

Original article

## Routine maintenance as a main determinant of technical efficiency of a military vehicle resulting from the driver's duties

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### INFORMATIONS

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### ABSTRACT

The article presents selected aspects related to the primary type of technical maintenance of military vehicles, namely the routine maintenance. Its organizational principles have been discussed based on the applicable military industry regulations. Moreover, the basic driver's duties have been characterized.

### KEYWORDS

military equipment (SpW), technical maintenance, routine maintenance, driver

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## Introduction

Routine maintenance (OB) [1, 2] is the basic scope of service activities performed on military equipment (SpW) by the user: a driver, an operator, a crew, assisted by separate forces and technical and logistic means of technical services, and most often by the tank-and-car service. [2-4]. The scope of OB includes a number of activities provided under the instruction to perform in the subunits by SpW's crews or drivers operators during daily use, using tools that are on individual equipment of each vehicle/SpW. It should be noted that the purpose of OB is to ensure the continuous and failure-free operation of the equipment, by checking the status of individual systems and components, detecting and removing equipment failures and restoring the instructional technical parameters and levels of operating fluids [1, 5-7].

In the typical case of OB implementation, a driver/crew does not need any additional tools to perform OB, as each type of vehicle/SpW is, in principle, equipped with them. Since the assumption was made that OB activities must be performed by drivers/operators or SpW crews by themselves on their equipment, both in stationary [2] and in field conditions [8]. When organizing and implementing servicing of this kind, it should be borne in mind that

the most important document regulating the scope and principles of OB execution is always the service/operation manual for a given type of a vehicle/SpW. Therefore, a driver of a military motor vehicle [9, 10] is the first and main pillar of, among others, responsible for the technical performance of a vehicle/SpW, not only in terms of its safe operation, but also ensuring, among others, its readiness for crisis operations, mobilization and combat readiness of the Armed Forces related to providing supply, transport, evacuation, and other tasks through this performance. A driver applies the abovementioned determinant also through the proper driving technique, selection of appropriate gear ratios to the engine speed, selection of speed for terrain conditions, proper preparation of the vehicle for operation during the routine maintenance, as well as observation and control of individual units, systems, components and mechanisms. It has been assumed that the basic principles of operation that determine the technical efficiency of a vehicle/SpW include [1, 7, 9, 11] a driver's action related to servicing, repair, storage and maintenance, also basic activities related to loading and unloading, washing and cleaning. Hence, keeping a vehicle in full technical efficiency, including by performing specific service and repair activities by a driver should proceed strictly according to the pre-determined order and in a systematic manner. The article refers to the main determinant of the driver's duties and activities performed during OB of vehicles/SpW of the tank-and-car service [1, 3, 10, 12].

## 1. Types and periodicity of technical maintenance of equipment of the Tank-and-Car Service

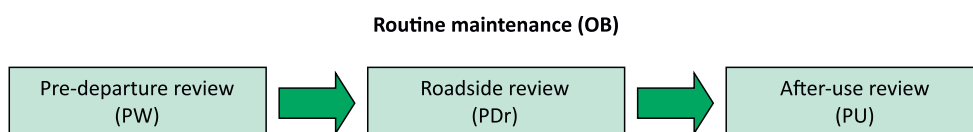
Technical maintenance of equipment [1, 5, 9, 11] is divided into the following types depending on the scope of operations and the period of utilization:

1) routine maintenance (OB) – Figure 1:

