Fundamentals of the organization of supervisory activities for labor safety during the repair of mobile power facilities in agriculture

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Abstract. The article is aimed at creating a correct worldview about labor protection among engineering and technical workers of the agro-industrial complex engaged in the repair and maintenance of energy facilities. In our case, modern tractors and combines act as energy means. The main method is the analysis and conditions of operations for the repair and maintenance of tractors and combines, on the basis of which there is a need to properly organize the supervision of labor safety. As a result, the directions of work of the occupational safety specialist and the organization of his activities for the supervision of occupational safety have been developed and formulated, and the duties of engineering and technical workers in relation to this direction are also given. This article will be useful for masters and postgraduates studying the organization of maintenance and repair of tractors and combines, as well as engineering and technical workers of agro-industrial enterprises.

1 Introduction

The production of competitive agricultural products relies heavily on the use of advanced machine technologies. These technologies involve various technical means, such as machinery, equipment, and tools designed to increase productivity, efficiency, and precision in agricultural processes. In this regard, there is a technological and technical re-equipment of agriculture, modernization of agricultural machinery, an increase in the supply of modern equipment. The operation of machines is accompanied by the processes of wear, physical and moral aging. As a result, the technical and economic indicators of the equipment used deteriorate. To maintain the machines in good condition, it is necessary to manage their technical condition, carry out maintenance and repair in a timely and high-quality manner, and store equipment [1].

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To ensure the optimal performance and longevity of agricultural machinery, it is essential to establish a comprehensive technical service system. This system involves various stages and activities aimed at maintaining the equipment in proper working condition throughout its service life. The technical service system typically includes the following stages:

1. Installation and commissioning: This stage involves the proper installation and setup of the agricultural machinery. It includes tasks like assembling, calibrating, and configuring the equipment according to manufacturer's guidelines.

2. Preventive maintenance: Regular and scheduled maintenance activities are performed to prevent equipment breakdowns and ensure its smooth operation. This includes tasks such as cleaning, lubrication, inspection, and replacement of parts or components as per maintenance schedules.

3. Repairs and troubleshooting: In the event of a breakdown or malfunction, the technical service system provides for timely repairs and troubleshooting. This can involve diagnosing the problem, identifying faulty parts, and executing the necessary repairs or replacements.

4. Technical support: The technical service system provides continuous technical support to farmers and operators. This can include assistance with operational problems, providing guidance on maintenance procedures, and answering any technical queries or concerns.

5. Training and education: The technical service system offers training programs and educational resources for farmers and operators. This helps them understand the proper operation of machinery, maintenance practices, and troubleshooting techniques.

6. Spare parts management: The system also involves efficient management of spare parts inventory, ensuring the availability of genuine parts when needed. This can include maintaining stock levels, identifying high-usage parts, and establishing reliable supply chains.

By establishing a robust technical service system, farmers can maximize the uptime of their machinery, reduce equipment downtime, and optimize its performance throughout its service life. This ultimately supports the efficient and effective production of agricultural products.

Technical service in the agro-industrial complex refers to a range of services provided to meet the needs related to the operation of machinery, equipment, and other technical means used in agriculture and its production infrastructure. These services aim to ensure the proper functioning, maintenance, and repair of agricultural machinery and equipment.

The provision of technical service in the agro-industrial complex is crucial for maintaining the operational efficiency of machinery and equipment, reducing downtime, and ensuring the sustainable production of agricultural products. It plays a significant role in supporting farmers and operators in their day-to-day activities and optimizing the overall productivity of the agro-industrial sector.

Figure 1 shows an approximate scheme of the technical service system of a constituent entity of the Russia.

