ASPECTS OF APC ROSOMAK EXPLOITATION SYSTEM EVALUATION

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Abstract

This article analyzes and assesses the basic assumptions of planning and executing the service-repair activities for the Rosomak APC. The service-repair system, which is one of the main points of the exploitation system, is created by a number of inter-related elements which are supplementary to one another: technical servicing, diagnostics and on-board diagnostics and services/repairs. Such a system which is common in the army is the planning-prevention system. In this system, the individual service-repair activities are conducted after a strictly determined mileage or working time. Such a system ensures that within the appropriate time, there is the possibility to spot and remove the defects occurring in the vehicle.

Basing on the fabric data, the authors have presented in this article the main activity scopes for the technical servicing for the Rosomak APC. The basic technical materials and exploitation liquids have been presented, as well as their polish counterparts which are used during the transporter's exploitation. A comparative analysis of the Rosomak APC service system with the service systems of other APCs exploited in the army has been made. The other APCs which have been compared here are: SKOT 1/2 and BTR 50/60.

Keywords: *exploitation systems, planning-prevention systems, APC, technical service plan, comparative analysis*

1. Introduction

Each vehicle undergoes physical ageing during the process of exploitation, which leads to partial or full loss of its operational use properties. In order to reduce the intensity of the ageing process, as well as recreating the vehicle's operational use properties, a specified scope of service-repair activities is conducted on the vehicle.

As far as the scope of the service-repair system is concerned, which is one of the basic elements of the exploitation system, there are integral systems which are inter-connected and which mutually condition one another with respect to technical servicing, diagnosing and repairs.

The service-repair projects can be realized in the following form, from preventing quick element parts by removing the causes, to revealing accelerated wearing and liquidating its effects, which in turn leads to recreating the operational use properties.

Depending on the exploitation conditions and the type of the technical back-up facilities and the type of vehicles, the service-repair projects can be realized within a certain organization system.

As for the currently applied service-repair systems, these are e.g. planning-prevention, planning-result, according to the needs, planning-prophylactic and compulsion-prophylactic.

As it is known, the planning-prevention system is about conducting the service-repair activities during the vehicle exploitation after a certain mileage or after a certain time. These activities are a result of the fabric adaptations of manuals to meet the existing conditions and their main aim is to prevent the occurrence of accelerated wearing of its elements. This system enables relatively easy settlement of inter-repair mileage and in this way it makes planning easier, providing exchange parts and the load and rhythm of service-repair works.

Combat efficiency of armies largely depends on the accepted technical service system and repairs of mechanical vehicles. The practice has shown that for mechanized armies, the most rational technical servicing system is the planning-prevention system. This system foresees planned technical servicing and repairs depending on the technical condition which is settled during the servicing. Planning is a characteristic confirming that technical services and repairs are planned. In times of peace, the basis for repair planning are the exploitation norms for mechanical vehicles and the working time between repairs, and during war, damage to the vehicles during battle are taken into consideration.

Prophylactic is a characteristic confirming that the system allows to detect and remove the defects occurring in vehicles, thanks to which these defects do not cause serious damage.
Conducting the services according to the planning-prevention system enables enlarging the total time of vehicles exploitation, keeping the vehicles constantly technologically ready, prolonging the inter-service period, lowering the repair time and therefore shortening the time during which the vehicle is repaired and appropriate economics of spare parts and materials during services and repairs. A big advantage of the planning-prevention system is the fact that it is identical for activities during times of peace and war. This allows for quire quick repair organization and there is no need to hire additional workers and acquire additional materials in order to accustom them with the needs of war times.

The 8x8 Rosomak APC is a wheel carrier designed as a basic version for people and equipment transport and as a battle version armed with a turret and allowing carrying an infantry team. The vehicle has an armed steel body allowing ballistic protection. In order to enhance ballistic protection, additional armour elements can be provided.

The armoured body protects the vehicle's construction, system and crew from mines. The vehicle can have many versions, e.g. the battle version with a turret system or as a basic vehicle used differently, i.e. as an ambulance, workshop, command vehicle, communication vehicle etc.
The vehicle may be transported via railroad, road or via air. Below, the battle and basic versions of the vehicle have been presented (in Fig. 1 and Fig. 2. respectively).

Fig. 1. Vehicle in the basic version

Fig. 2. Vehicle in the battle version

The available literature presenting quite up-to-date data concerning the analyzed topic is mentioned in the following references: normative documents [1, 2, 3, and 13], exploitation-service-repair APC Rosomak details [4-10], APC analyses and comparisons [11, 12, and 14], services and repairs of military vehicles [3, 13, 15-20].

2. APC technical service plans

As any other mechanical vehicle exploited in the army, the Rosomak APC also has a fabric technical service and repairs plan [4, 5]. Some of the examples of the activities of this plan have been presented below in Table 1. The individual tasks depending on the servicing period and place of checking/control have been enumerated.