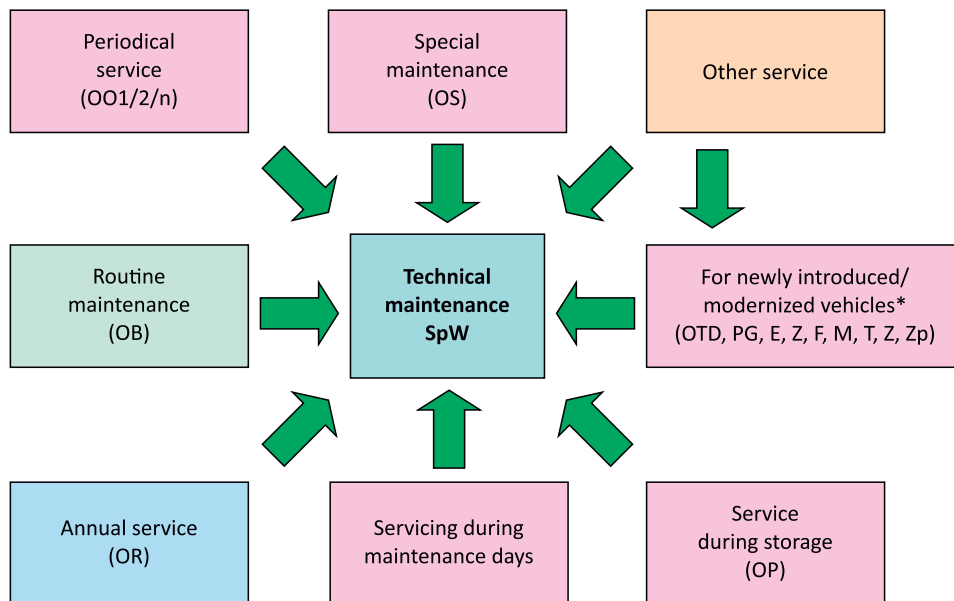
- pre-departure review (PW),
- roadside review (PDr),
- after-use review (PU).

2) periodical service (OO) – after a specified mileage or during storage – Figure 2 includes:

- periodical service No. 1 (OO-1),
- periodical service No. 2 (OO-2),
- further periodical service (OO-n),
- special maintenance (OS):
  - servicing of the chassis of tracked vehicles,
  - checking before and after overcoming the water obstacle,
  - replacement of toolkits provided for a given type of equipment,



**Fig. 1.** Components of the routine maintenance  
*Source: Own elaboration.*



**Legend:**

- \*OTD1/2 – service during the running-in period,
- PG1/2 – warranty inspection,
- E – service during the running-in period,
- Z – service depending on the time of vehicle usage,
- F – service depending on mileage in km or mph,
- M – service depending on mileage in km,
- T – service depending on exploitation in years,
- Zp – service depends on the amount of fuel consumed

**Fig. 2.** Types of technical maintenance  
*Source: Own study.*

- service during storage (OP),
- annual service (OR) – implemented until changes in doctrinal documents were introduced,
- servicing during maintenance days (DT),
- other, resulting from the specificity of exploitation or construction of equipment, e.g., seasonal.

As previously mentioned, the considerations refer in detail to the basic type of servicing which is the routine maintenance OB.

In everyday use of equipment, a significant service is the Pre-Departure Review (PW), which is carried out by a driver (crew, operator) of the vehicle [1]. During the review, it is essential to check the operation of systems and mechanisms that determine the driving safety, as well as the vehicle equipment. The driver [1] confirms the conduct of PW with his/her signature and the date of execution in the route order – Figure 3. It should be noted that any other type of equipment (not a vehicle) must be checked (inspected) before use as well.

**ROZKAZ WYJAZDU (PRACY)**      **Seria z Nr 204383**      **POJAZD SPRAWNY (TECHNICZNE)**

Wydany dnia **01.03** ..... ważny do dnia **07.03.2016**      **JW 76106**      **Pojazd (sprzęt) sprawny**  
(podpis d-cy, pom. ds. łącz. technika – pododdział)

Marka pojazdu (sprzętu) **SCANIA RIZAR** nr rej. **UD01662** grupa **E** przyczepa nr rej. **6/16/3**  
(stopień, imię i nazwisko)

Kierowca **Arkadiusz ADAMUS** Podstawa **2006/6/16/3**

**L: 200km**

Dysponent	<b>P. ADAMUS</b>	<b>A. ADAMUS</b>	<b>P. ADAMUS</b>										
Trasa	<b>KOSZALIN</b>	<b>Koszalin</b>	<b>Raj. Koszalin</b>										
Cel wyjazdu	<b>POLEJBY</b>	<b>Raj. Koszalin</b>	<b>Stacja MRS</b>										
Rodzaj przewoźu	<b>OSOBOWY</b>	<b>Osobowy</b>	<b>Techniczny</b>										
Pojazd wyjechał z parku	data, godz. <b>01.03.16 6:20</b> stan licz. <b>48837</b> podpis dyż. PKT <b>[Signature]</b>	data, godz. <b>01.03.16 7:15</b> stan licz. <b>48831</b> podpis dyż. PKT <b>[Signature]</b>	data, godz. <b>01.03.16 8:00</b> stan licz. <b>48847</b> podpis dyż. PKT <b>[Signature]</b>										
Pojazd wrócił do parku	data, godz. <b>01.03.16 13:00</b> stan licz. <b>48831</b> podpis dyż. PKT <b>[Signature]</b>	data, godz. <b>01.03.16 13:00</b> stan licz. <b>48847</b> podpis dyż. PKT <b>[Signature]</b>	data, godz. <b>01.03.16 13:00</b> stan licz. <b>48848</b> podpis dyż. PKT <b>[Signature]</b>										