From Figure 1, it is clear that the direct interaction of technical service with serviced technical means is carried out at the levels of owners of mechanization means with the help of resources at their disposal and service enterprises located on the territory of administrative districts [2, 3, 4].
2 Materials and methods

Maintenance includes the following basic operations: cleaning and washing, inspection, diagnostic, fixing, assembly and disassembly, filling, lubrication, adjustment, etc. When developing technologies for the maintenance of agricultural machinery, it is necessary to adhere to the following principles [5, 6, 7]:

1. Carrying out maintenance (maintenance) taking into account the assessment of their technical condition;
2. Division and specialization of labor in the performance of maintenance;
3. Ensuring the sequence of work;
4. The use of mechanization tools.

The frequency of maintenance of tractors and combines is set in operating hours. The frequency and conditions of maintenance of tractors and combines are given in Tables 1 and 2 [8, 9].

Table 1. Frequency and conditions of maintenance of tractors.

<table>
<thead>
<tr>
<th>Type of maintenance</th>
<th>Frequency, conditions of maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-sale</td>
<td>In preparation for sale by dealer enterprises</td>
</tr>
<tr>
<td>During operational run-in</td>
<td>During the preparation, conduct and completion of the run-in</td>
</tr>
<tr>
<td>ETO</td>
<td>After 8-10 moto-hours</td>
</tr>
<tr>
<td>TO-1</td>
<td>After 125 moto-hours</td>
</tr>
<tr>
<td>TO-2</td>
<td>After 500 moto-hours</td>
</tr>
<tr>
<td>TO-3</td>
<td>After 1000 moto-hours</td>
</tr>
<tr>
<td>table</td>
<td>At a steady average daily ambient temperature above 5 °C</td>
</tr>
<tr>
<td>STO-OZ</td>
<td>At a steady average daily ambient temperature below 5 °C</td>
</tr>
<tr>
<td>In special operating conditions</td>
<td>When operating in desert and sandy soils; at prolonged low and elevated temperatures; on stony soils; on swampy soils</td>
</tr>
<tr>
<td>In preparation for long-term storage</td>
<td>No later than 10 days after the end of use</td>
</tr>
</tbody>
</table>
During long-term storage | 1 time per month – when stored in open areas and under a canopy; 1 time every 2 months – when stored indoors
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When removed from long-term storage | 15 days before the start of use

**Table 2.** Frequency and conditions of maintenance of combines and other agricultural machines.

<table>
<thead>
<tr>
<th>Type of maintenance</th>
<th>Frequency, conditions of maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-sale</td>
<td>In preparation for the sale of the car</td>
</tr>
<tr>
<td>During operational run-in</td>
<td>During the preparation, conduct and completion of the running-in of machines</td>
</tr>
<tr>
<td>this</td>
<td>After 10 hours (monthly) for all types of agricultural activities</td>
</tr>
<tr>
<td>TO-1</td>
<td>60 hours of operating time – for combines and complex self-propelled stationary machines, aggregates and complexes</td>
</tr>
<tr>
<td>TO-2*</td>
<td>240 moto-hours of operating time – for combines and complex self-propelled machines</td>
</tr>
<tr>
<td>Postseason</td>
<td>After finishing the work of simple agricultural machines</td>
</tr>
<tr>
<td>Before the start of the work season</td>
<td>For seasonally operating complex agricultural machines</td>
</tr>
<tr>
<td>In preparation for long-term storage</td>
<td>No later than 10 days from the end of the use period</td>
</tr>
<tr>
<td>During long-term storage</td>
<td>1 time per month – when stored in open areas and under a canopy; 1 time every 2 months – when stored indoors</td>
</tr>
<tr>
<td>When removed from long-term storage</td>
<td>15 days before the start of use</td>
</tr>
</tbody>
</table>

*Note.* The frequency of TO-1 non-self-propelled machines should be 60 hours, TO-2– 240 hours of main work under load.

It can be seen from the tables that all work related to the maintenance of energy facilities is strictly regulated by time. In our case, modern tractors and combines act as energy means.

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**Fig. 2.** Layout of the housing of maintenance and repair of tractors, trailers and attachments.