Tab.1. The scope of works during APC servicing

Type of task	Place of activity	Servicing period							
		Daily	Weekly	Monthly	Half-yearly	Yearly or every 400 h	Every 2 years	Every 4 years	Observations
Inspection	Control before driving	X	X	X	X	X	X	X	
Cleaning	Optical observation equipment	X	X	X	X	X	X	X	
Inspection	Inspection and engine oil filling	X	X	X	X	X	X	X	
Inspection	Activities and vehicle lights condition	X	X	X	X	X	X	X	
Inspection	Tire condition and pressure	X	X	X	X	X	X	X	
Testing	Rear view camera	X	X	X	X	X	X	X	
Inspection	Gear lubricant level		X	X	X	X	X	X	
Lubrication	Chassis lubrication points			X	X	X	X	X	
Cleaning	Air inlet cyclone filter			X	X	X	X	X	
Inspection	Inspection and oil addition to the transition			X	X	X	X	X	
Testing	Air-conditioning system functioning			X	X	X	X	X	
Cleaning	Water drailing pump coarse filter			X	X	X	X	X	
Inspection	Oil level inspection and adding oil			X	X	X	X	X	
Lubrication	Outer lubrication points				X	X	X	X	
Adjusting	Absorber pressure				X	X	X	X	
Inspection	Parking brake inspection and regulation				X	X	X	X	
Change	Engine oil and filter					X	X	X	
Inspection	Lateral control rod mount condition					X	X	X	
Change	Air filter input					X	X	X	
Inspection	Coolant quality					X	X	X	
Inspection	Fluid and battery loading level					X	X	X	
Change	Nave transmission oil					X	X	X	
Change	Main transmission oil					X	X	X	
Inspection	Toe-ins					X	X	X	
Inspection	Level and supplementing winch oil					X	X	X	
Testing	Swimming engine functioning					X	X	X	
Change	Air compression unit filter					X	X	X	
Change	Fuel system water separator						X	X	
Change	Fuel filter						X	X	
Change	Coolant						X	X	
Inspection	Hydraulic fluid condenser						X	X	
Change	Oil and gear oil filter						X	X	
Change	Oil and transfer box filter						X	X	
Change	Fluid and brake fluid filter						X	X	
Change	Hydraulic oil and filter						X	X	
Change	Water separator input						X	X	
Testing	Failsafe system						X	X	
Change	Initial fuel farm filter							X	
Change	Engine thermostat							X	
Change	Oil and steering system oil filter							X	

Analyzing the above table with the scope of various activities, one can state that the following occur here: typical organoleptic inspection methods, cleaning with using the available technical materials, testing and checking with using specialist equipment and special tools [7], lubrication and conservation. The individual activities are carried out in cycles, depending on the exploitation period: daily, weekly, monthly, half-yearly or every two and every four years. One can note similarities between the activity groups in the service-repair system for Rosomak APC [4, 5, 6] and the hitherto functioning service-repair system for military vehicles [15, 16, 17, 18, 19, 20] in accordance to [1, 2, 3, 13] e.g. inspection, cleaning – and the scope of current servicing, inspection, regulation – and OT-1/OO-1 activity scope, lubrication, changing oil - and OT-2/OO-2 activity scope, system testing – and scope of technical examination. The periods/cycles are also similar despite the fact that they are partially dependent on the mileage or the amount of hours worked (mtg/h).

Examples of pictures of unit and elements undergoing servicing are presented below. Fig. 3 shows the overall engine and engine cubicle view, Fig. 4 – auto transmission selector. Fig. 5 presents a partially demounted air filter and Fig. 6 – the view of on-board batteries.

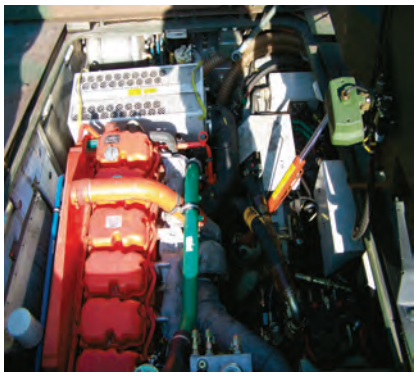

Fig. 3. Overall engine cubicle view

Fig. 4. Auto transmission steering

Fig. 5. Air filter view

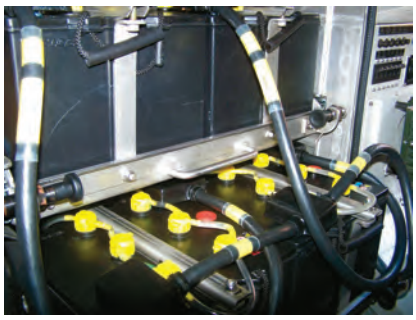

Fig. 6. Battery view

3. Basic exploitation materials

The transporter and its individual systems have a certain capacity and they have to be filled with certain types of fluids and exploitation oils which have to meet the strict quality regulations according to the Defense Norms.

It is also worth to note that fuel and most oils and exploitation fluids are produced as cheaper and alternative equivalents by Polish refineries and chemical plants. One can point at the following here: Turdus Semisyntetic engine oil, meeting the API-CCF standards, ACEA-E-4 10W/40 produced by Lotos Oil, Hipol Synthetic GL-5 75W/140 oil meeting the TWT-RNJe 14/96 standards, hydraulic oil Hipol ATF II E meeting the TWT-RNJe 20/96 standards, produced by the Jedlicze Refinery.