Data	Trasa skąd – dokąd	Rozliczenie pracy pojazdu (sprzętu)										Stan licznika godz. i miejsce zakończenia pracy oraz podpis dysponenta	
		Stan licznika		przejechano km	przepracowano mtg.	radio-stacji w godz.	noktowizora w godz.	stabilizatora w godz.	żyroskopu w godz.	inne			
przed wyjazdem	po powrocie	3	4									5	
01.03	PST-1 - CSSP Koszalin	48837	48857	80									
01.03	CPSF Koszalin - PST-1	48857	48857	0							3		48831 PST-1 13:00
01.03	CPSF Koszalin - PST-1	48857	48831	24									48831 PST-1 13:00
02.03	PST-1 - CSSP Koszalin	48831	48836	5									
02.03	CSSP Koszalin - Raj. Koszalin	48836	48838	2									
02.03	Raj. Koszalin - CSSP Koszalin	48838	48839	1									

Oddano strzałów z armaty ..... szt.      z km ..... szt.      z wkm ..... szt.

Fig. 3. The route order – the first page

Source: Own material.

Another type of check is the Roadside Review (PDR), which is carried out by the driver (crew) of the vehicle during organized rests on the route or during breaks in the task fulfilment. The purpose of the review is to check the condition of the vehicle and to remove any defects found. Similar operations must be performed on other types of equipment. However, after the vehicle's use, the driver (crew) carries out the After-Use Review (PU) [1] on a given day. The review is aimed at bringing the vehicle to full technical efficiency and preparing it for re-use. The driver (commander, operator) records the execution of PU in the route order (work card) in the form of a record: "PU accomplished – equipment in kilter", signs it and enters the date – Figure 4.

In the situation when during the performance of the PU it is established that the equipment needs to be repaired, the driver (operator) reports this to the subunit commander [1]. It should be borne in mind that the detailed scope of service activities is specified in the manufacturer's documentation, instruction manuals, SpW technological cards/ guides, documents from military operation and standardization bodies [3, 5], and other documents. The activities affecting the safety and operation of teams should be executed first. A driver/an operator is most frequently the first link stating the fact of the defective technical condition of a vehicle/SpW. In the case of higher order maintenance, servicing should take place with the participation of specialists from the maintenance and repair subunit of the military unit. To emphasize the place of the routine maintenance in the hierarchy of technical maintenance it will be reasonable to present the scope of activities included in the current service, which are as follows [2, 4, 9]:

Treść	Rodzaj MPS w litrach							Nr dziennika rozchodu MPS i podpis wydającego	Przystługujące dodatki do NZ				Rozliczenie paliwa		
	1	2	3	4	5	6	7		8	9	10	11	12	13	14
Stan MPS przed wyjazdem	ON														
Pobrano z magazynu	72							3275/13	Widokowo... X. 3. 2016	NZ	171	35	59	Przysługuje pod-formy i dodatkami	72
Pobrano w drodze											3	4	12	Zużycie faktyczne	72
														Zaoszczędzono	-
														Zużyto ponad normę	-
Pravidłowość rozliczeń MPS sprawdził	(Szef zaopatr. MPS – podpis)										Razem	X	X	71,9	

Niesprawności pojazdu (sprzętu) powstałe w czasie jazdy (pracy), uwagi organów kontrolnych oraz wymagany zakres obsługi itp.:

Instrukcja do wyjazdu nr 2016-02-26 w N. 1000

Przy pojeździe (sprzęcie) wykonano obsługę techniczną, remont, itp. w zakresie:

Przy wyjeździe	Przy wyjeździe
Data: 02.03.2016	Data: 02.03.2016
Podpis: [signature]	Podpis: [signature]

Pojazd (sprzęt) obażyony i sprawny technicznie postawiono na miejscu postępu	data: 02.03.2016	godzina: 13	podpis: [signature]
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Pravidłowe wypełnienie i rozliczenie rozkazu wyjazdu (pracy) sprawdził [signature] (podpis osoby odpowiedzialnej za eksploatację)

1. Przy rozliczeniu pracy agregatu (użytecznej) i jałowej, wpisywać należy zużycie MPS w oddzielnych pozycjach tylko w litrach.  
 2. Przy rozliczeniu zużycia MPS przez pojazd mechaniczny wypełnić wszystkie rubryki.