1 – a platform for diagnostics; 2 – maintenance posts for tractors and trailers; 3 – a workbench or a trolley for tools; 4 – a cabinet or a rack of diagnostic devices; 5 – an office for engineering and technical personnel; 6 - a gas and electric welding site; 7 – a repair site for parts; 8 – a copper-tin site; 9 – diesel fuel equipment repair site; 10 – hydraulic system components repair site; 11 – electrical equipment repair site; 12 – node repair site; 13, 14 – locksmith sites; 15 – compressor room; 16 – toilet and washbasin; 17 – household room; 18 – lubrication site; 19 – crane beam; 20 – grinding machine; 21 – hydraulic press site; 22 – washing bath; 23 – drilling machine; 24 – jack jack; 25 – transmission racks for removal and installation of aggregates.
The volume of periodic operations THEN increases with increasing numbers. Moreover, each subsequent TO contains all the operations of the preceding TO and additional operations.

The content of maintenance operations of agricultural machinery performed in stationary points (Figures 2 and 3) and mobile units (Figure 4) is shown in the diagram (Figure 5).

Fig. 3. Layout of the housing, diagnostics and repair of combines.

Fig. 4. Trailed repair and maintenance unit PROA-1.
The trailed repair and maintenance unit PRO A1 is designed for maintenance of tractors and combines in the field, welding, locksmithing and other work when troubleshooting equipment in mobile technical formations. Its equipment is placed on the frame of a single-axle trailer, a container with folding walls and allows cleaning machines, their components and assemblies with compressed air, tire pumping, disassembly, assembly, locksmith work, adjustment operations, welding and cutting of metal, as well as refueling with petroleum products and refueling of hand syringes \[1, 4, 10\].

![Fig. 5. The scheme of maintenance of the operations of agricultural machinery performed at stationary points and with the help of a mobile unit TO PROA-1.](image)
Analyzing the activities of an agricultural enterprise in the field of maintenance and repair of tractors and combines, you can see a wide range of work performed both in stationary premises and in the field. In this regard, there is a problem of ensuring the safety of work, which is expressed in the need for strict control by officials. In accordance with art 217 of the Labor Code of the Russian Federation in order to ensure compliance with labor safety requirements, monitoring their implementation, each employer creates a labor protection service or introduces a position of a labor protection specialist with appropriate training or work experience in this field [10].

3 Results

For greater clarity, we will present a scheme for organizing the work of a labor protection specialist at an agricultural enterprise (Figure 6), where the main zone is the zone of orders, orders, standards of the enterprise. In accordance with the functions and tasks of labor protection management, the employer determines the responsibilities of each division of the enterprise and introduces them into the job descriptions of the heads of departments. The employer’s authority to organize work on labor protection is shown in the diagram (Figure 7) [10].

Fig. 6. Scheme of organization of work of a labor protection specialist in an agricultural enterprise.

One challenge faced by agricultural enterprises is the wide geographical dispersion of their facilities and the distance from settlements. This can make it difficult to effectively monitor the safety of work and ensure the well-being of workers. However, there are ways to address this challenge and improve safety in agricultural operations.

1. Communication technologies: Employing reliable communication systems such as mobile phones, two-way radios, or satellite communication can help establish effective communication channels between workers in remote locations and central
facilities. This allows for real-time communication in case of emergencies or unsafe conditions.

2. Remote monitoring systems: Implementing remote monitoring systems, such as CCTV cameras or sensor networks, can provide continuous surveillance of agricultural operations and remote locations. These systems can be connected to a central control room or accessed remotely, enabling swift detection of any safety issues that may arise.

3. Regular safety training: Conducting regular safety training programs for all workers and managers is essential. This should include training on hazard identification, emergency response procedures, safe handling of equipment and chemicals, and personal protective equipment (PPE) usage. Workers should be well-informed about potential risks and how to mitigate them.

4. Safety protocols and procedures: Developing and implementing comprehensive safety protocols and procedures specific to the agricultural activities being carried out in remote locations. These protocols should address key safety concerns and outline clear steps for preventing accidents, controlling hazards, and addressing emergencies.

