

Development of Methodology and Technology for Storage of Grain Harvesting Combines

Pardayev Obid Rakhimboboyevich

Professor, Department of General Technical Sciences, Jizzakh Polytechnic Institute, Uzbekistan

Metinqulov Javlon Tulqin ugli

Assistant, Department of Radioelectronics, Jizzakh Polytechnic Institute, Uzbekistan

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Abstract: This article discusses the issues of improving the methodology and technology for the off-season storage of grain harvesting combines. The main factors affecting the preservation of the technical condition of combines, including storage conditions, quality of maintenance, and the qualification of the operator, are analyzed. Based on the research, the causes influencing the reduction of the service life of combine units were identified, and patterns enabling their quantitative evaluation were developed. In addition, recommendations are provided to improve the reliability and service life of combines through the optimization of maintenance and storage processes.

Keywords: Grain combine, maintenance, storage methodology, operational reliability, operator qualification, malfunction, technical factors, seasonal storage, resource, agricultural machinery.

INTRODUCTION:

A method has been developed to assess the impact of storage conditions and protective compositions on the preservation of components of agricultural machinery. The reasons for the reduction in the service life of V-belts during off-season storage have been identified. Regularities have been determined that allow a quantitative assessment of the impact of storage conditions and protective compositions on the reduction in the service life of belt drives and cutting apparatus blades.

The methodology and technologies for implementing the results of theoretical and experimental research have been established as follows.

Based on the results of practical, theoretical, and

experimental studies, it was determined that the reliability of the combine largely depends on the technical knowledge of the operator. For example, if the operator uses the combine correctly and the machine is under constant technical supervision, it maintains a high level of technical condition. If the operator does not fulfill their responsibilities conscientiously, the combine loses its technical condition and quickly becomes faulty. If a malfunction is not properly eliminated by a service center mechanic, the combine will fail again in a short time. Therefore, it can be concluded that maintaining the technical condition of combines at a high level and providing proper maintenance constitute an integrated system. (Figures 1–2)



Figure 1. Technical servicing of the combine



Figure 2. Preparation of the combine for storage

The list of main indicators characterizing the technical operation of combines and affecting their reliability was clarified. In addition, factors describing maintenance, repair processes, the quality of fuels and lubricants used, storage conditions of combines, and operator characteristics were selected and systematized.

For the final selection and structuring of these factors, six experts were involved—highly qualified specialists with many years of experience in the operation,

repair, and reliability analysis of grain harvesting combines.

In the section entitled “Study of Factors Determining Operational Reliability”, based on the analysis of tests and observations conducted under real operating conditions of combines, the list of factors influencing the significance of combine failures and their levels was refined (Table 1).

Classification of Combine Failures

Table 1

Factors Characterizing the Consequences of Failures	Indicators	Low – Moderate		
		Low Moderate	Low Moderate Severe	Severe
Costs of Eliminating Failures	Spare parts cost, % of machine price	Grain combines		
		Less than 0.05	0,05 – 0,5	More than 0.5
		Grain combines		

		Less than 0,04	0,04 – 0,4	More than 0,4
Losses caused by combine downtime	Duration of downtime (hours)	Less than 1	1 – 5	More than 5
Complexity of failure elimination (repair facility requirements)	Required equipment	Standard tools, wrenches, universal pullers	Mechanical tool set, universal lubrication equipment, welding equipment	Specialized equipment, testing and diagnostic stands
Safety risk	Probability of an accident	Accidents resulting from failures are unknown but possible.	Cases of harm to people are known or probable.	

When using the proposed classification, the failure is assigned to the highest significance group based on the factor with the worst indicator.

The condition of the factor was evaluated not only by quantitative but also by qualitative indicators. The

relationship between them is largely characterized by the level of compliance with operating rules (Table 2).

Evaluation indicators of technical factors in combine operation

Table 2

Quantitative evaluation, w		Qualitative (actual) assessment	Level of compliance with operating rules
Moderate	Intermedate		
0,95	1,00 – 0,91	High	Operating rules are being followed in practice
0,80	0,90 – 0,71	Moderate	There are some deviations from operating rules that may lead to severe failures.
0,60	0,70 – 0,51	Low	Frequent violations of operating rules lead to malfunctions, including severe failures.

0,35	0,50 – 0,20	Very low	Operating rules are regularly violated. Numerous severe failures occur, including those requiring major (overhaul) repairs of units. The service life of the combine is reduced.
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Taking into account the design features, technology, and storage methods of the combine under maintenance, it is possible to improve the efficiency of preparing combines for long-term storage by optimizing seasonal maintenance operations. By adhering to the technology of preparing combines for long-term storage, it is necessary to ensure compliance with the methodology for evaluating the quality of agricultural machinery storage, based on the developed criteria for the adaptability of combine components to storage conditions. This makes it possible to justify a set of rational measures aimed at improving storage conditions of combines.

The conducted studies have shown that the reliability and long-term efficient operation of grain harvesting combines depend not only on their design features, but also directly on the quality of maintenance, storage conditions, and the human factor. In particular, the technical competence and responsibility of the operator play a crucial role in maintaining the technical condition of the combine.

By scientifically organizing seasonal storage processes, optimizing maintenance, and improving storage conditions, it is possible to significantly increase the service life and operational efficiency of combines. The proposed methodology contributes to the efficient use of agricultural machinery and the reduction of their operating costs.

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