MON-EKSPL-10 Druk: DCZG, zam. 738/12

Fig. 4. The route order – the second page

Source: Own material.

- checking the preparation of the vehicle/SpW for operation in given conditions – Figure 5 or the implementation of a specific task; developing components,
- checking the technical condition, operation parameters of basic units and subassemblies,
- regulations of cooperating systems,
- assembling, folding, refilling operational liquids and POL materials – Figure 6,
- cleaning, washing, maintenance,
- repairing minor defects (malfunctions) of equipment, instruments, and individual kit,
- charging (recharging) of batteries,
- checking and supplementing repair kits (technical aid chest) and individual vehicle/SpW equipment.

It is estimated that this type of maintenance is carried out in order to prevent the causes of excessive wear of assemblies, subassemblies and vehicle/SpW parts, or damage to them. Summarizing the tasks and role assigned to a driver/crew by the military regulations in the field of routine maintenance as well as other technical services [1, 7, 11, 13], it is clear that it plays the prime role in the essential aspects regarding technical efficiency and operational safety. Moreover, it determines keeping the SpW's readiness for use in emergency states (a martial law, an emergency, a natural disaster).

In conclusion, technical support of each type must include 100% of vehicle/SpW states in a given organizational unit/institution. What is important, that is irrespective of the generation and year of production, the degree of complexity and saturation with electronics [14, 15], the exploitation group and the type of operating conditions [8, 16, 17], as well as other requirements. It is simply a necessity without which the imposed and planned tasks will



**Fig. 5.** Checking the filter cleanliness  
 Source: Own materials.



**Fig. 6.** Checking the oil level in the engine  
 Source: Own materials.

not be successful. The necessity applies not only to the military but also to the non-military sphere, as well as any user of technical equipment, a car passenger as well.

### 1.1. Labor intensity of maintenance and repair works

The laborious standard is a significant indicator in maintenance and repair activities. The standard of labor intensity is expressed in man-hours/minutes for a given service/review. Military guidelines and instructions [6] as well as manufacturer's service instructions govern them. The performance of each maintenance or repair range requires a specific time settled in man-hours (rbh). Table 1 [12] presents the planning standards for the labor consumption of technical services and repairs of vehicle, for which the Administrator or Central Logistic Body is the Command of the Tank-and-Car Service of the Inspectorate for Armed Forces Support. The labor intensity for routine maintenance is marked in red.

**Table 1.** Laborious standards for technical maintenance and repairs [6]

No.	Type of SpW	Unit	Type of maintenance				Type of repair	
			OB	OO-1	OO-2	OO-n	NB	NŚ
1.	T-72 medium tanks and derivatives	rbh	<b>18-20</b>	32-36	88-96		up to 200	–
2.	PT-91 medium tanks and derivatives	rbh	<b>18-20</b>	34-38	92-100		up to 200	–
3.	Leopard-2 medium tanks	rbh	<b>18-20</b>	Chassis technical review: F1 – 20 F2 – 60 F3 – 120 F4 – 200 Turret and armament technical review: F1 – 14 F2 – 74 F3 – 90-100			up to 200	–