5. On-site safety officers: Assigning dedicated safety officers or supervisors who oversee the implementation of safety measures and ensure compliance with safety protocols. They can regularly visit different locations to conduct safety inspections, provide guidance, and support workers in maintaining a safe working environment.

6. Emergency response plans: Establishing emergency response plans that outline specific procedures to follow in case of accidents, injuries, or other safety-related incidents. These plans should include emergency contact information, evacuation procedures, first aid protocols, and communication protocols during emergencies.

By implementing these measures, agricultural enterprises can enhance the safety of their workers and improve the effectiveness of monitoring work practices in remote locations. It is important to prioritize safety in these environments to minimize risks and ensure the well-being of all involved in agricultural operations [10]. In addition, there are types of work that require constant monitoring of the safety of their performance, and a representative of the labor protection service cannot simultaneously be at several facilities at the same time due to their distance from each other. This fact increases the role of engineering and technical workers in supervising the safety of work on the repair and maintenance of combines and tractors. An engineering and technical worker engaged in the maintenance and repair of agricultural machinery, in his work on labor protection, is guided by legislative regulations, orders, orders and instructions of the heads of enterprises, are responsible for the state of labor protection in the supervised areas and are obliged to: ensure health and safe working conditions in the workplace, compliance with applicable standards, rules and regulations on labor protection and fire protection, regulations and proposals of regulatory authorities, an occupational safety engineer; control over: ventilation, lighting and heating; monitor the timely testing, technical inspection and registration of boiler installations and other equipment subject to periodic testing and inspection; suspend work in case of a threat to human life and health; participate in the certification of the sanitary and technical condition of departments, workshops, facilities, in the development and implementation of comprehensive plans to improve the conditions of labor protection and sanitary and health measures, as well as relevant sections of the collective agreement (agreements on special issues and labor protection); prevent the management of electromechanization equipment, boilers, tanks operating under pressure, lifting machines and other installations and aggregates of persons who have not reached the required age, do not have certificates and have not passed certification; together with the main specialists to make applications for personal protective equipment.
Fig. 7. The employer's authority to organize work on labor protection at the enterprise.

Also, ITR, he, together with a labor protection specialist and other employees of the enterprise administration, organizes the maintenance and storage of the following documents:

In the personnel department of the enterprise - orders of the head of the enterprise [10]:
- on labor protection and fire safety;
- on the appointment of officials responsible for checking the technical condition of the machines when they are put on a flight or to perform work;
- about securing cars for tractor drivers (drivers);
- on securing territories and objects of engineering and technical support for officials;
- on the organization of supervision over the use of measuring instruments;

In the control room:
- samples of waybills;
- tractor waybills;
- registration sheet of a tractor driver;
- magazines:
  a) the journal of the movement of waybills;
b) log of the exit and return of machines;
c) the journal of registration of instruction on labor protection at the workplace;
d) log of instruction of drivers of motor vehicles;
e) the log of registration of pre-trip medical examinations, conducted according to the instructions;
f) a log of pre-trip technical inspections of motor vehicles.

 evacuation plan for tractors and combines in case of fire.

4 Service

Separately, I would like to note that in our opinion, one of the main duties of an engineering and technical employee in terms of ensuring the safety of personnel during maintenance and repair of tractors and combines is the layout and organization of workplaces.

The layout of workplaces plays a crucial role in ensuring the convenience, efficiency, and safety of work in agricultural operations. Here are some key requirements and considerations for designing an optimal workplace layout:

1. Working area optimization: The layout should ensure that the working area has enough space for workers to perform their tasks comfortably without unnecessary constraints or obstructions. Sufficient space allows for ease of movement, reduces fatigue, and minimizes the risk of accidents or injuries.

2. Rational placement of equipment and tools: The arrangement of equipment, fixtures, tools, and other objects should be planned in a logical manner that minimizes the need for unnecessary movements or excessive reaching. Frequently used items should be placed within easy reach, while less frequently used items can be stored further away.

