

REPORT

by **Prof. Eng. Rayko Danailov Stanev, Ph D** regarding a dissertation work for obtaining the educational and scientific degree "Doctor (Ph D)" in a scientific area 5. "Technical Sciences", professional direction 5.1. "Mechanical Engineering", in the doctoral program "Engineering Materials Technology".

Author of the dissertation paper: Eng. Plamen Ivanov Stoyanov

Topic of the dissertation paper: „Effect of the Deep Cryogenic Treatment on the Structure and Properties of Heat-Treatable and Non-Heat-Treatable Aluminum Alloys“

REASON for preparing the report: Order No. **716/29.10.2025** of the Rector of the Technical University – Varna for appointment of a scientific jury and decision of the scientific jury, reflected in the protocol of its first meeting, held on 18.11.2025.

1. Actuality of the problem elaborated in the dissertation paper

The development of aviation and space technique, automotive production and remaining branches of mechanical engineering, metallurgy, chemical industry, and other manufacturing sectors imposes increased requirements on the properties of aluminum alloys used by them. It is therefore particularly important to select suitable methods for their treatment in order to optimize their mechanical and operational parameters.

Compared to traditional heat processing, the deep cryogenic treatment (DCT) has certain advantages at improving the microstructure and properties of aluminum alloys. For it small deviations in the dimensions and shape of the treated metals, while ensuring acceptable levels of technical-economical and environmental indicators of the process are typical. DCT is applicable to both heat-treatable and non-heat-treatable aluminum alloys. Its effects depend on the specific composition of the metal and the processing conditions. Therefore, the problems related to the optimization of the parameters of the procedure under consideration are of key importance for achieving the desired results, which makes the research covered by this work relevant and significant in scientific and scientific-applied terms.

From the above, it can undoubtedly be concluded that the problem chosen for solution in the proposed dissertation reveals serious challenges and is highly relevant and significant for modern industry. Its main objective, which is **to analyze the changes in structure resulting from deep cryogenic treatment and their impact on the mechanical properties of thermally hardenable and thermally non-hardenable aluminum alloys**, as well as the tasks arising from it, are also relevant, and their formulation is clear and specific.

2. Contributions of the dissertation paper

The studies described in this work have given the author grounds to claim a total of 11 contributions, classified by type as follows: 3 scientific, 5 scientific-

applied, and 3 applied. The put under No. 2 in the first category enriches the existing knowledge on the issues under consideration, while the other two are of a confirmatory nature. The scientific-applied contributions numbered 3 and 4, as well as all those listed in the third category, have a potential to be implemented in practice and to achieve a corresponding economic effect. The remaining three scientific-applied contributions enrich the existing knowledge on the influence of DCT on the structure and properties of thermally hardenable and thermally non-hardenable aluminum alloys, and provide an opportunity for quantitative description of the parameters characterizing this technology.

I support both the validity of the author's stated achievements and the correctness of their distribution by category.

3. Critical remarks on the presented paper

I have no remarks and recommendations for the author and his work.

The third scientific-applied contribution claims that the developed technology through an application of DCT, along with its other advantages, is also economically grounded. In this regard, I have the following question:

Does the colleague have any specific data on the cost of the proposed processes and possible comparisons with alternative methods for improving the properties of aluminum alloys?

Conclusion

The presented work has the volume and quality of a dissertation for awarding the educational and scientific degree "Doctor (Ph D)". It corresponds to the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Regulations for its Application and the Regulations for Admission, Training of Doctoral Students and Acquisition of the Educational and Scientific Degree "Doctor" and the Scientific Degree "Doctor of Science" at the Technical University – Varna.

In view of the above findings I give a **positive evaluation** of the dissertation and recommend to the remaining members of the esteemed scientific jury to support the awarding of Eng. Plamen Ivanov Stoyanov of the educational and scientific degree "Doctor (Ph D)" in a scientific area 5. "Technical Sciences", professional direction 5.1. "Mechanical Engineering", in the doctoral program "Engineering Materials Technology".

08.01.2026

Signature:
(Prof. Eng. Rayko Danailov Stanev, Ph D)