No.	Type of SpW	Unit	Type of maintenance				Type of repair	
			OB	OO-1	OO-2	OO-n	NB	NŚ
4.	Armored tractors on the T-72 chassis	rbh	<b>14-16</b>	32-36	88-96		up to 200	–
5.	Armored tractors on the T-55 chassis	rbh	<b>14-16</b>	30-32	84-90		up to 200	–
6.	Armored tractors on the Leopard-1 chassis	rbh	<b>14-16</b>	Technical reviews: F1 – 20 F2 – 50 F3 – 100 F4 – 150			up to 200	–
7.	Special crawler chassis	rbh	<b>10-12</b>	26-30	72-80		up to 150	–
8.	Combat infantry vehicles	rbh	<b>10-12</b>	30-32	82-86		up to 150	–
9.	Tracked armored personnel carriers	rbh	<b>10-12</b>	26-30	72-80		up to 150	–
10.	Wheeled armored personnel carriers and chassis	rbh	<b>3-6</b>	15-20	32-38		up to 120	–
11.	Wheeled armored personnel carriers KTO Rosomak	rbh	<b>8-9</b>	Chassis maintenance: – OMI – 4-5 – OPR – 8-9 – OR – 17-18 – O2R – 24-25 – O4R – 26-27 Turret and armament maintenance: – OMI – 6-7 – OKR – 8-9 – OPR – 9-10 – OR – 17-18 – O2R – 20-21 – O4R – 23-24			up to 150	–
12.	Armored cars	rbh	<b>2-3</b>	12-17	25-32		up to 120	–
13.	Medium-sized high-mobility vehicles	rbh	<b>3-4</b>	4-6	6-10		up to 100	–
14.	Light-duty high-mobility cars	rbh	<b>3-4</b>	4-6	6-10		up to 100	–
15.	Truck-tractors	rbh	<b>3-4</b>	4-6	6-10		up to 100	–
16.	General purpose large-capacity vehicles	rbh	<b>3-4</b>	4-6	6-10		up to 100	–

No.	Type of SpW	Unit	Type of maintenance				Type of repair	
			OB	OO-1	OO-2	OO-n	NB	NŚ
17.	Medium-sized general-purpose vehicles	rbh	<b>3-4</b>	4-6	6-10		up to 100	–
18.	General purpose, low-capacity cars	rbh	<b>2-3</b>	3-5	5-6		up to 100	–
19.	High-mobility cars and trucks	rbh	<b>1-2</b>	2-3	3-6		up to 100	–
20.	Cars	rbh	<b>1.0-1.5</b>	2-3	3-4		up to 100	–
21.	Minibuses	rbh	<b>2-3</b>	3-5	5-6		up to 100	–
22.	Passenger buses	rbh	<b>3-4</b>	9-11	26-32		up to 100	–
23.	Dump trucks	rbh	<b>3-4</b>	4-6	6-10		up to 100	–
24.	Wheeled tractors	rbh	<b>0.8-1.0</b>	6-8	18-25		up to 100	–
25.	Motorcycles	rbh	<b>0.5</b>	0.8-1.0	1-1.5		up to 20	–
26.	Four-wheeled vehicles	rbh	<b>0.8-1.0</b>	1-1.5	1-2		up to 20	–
27.	Transport trailers and special	rbh	<b>0.5-0.8</b>	2-3	3-4		up to 40	–
28.	Semitrailers	rbh	<b>2-3</b>	3-4	6-10		up to 100	–
29.	Truck cranes	rbh	<b>3-4</b>	4-6	6-10		up to 100	–
30.	Mobile workshops	rbh	<b>3-8</b>	4-10	6-12		up to 100	–

It has been assumed in the Armed Forces that during the operation of military motor vehicles in particularly difficult conditions (roadlessness, significant dustiness of the air) the Head of the Tank-and-Car Service of the Military Economy Branch or the entitled person has the right to [1]:

- reduce maintenance frequency,
- shorten the service cycle of a group of vehicles or individual items – depending on their current technical condition,
- in justified cases (marches, regroupings), organize the performance of maintenance in several stages.

It must be stressed that increasing the maintenance frequency, extending the service cycle, changing the scope of work and *reducing the service time at the expense of the quality of*



*maintenance activities* is prohibited. However, during the maintenance, it is necessary to strictly comply with the provisions contained in the instructions on the use and maintenance of equipment, technologies for their diagnosis, the scope of servicing activities of a given type or group of vehicles, as well as the recommendations of the Head of the Tank-and-Car Service and a diagnostician [13].