3. Workflow efficiency: The layout should be designed to facilitate a smooth workflow, minimizing time wasted on unnecessary movements or inefficiencies. This can involve arranging workstations in a logical order to follow the sequence of tasks or implementing assembly line or zone-based layouts for specific agricultural processes.

4. Ergonomics: The workplace layout should take into account ergonomic principles to ensure the well-being of workers. This includes considering factors such as proper seating, appropriate work surface heights, and ergonomically designed tools and equipment. Ergonomic considerations can help reduce the risk of musculoskeletal disorders and improve overall worker comfort and productivity.

5. Hazard prevention: The layout should incorporate measures to minimize occupational hazards and ensure the safety of workers. This can involve keeping hazardous materials or equipment separate from work areas, providing clear pathways for emergency evacuation, and implementing safety protocols for the handling and storage of potentially dangerous substances.

6. Flexibility and adaptability: The layout should be designed with flexibility in mind to accommodate changes in production processes, technology upgrades, or scalability of operations. This allows for easier modifications or reconfigurations as needed without causing disruptions to workflow or safety.

By adhering to these requirements and considerations, agricultural enterprises can create workplace layouts that optimize working conditions, promote efficiency, and prioritize worker safety. Regular reviews and updates to the layout should be conducted to ensure ongoing optimization and continuous improvement.

Absolutely, a rational layout of the workplace in agricultural operations eliminates unnecessary movements and contributes to increased labor productivity. Here are some further details regarding the rational size and number of work items in the workplace:
1. Eliminating unnecessary movements: By arranging equipment, tools, and materials in a logical and efficient manner, workers can minimize the time and effort spent on unnecessary movements. This reduces idle time and improves overall productivity by allowing workers to focus on essential tasks rather than navigating through cluttered or disorganized work areas.

2. Convenient and safe work: The size of the workplace area should be determined based on the specific tasks to be performed and the equipment or machinery involved. It should provide enough space for workers to perform their tasks comfortably and safely, without hindrance or risk of accidents. Adequate space ensures the proper handling of machinery, the movement of equipment or vehicles, and reduces the likelihood of collisions or injuries.

3. Number of work items: The number of work items, such as machinery or equipment, within a workplace should be aligned with the actual requirements of the job or shift. Overcrowding the workplace with an excessive number of items can lead to congestion, reduced maneuverability, and increased risk of accidents. Balancing the number of work items with the shift requirements ensures that workers can effectively utilize the available resources without disruptions. It allows for better organization, faster access to equipment when needed, and minimizes the chances of errors or delays caused by overcrowding.

Overall, a rational layout in terms of size and number of work items in the workplace is essential for maximizing labor productivity and ensuring the safety and efficiency of agricultural operations. Continual evaluation and adjustments should be made to these factors based on changing work requirements and operational needs for optimal results.

Here are examples of the layout of some workplaces (sections) of buildings for the repair and maintenance of tractors and combines (Figures 8-12).

**Fig. 8.** The site of repair and running-in of automotive engines.

1 – universal stand for disassembly and assembly of diesel engines OPR-5557; 2 – electric TE–200-5211; 3 – stand for disassembly and assembly of V–shaped parts KI-5500; 4 - stand for winding and braking KI-5543M; 5 – workbench for one workplace ORG-1468-05320; 6 – a sand box; 7 – a weighing device for the stand; 8 – a rack ORG-1468-05320; 9 – a stand for grinding valves R-186; 10 – a device for lapping valves R-177; 11 – a workbench ORG-5365 with a calibration plate; 12 – a rack ORG-1468-05320; 13 – mobile washing bathroom OM-1316; 14 – hydrofected equipment for TR engines 70-7823-3709
1 – shelving for repair stock and finished products ORG-1468-05-230A; 2 – bin for cleaning material ORG-5133; 3 – washing bath OM-5365; 4 – locksmith workbench ORG-5365; 5 – device for testing and adjusting fuel equipment KI-15706; 6 – a stand for testing and adjusting fuel equipment KI-15711M; 7 – a table for processing injectors; 8 – a rack for storing equipment ORG-1468-05-230A; 9 – chair; 10 – office desk; 11 – wardrobe; 12 – sand box

Fig. 9. Section TO and P of diesel fuel equipment.

