ABSTRACT

of the dissertation by Saltanat Amangeldievna Nurkusheva on the topic "Scientific Substantiation of the Parameters for a Scissor-Type Automotive Lift Platform" submitted for the degree of Doctor of Philosophy (PhD) in the educational program 8D07106 – "Transport, Transport Equipment and Technologies"

The relevance of the dissertation work is driven by the need to enhance the The dissertation research was carried out within the framework of the priority scientific areas “Energy, Advanced Materials and Transport”, defined by the strategic state documents, including the Concept for the Development of the Transport and Logistics Potential of the Republic of Kazakhstan until 2030, as well as the directions of industrial digital transformation and the implementation of modern engineering design technologies.

Under modern economic conditions, automotive service enterprises represent an important component of the infrastructure ensuring vehicle mobility and transportation safety. The increasing number of vehicles and growing requirements for the quality of maintenance and repair necessitate the introduction of advanced technological equipment capable of improving the efficiency and safety of service operations.

One of the most widely used types of equipment at automotive service stations is the scissor-type vehicle lift designed for lifting vehicles during diagnostic, repair, and maintenance operations. The use of such equipment improves access to vehicle assemblies and units, reduces the duration of technological operations, and enhances occupational safety.

However, the analysis of vehicle lift operation reveals several structural and operational drawbacks. The most common problems include the high metal consumption of the platform structure, significant dimensions and weight of the equipment, as well as displacement of the scissor lift platform during lifting, which may lead to аварийные situations and vehicle damage. Other issues include component wear caused by insufficient maintenance and improper adjustment of the control system, resulting in uneven lifting.

Existing structural solutions for scissor lift platforms, in most cases, do not provide an optimal balance between structural rigidity and metal consumption.

Therefore, there is a need for scientific substantiation of the lift platform parameters aimed at reducing the structural weight while maintaining the required strength and operational characteristics. Solving this problem requires the use of modern engineering technologies, including computer simulation methods and numerical analysis of the stress-strain state of structures, which provide broad opportunities for improving lifting equipment. In this regard, the dissertation research devoted to the scientific substantiation of geometric parameters of lifting equipment structural elements is highly relevant.

The object of the research is the operating process of an automotive scissor lift platform under various operational loads.

The subject of the research is the regularities of changes in the stress-strain

state of the automotive scissor lift platform structure depending on different operational loads.

The aim of the research is the scientific substantiation of the parameters of an automotive scissor lift platform to reduce its metal consumption.

To achieve this aim, the following o**bjectives** were formulated:

1. To analyze the structures and operation of lifts used during vehicle maintenance;
2. To substantiate the theoretical parameters of a perforated platform structure with stiffening ribs;
3. To conduct experimental studies aimed at reducing metal consumption and to describe the research methodology and procedure;
4. To evaluate the economic efficiency of implementing the research results in production.

The main idea of the research is to reduce the metal consumption of the scissor lift platform through modernization by introducing a perforated structure with stiffening ribs while maintaining the required platform stability under operational loads.

Research methods. The dissertation employed methods of system and comparative analysis of existing vehicle lift structures; methods of mathematical modeling and numerical structural analysis using ANSYS and SolidWorks software based on the theory of strength of materials and structural mechanics; simulation modeling methods considering the stress-strain state of the proposed perforated platform structure; experimental methods for determining platform deformations under various loading conditions; as well as methods of mathematical statistics and techno-economic analysis for processing experimental data.

The scientific novelty of the research is as follows:

– it was established that perforation with stiffening ribs in the structure of the automotive scissor lift platform reduces metal consumption by 13% and increases structural strength by 2.8 times;

– it was determined that increasing the diameter and spacing of holes along the length and width, as well as increasing the height of side stiffening elements, negatively affects the stress-strain state of the scissor lift platform;

– quantitative relationships between deformation changes of the upper scissor lift platform and the magnitude of the load and geometric perforation parameters were experimentally established;

– the influence of hole diameter, spacing along the length and width, and the height of side stiffening elements on the stress-strain state of the platform was determined;

– a methodology for determining the optimal geometric parameters of a perforated scissor lift platform ensuring reduced metal consumption while maintaining the required rigidity was developed.

Scientific provisions submitted for defense:

1. Established quantitative relationships between platform deformations and operational load values enabling assessment of changes in the stress-strain state during operation;

2. A methodology for optimizing the scissor lift platform structure ensuring reduced metal consumption while maintaining the required strength characteristics;
3. A structural solution for an automotive scissor lift platform with a perforated surface and side stiffening elements ensuring reduced structural weight while preserving the required strength characteristics.

The practical significance of the dissertation lies in the fact that the proposed methodology makes it possible to generate new structural solutions that can be implemented in practice to reduce metal consumption and increase platform rigidity.

Keywords: maintenance, lift, optimization, strength, rigidity, deformation, platform, vehicle service.