## **2. General principles of the military maintenance and repair system**

In the scope of the maintenance and repair system in force in the Polish Armed Forces, as one of the basic components of the operation system [1, 3, 5, 6, 17, 18], there are integrally intertwined and mutually conditioned systems for technical maintenance, diagnosis and repair, as well as supply. With regard to the SpW technical maintenance, it must be stated that it is one of the elements of technical protection that ensures the equipment's readiness for use and that restore the capacity if any damage has been done. Hence, technical maintenance is a set of organizational and technical measures aimed at ensuring fault-free operation of SpW during long-term and intensive utilization in tactical operations [12, p. 18]. The adopted system of the technical maintenance of equipment includes planning and organizational and technical undertakings, as well as necessary measures and resources. The technically operational SpW, which is on record in a military unit, is subject to technical maintenance. On the other hand, the scope of service activities is included in the instruction manuals for a given type of SpW and depends on the intensity of use and the time and type of storage. It should be emphasized that commanders of the subunits, in which the given SpW is located, and whose duty is to determine the place, time, scope and order of performing servicing operations by individual subunits, are responsible for implementing technical maintenance both current and periodical of lower order (OO-1). It should be pointed out, that the basic tasks of technical subunits in servicing technical equipment include:

- accepting and delivering technical material resources to the units (subunits) and supervising their proper exploitation,
- preparation of repair subunits to technical maintenance,
- performing technical services using the principle of reproduction in the first instance the technical capacity of the SpW, which falls under the priority,
- checking, adjusting measuring devices and ensuring their correct operation.

It is noteworthy that the main idea behind technical maintenance is not violating the combat readiness of the troops. This is reflected in the fact that the number of SpW being simultaneously serviced will depend on its duration and technical situation. During the organization and implementation of technical maintenance, the rules of the scope of service, acceleration of implementation, stages and priority [19, p. 83] should be followed. Depending on operational conditions, as well as technical equipment and the type of vehicles – maintenance and repair undertakings are carried out in the required organizational system, at each organizational and structural level of the Armed Forces of the Republic of Poland (SZ RP). It should be emphasized that the considerations refer to the land component [19], i.e., the operation of SpW in road traffic.

Current maintenance and repair systems established for in the Armed Forces of the Republic of Poland provide for technical maintenance to be carried out in certain periods, as well specific types of repairs if necessary [7, 16]. The type of service of the tank-and-car service

equipment [1, 11] depends on mileage (kilometers driven or worked hours) and the storage period [11]. While the ranges of maintenance frequency are specified in the catalog of land operation standards [12] or instructions/commands introducing the equipment for use in the Polish Armed Forces adequately for the type of equipment [1, 5, 18]. However, the competent commanders of units and subunits to which the vehicles are allocated are liable for timely maintenance implementation, while drivers, crews and operators bear the responsibility for its execution. Technical maintenance of equipment is to be performed both in stationary [1, 7, 20] and in field conditions [8, 17, 18].

### **3. Routine maintenance – general principles**

The exploitation of the existing vehicles/SpW as well as modern ones successively introduced into operation in the Polish Armed Forces [1, 3, 12, 14, 15] is connected to the necessity of proper prophylactic treatment contributing to their good condition and full technical efficiency, which also determines the appropriate level of combat readiness. As previously mentioned, the basic form of preventive treatments is routine maintenance. The necessity to perform OB is dictated by the fact that in the process of exploitation, the vehicle/SpW is consumed due to friction of individual systems and mechanisms. What is more, metal elements and non-metal parts lose their properties because of developing corrosion and their aging. The connections on the fastening elements become loosened and the position of the individual parts changes. Dysregulation causes, among others, greater clearances in various combinations and in the vehicle subassemblies, as well as the increase in the use of propellants, maintenance lubricants and operating fluids. This condition requires continuous technical supervision by the driver and prompt remedial action. To ensure this, it is necessary to function and work in a specific organizational system [1, 12, 18, 21], have appropriate maintenance and repair infrastructure, both in stationary and field conditions, together with the necessary equipment and instrumentation, and protection in technical material resources, spare parts, accessories and fluids [2, 7, 11, 13, 16]. It is indispensable to design appropriate documentation to regulate such activities, including technological cards with the OB range for a given type of SpW vehicle, based on applicable regulations and industry provisions.

It should be reminded that routine maintenance in the vehicles/SpW operation system is the basic type of service that allows pre-determining the actual technical condition of the vehicle, and the practical implementation of its activities developed for a given type of vehicle (equipment) in the form of framework (technological) cards enables inspection and preparation of the vehicle for further use or immediate referral to the military repair workshop (PSO) or a civilian service [1, 2, 4, 7].