1 – locksmith workbench for one workplace ORG-1468-01-060; 2 – mobile washing bath OM-1316; 3 – a set of accessories for TR hydraulic units ORG-12510; 4 – a test bench for hydraulic drive units KI-4815M; 5 – a chest for cleaning material ORG 5133; 6 – a box for sand; 7 – rack for assemblies and aggregates ORG1468-05-230A; 8 – bedside table for the instrument

Fig. 10. Section TO and P of hydraulic units.
Fig. 11. Cleaning and washing area of agricultural machinery.

1 – cleaning and washing area; 2 – mobile washing bath OM-1316; 3 – bin for cleaning materials ORG-5133; 4 – sand box ORG-5139

Fig. 12. Section of TO and R electrical equipment.

1 – a chest for cleaning materials; 2 – a cabinet for tools and mounting devices; 3 – a table grinding machine 3E631; 4 – a locksmith workbench ORG-5365; 5 – a table drilling machine R-105 or 2M112; 6 – a stand for checking and adjusting automotive electrical equipment KI-968; 7 – a chair; 8 – single-column office table; 9 - locksmith workbench ORG–5101; 10 – a set of devices for checking and cleaning candles E–203; 11 – a rack for storing aggregates; 12 – a box for sand

5 Conclusion

Thus, it can be noted that engineering and technical workers engaged in the organization of repair and maintenance of tractors and combines should not only conscientiously and competently perform their official duties, but have the right worldview in the field of labor protection, its organization and promotion, and also be ready to partially perform the duties
of a labor protection specialist, taking into account the specifics of the activity of an agricultural enterprise, as mentioned above. Absolutely, the agro-industrial complex system requires personnel who possess a wide range of expertise and knowledge in various areas related to maintaining equipment, ensuring safety, and managing facility infrastructure. Here are some key areas of expertise that are important for personnel within the agro-industrial complex:

1. Maintenance and repair: Personnel should have a strong understanding of maintenance and repair methods and techniques for agricultural machinery and equipment. This includes knowledge of diagnostics, troubleshooting, preventative maintenance, and the ability to identify and rectify technical issues.

2. Storage and preservation: Personnel should be familiar with proper storage practices for machines and equipment. This involves understanding principles of preservation, protection against corrosion, and the safe storage of spare parts and consumables.

3. Labor protection: Knowledge of workplace safety norms and rules is crucial for personnel in the agro-industrial complex. They should be well-versed in safety protocols, hazard identification, risk assessment, and the implementation of safety measures to ensure the well-being of workers.

4. Training and supervision: Personnel should be capable of providing training to workers in safe work methods and best practices. This includes ensuring that workers have the necessary skills and knowledge to operate machinery safely, follow proper procedures, and use personal protective equipment (PPE).

5. Facility infrastructure management: Personnel should have proficiency in managing and maintaining lighting, ventilation, heating systems, and other aspects of facility infrastructure. They should be aware of energy efficiency practices, maintenance schedules, and the implementation of safety measures in relation to these systems.

6. Fire safety management: Personnel should understand and implement fire safety measures to mitigate the risk of fire hazards in agricultural facilities. This includes knowledge of fire prevention, fire detection, emergency response protocols, and the maintenance of fire safety equipment.

The expertise and knowledge of personnel in these areas contribute to the effective and efficient functioning of the agro-industrial complex, ensuring the safe operation of machinery, protection of workers, and the proper maintenance of infrastructure. Professional development and ongoing training should be provided to keep personnel up to date with the latest advancements and best practices in their respective areas of expertise.

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