementation in the educational process is also completely adequate.

***7. Critical remarks***

I have no critical remarks on the development of a dissertation submitted to me for an opinion. It is a useful, theoretical and experimental study with a specific contribution in the field of materials science and subsequent processing of aluminum alloys in order to improve the qualities and characteristics of the final product. The development fully meets all the requirements for a doctoral dissertation under the Law on Republic of Bulgaria.

***8. Evaluation of the abstract***

The abstract is formatted in accordance with the requirements of the Law on the Prevention of Corruption and Corruption and reflects in an abbreviated form the main content of the research in the dissertation. The published scientific papers reflect the main results and contributions of the dissertation.

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***CONCLUSION:***

From the presented evidence and analyses, it can be seen that the defended contributions in the doctoral dissertation are significant and are oriented towards theory and practice, showing new facts related to the use of deep cryogenic treatment on various types of thermally hardened and thermally non-hardenable aluminum alloys in order to improve the qualities and characteristics of the manufactured final product.

Given the relevance, scientific level and contributions of the dissertation relating to a problem whose solution is of great environmental and economic importance, I believe that the dissertation submitted to me for opinion can be given an overall **positive** assessment.

I propose to the Honorable Scientific Jury to award to the PhD student **Plamen Ivanov Stoyanov** the educational and scientific degree "**Doctor"** in the doctoral program "Technology of Machine-Building Materials" in PN 5.1. Mechanical Engineering".

12.01.2026
Varna

Member on NJ:.....
/Assoc. Prof. PhD Eng. R. Dimitrov/