As far as exploitation fluids and lubricants are concerned, the following can be mentioned: the Borygo Alu Formula cooling liquid meeting the ASTM D standards, produced by the Boryszew Plan, brake liquid DOT 5.1meeting the ISO 4925, FMVSS 116 and SAE J 1703 standards, produced by the Organika Chemical Plants, synthetic lubricant Tytalit AV 395 meeting the NO-91-212 standards, G-421 lubricant meeting the WT-O5 OBA-031 standards, produced by Lotos Oil.

4. The comparison of current service systems for chosen APCs

It is also worth to compare the service system for the Rosomak APC with other APCs exploited within the Polish Armed Forces, i.e. the SKOT ½ APC and the BTR 50/60 APC. According to [3, 13] and [17, 18, 20] and the fabric manuals, the mentioned APCs have elaborated and implemented systems for services and repairs which guarantee their full technical efficiency and – what follows – a long-term exploitation period. Selected comparison of these systems has been presented below in Table 2.

Tab. 2. The comparison of APC exploitation systems

APC name **Type of service/repair**	**ROSOMAK**	**SKOT 1/2**	**BTR 50/60**	**Observations**
Daily/current servicing	X	X	X	- before driving, - during standstill and stops, - after returning
Weekly servicing	X			
Monthly servicing	X			
Half-yearly servicing	X			
Yearly or every 400 h servicing	X			
Servicing every 2 years	X			
Servicing every 4 years	X			
Servicing during the lapping period	X	X	X	- strictly according to the producer/warrant recommendations
Seasonal/yearly servicing	X	X	X	or changing the exploitation system: - fall - winter, - spring - summer
Special servicing, e.g. after wading, swimming	X	X	X	also in case of inspections and supervision examinations
Technical servicing type OT/OO – 1 (km)		900 – 1000	every 1000	
Technical servicing type OT/OO – 2 (km)		1800 – 2000	every 3000	
Other types of technical servicing (km)			every 6000	
Servicing during the storage period	X	X	X	short-term up to 1 year, long-term over 1 year.
The exploitation norm (years/km)	no data	25/85000	25/110000	legal possibility of prolonging the norm

APC name Type of service/repair	ROSOMAK	SKOT 1/2	BTR 50/60	Observations
The norm up to the first repair (km)	no data	20000	25000	* or respectively in mtg
The norm up to the next repair (km)	no data	15000	20000	* or respectively in mtg
The NG norm up to the first repair (km)	no data	35000	40000	* or respectively in mtg
The NG norm up to the next repairs (km)	no data	25000	35000	* or respectively in mtg
The norm up to the conservation repair NK (years)	no data	10	10	

The comparative analysis of the service systems for the analyzed APCs indicates that e.g.:

- in certain systems, emphasis is given to the services coming from days/weeks/months/years, therefore the services coming from the exploitation period,
- in the SKOT/BTR APC systems, dominating are the services which are based on the mileage in kilometers/mtg, which within intensive exploitation causes the necessity of quite frequent servicing, which in turn disables these APCs from exploitation for a certain period of time. It has to be underlined that the transporters are equipped with various technical solutions, e.g. the SKOT APC has a planetary Wilson gear shift, the BTR APC – two sustainer motors,
- elaborated military exploitation systems are based on fabric/producer solutions and their transformation onto military exploitation, according to the know service planning algorithms and have been finally prepared as e.g. catalogues and defense norms, e.g. for the analyzed SKOT/BTR APCs the scopes are as follows: OT/OO-1 (15-20 rbh), OT/OO-2 (32-38 rbh),
- in service-repair systems for APCs, changes occur in a cyclic fashion due to e.g. the development of modern technologies, the production of new-generation materials, applying multi-seasonal exploitation liquids and oils, which causes prolonging the exploitation norms, as well as the next OT/OO cycles and shortening the time of other services,
- the factual realization times for OO/OT, as well as for repairs, are shortened due to e.g. the wide application of servicing based on computer technology and on-board diagnostic of OBD/EOBD type,
- the exploitation systems for the APCs analyzed here do not interfere with the global technical standards which are valid in other countries.

5. Recapitulation

Within the realized service-repair system for APCs are the assumptions preceded by precise identification and assessment of their technical condition. It is more and more common to use both external and on-board diagnostic means as a way to locate malfunctions and damage to the vehicles and to prevent them. In effect, this always leads to beneficial shortening the amount of working time for technical services and repairs of these vehicles.

In the contemporary system of APC technical servicing within the Polish Armed Forces, the diagnostic and service-repair susceptibility of these vehicles is very important. A high susceptibility enables current identification and technical condition assessment for these vehicles, which often also ensures the execution of justified prophylactic operations.

However, it goes without question that the modern service system, meeting the contemporary technical standards, requires solving many technical-technological, organizational-systematic, training, examination and terminological problems. This concerns such issues like e.g. APC exploitation planning on the basis of valid norms, exploitation and service-repair system organization for these vehicles in combat conditions or the application of local information networks in the organization and management of their exploitation on the level of a force and above.

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