### **4. Basic driver's duties while performing the routine maintenance**

It needs to be emphasized that apart from the knowledge of the construction of the equipment, an important feature of the driver/crew is the knowledge of basic maintenance activities that should be carried out with the equipment entrusted. It can be said that the skills of a military driver, which arise, among others, from their professional qualifications [10] and are acquired during training must be universal in relation to the military maintenance and repair system. The above also applies during the operation of the vehicle in garrison and field conditions, as well as when performing specific maintenance activities on the route, in the

field, in the stationary base, periodic checks and maintenance [9, 11, 13, 20, 21]. The set of skills that a driver/crew should have comprises:

- the driver’s ability to use tools that are included in the composition and equipment of the vehicle: a lift, a connection for pumping wheels, locking wedges, and a wrench for wheels in a safe manner,
- ability to operate (not only in the scope of the *on-off* activities) special devices, such as a winch, and carry out maintenance and periodically check its components,
- continuous monitoring of the observation of indicators related to engine operation, observation of signals and OBD codes in vehicles/SpW of a new generation, including the ability to prepare and operate the engine at low temperatures,
- periodical cleaning, regulation and leak testing of the central wheel pumping system (CPK),
- knowledge of the purpose, completion and proper storage of equipment for crossing, overcoming water obstacles, including temporary maintenance,
- full implementation of recommended maintenance and repair activities for a given type of SpW (including trailers and semi-trailers),
- self-execution of the routine maintenance and other servicing in the assigned vehicle/SpW,
- periodical inspection and tightening of screw connections of wheels and other elements of the drive system,
- checking the technical condition of tires, measuring and topping up pressure, making repairs and tire spacers under stationary, road, and off-road conditions,
- cleaning and washing the vehicle/SpW during and most often at the end of a specified period of use or carrying out a specific transport task at the routine maintenance station or other separate technical equipment park (PST) using handheld equipment such as brushes, cosmetics, vacuum cleaners,
- washing vehicles/SpW in carwashes located within the PST of military complexes, also in field conditions, washing passenger cars can be carried out against payment in the self-service system for Fleet cards at Orlen stations,
- checking before use and servicing after use distribution boxes with reducers or multipliers, drive bridges with interlocks controlled mechanically, electrically, or pneumatically,
- checking the cleanliness of air filters in the standard system, or the contamination level control on the indicator/sensor,
- continuously monitoring the vehicle operation and its current technical condition in the daily operation system,
- during the execution of OB, removing defects and malfunctions of the vehicle/SpW on a current basis, if it is not possible, following the procedure for the information flow, most often in the report system,
- each time checking the vehicle – trailer coupling, including towing hook mousing – Figure 7, and operation of trailer lights and brakes,
- in trailers, regardless of the design, checking the fitting of an additional safety chain or cable, paying attention to whether the cables connecting the lights and brakes of the trailer with the vehicle are properly fastened,



**Fig. 7.** Example of connecting a car with a trailer – securing with an additional connection  
*Source: Own study.*

- each time checking the fifth-wheel – trailer pin coupling, including the security systems of the transported wheeled or tracked SpW – Figure 8 and the functioning of the lights and brakes of the set,
- checking and carrying out maintenance and periodical checks on the charge status of starter batteries, including on-board batteries,
- checking the reliability of fixing and the efficiency of anti-slip chains and cables on wheels,
- checking mechanical connections, hydraulic connections, accessories, tightness of systems, periodical lubricating and maintaining in accordance with the technical documentation while performing OB [1, 6] on vehicles/SpW with devices such as Multilift – Figure 9-10, and Hiab – Figure 11-12,
- settling the operation of the vehicle/SpW in the route order in the current driving cycle, refueling the calculated amount of liquid fuel consumed depending on the type of vehicle/engine; it is carried out by refueling to the so-called full tank at the end of operation on a given day, which can be done, in addition to the military petrol stations, using the Fleet card at the Orlen station network.



**Fig. 8.** Example of securing the transported Sp  
*Source: Own study.*



**Fig. 9.** Vehicle with the Multilift system  
*Source: Own materials.*



**Fig. 10.** Container protection  
*Source: Own materials.*



**Fig. 11.** Vehicle with the Hiab system  
*Source: Own materials.*



**Fig. 12.** SpW control system  
*Source: Own materials.*

With regard to technical assets, the settlement of used, replaced small spare parts, e.g., V-belts, accessories such as bulbs, operating fluids, e.g. windscreen washer fluid, should be based on kept records in accordance with the applicable regulations of the tank-and-car service and guidelines of the organizer of this type of service at the subunit or a given military unit level [2].

## 5. Performing routine maintenance during operation of the vehicle in the field conditions

The scope of the driver's activities during the execution of OB and its labor intensity are a derivative resulting from the adopted organizational system and the level of logistic support for the maintenance and repair field base and providing it with individual elements, e.g., the Technical Equipment Park (PST) – Figure 13, the maintenance and repair area, including OB positions, the lubrication point and field battery charging station [4, 9, 8, 21]. Maintenance or repairs are carried out in a separate service area based on the field equipment, e.g., mobile workshops, technical tents – Figure 14.

If there is a possibility, the stationary technical infrastructure can be used, which is the responsibility of the Military Economic Branch (WOG), e.g., a maintenance and repair hall,





**Fig. 13.** SpW arrangement in the field technical equipment park  
*Source: Own materials.*



**Fig. 14.** SpW maintenance and repair area  
*Source: Own materials.*

a stationary car wash, or a vehicle inspection station (SKP) [13]. It should be noted that the specificity of maintenance and repairs realized in field conditions is different than when implemented in garrison conditions. It is based on mobile workshops and material and technical assets previously collected and transported on vehicles, as well as the planning of needs and their submission to the competent territorial Military Economic Branch.

## Conclusion

Based on the available literature describing the issues raised and the authors' own professional experience regarding functioning of the technical support system in military units, it should be noted that the most frequent failures in vehicles/SpW during OB execution are:

- leaks of operating fluids from wires, seals, systems, from under filters,
- blown bulbs and other surges in electrical installations,
- loosening of drive shafts and half-shafts,
- tire pressure losses or punctures of inner tubes,
- discharging starting (acid) batteries,
- clearances in steering systems,
- leaks in brake systems and clutch control, both hydraulic and pneumatic,
- other defects of a result nature such as incorrect indications and specific fault codes of the on-board diagnostic system (OBD).

It appears obvious that there are various kinds of difficulties resulting from the fact that the vehicles in use are obsolete, e.g., decaying and loosening of rubber hoses, electric wires, elements of tarpaulin covers. Nonetheless, most of such faults are relatively difficult to locate and their removal is time-consuming.

The outline of information on the basic service, namely routine maintenance (OB), presented in the article, proved that its current implementation translates directly into keeping technical efficiency of vehicles/SpW and, consequently, increasing the safety of road traffic, and ultimately determining the maintenance of certain states of emergency preparedness, as well as mobilization and combat readiness in the Armed Forces of the Republic of Poland.

The authors' professional experience shows the actual realization of the OB-type support, in accordance with the applicable regulations, can vary. One can encounter situations where it is omitted and is limited only to the required records in operating documents, for example in the route order. It also happens that the organization and implementation are simplified with the most important activities excluded or treated selectively. Sometimes there is a lack of a comprehensive and coherent organization of maintenance at the level of subunits, or at the level of a military unit.

It is estimated that in the era of "professionalization" and the professional Armed Forces there is an excessive generation of service and maintenance needs for specialists from subunits such as platoon, repair company, WOG workshops, workshops and civil services, which sometimes leads to unnecessary or additional financial and material costs to the Armed Forces. In fact, this scope of work should be performed by a driver, according to his/her professional qualifications.

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### **Conflict of interests**

All authors declared no conflict of interests.

### **Author contributions**

All authors contributed to the interpretation of results and writing of the paper. All authors read and approved the final manuscript.

### **Ethical statement**

The research complies with all national and international ethical requirements.

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### **Obsługiwanie bieżące jako główny determinant sprawności technicznej pojazdu wojskowego wynikający z obowiązków kierowcy**

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**STRESZCZENIE** W artykule przedstawiono wybrane aspekty związane z podstawowym rodzajem obsługiwania technicznego pojazdów wojskowych, jakim jest obsługiwanie bieżące. Omówiono jego zasady organizacyjne w oparciu o obowiązujące wojskowe przepisy branżowe, ponadto scharakteryzowano podstawowe czynności kierowcy.

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**SŁOWA KLUCZOWE** sprzęt wojskowy (SpW), obsługiwanie techniczne, obsługiwanie bieżące, kierowca

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