

Original article

Armored carrier MT-LB and support vehicles produced on its basis in Poland

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ABSTRACT

The article presents the history of construction of the armored carrier MT-LB designed in 1960s in Kharkiv Tank Factory in the USSR. The serial production of the carrier in Poland and the involvement of Polish scientific and research centers in the preparation of its specialized versions is discussed. The individual versions of the carrier are characterized, streaming them according to: vehicles produced in Poland, prototype vehicles constructed in Polish scientific and research centers and vehicles obtained for the Polish Armed Forces under import. Furthermore, the article outlines the utilization of the MT-LB armored carrier and anti-aircraft missile launchers, engineering vehicles, armored recovery and command-staff vehicles built on its basis by the Polish Armed Forces' units, drawing the attention to their role in process of technical modernization of the land forces.

KEYWORDS

military vehicles, the Polish Armed Forces, armored carrier, MT-LB



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1. Introduction

MT-LB armored carrier (in Russian MT-ЛБ многотелиевой тгачacz liekkij bronirowannyj – multipurpose light armored tractor) was the first mass produced tracked carrier by the Polish defense industry. Its modern, compact design became the basis for drawing various specialized versions, which entirely were the works of Polish constructors. The vehicles were developed taking into account the tactical and technical specifications and potential requirements of the Polish Armed Forces which within the frameworks of the modernization process of the land forces expected the Polish scientific and research centers and companies producing the armored equipment to offer varied vehicles supporting operations of armored and mechanized units. These expectations mainly concerned the recover, reconnaissance and engineering and command vehicles, which was fully achieved. The works on the development of other vehicles were also conducted, including: self-propelled anti-aircraft guns, self-propelled anti-tank launchers, CBRN reconnaissance vehicles, ammunition supply vehicles, etc. which, however, did not go into serial production which was connected with a significant level

of standardization of the Warsaw Pact's armored equipment hindering introduction of new constructions into service, dramatically increasing costs of their development as well as the lack of interest in them by the Armed Forces.

2. History of design

The construction works on the MT-LB armored carrier (Object 6) commenced in 1960 by the construction bureau of the Kharkiv Tank Factory under the supervision of Eng. Anatolij Biełousow¹. The tactical and technical criteria determined by the Technical and Economic Committee of the USSR Ministry of Defense assumed that the new carrier would be of closed, hermetic body assuring the safety of the crew under the conditions of the use of weapons of mass destruction, would reach the maximum speed of 60 km/h, and its capacity would be of 2.5 t. Additionally, it was assumed that would be capable of towing trailers with the mass not exceeding 6.5 t. The prototype vehicles in two versions: transport MT-L and armored MT-LB were subjected to comprehensive tests in various climate conditions in the Arctic and Turkmenia. In 1964, after elimination of detected defects, both the vehicles were submitted to acceptance by the state commission by which they were accepted to the mass production. The documentation of the MT-L carrier was provided to the Engineering Plant in Semipalatinsk where its mass production commenced. The MT-LB carrier was adopted into service in the Soviet Army in 1964 and its mass production was launched in 1967 in the Kharkiv Tank Factory. The same year, Eng. A. Biełousow's construction team developed the modified version of the carrier (*Object 26*) with extended body, later marked as MT-LB-usz (udlinionnyje szassi – extended chassis), which was used to build the 122 mm self-propelled howitzer 2S1 'Goździk'. In August 1969 first 4 prototype guns were sent to field tests. The extended MT-LB was subjected to the further construction works, which resulted in another version (Object 10) called MT-LBu (unificirowannyj – unified). The body's shape of the new vehicle was significantly changed; it was more capacious therefore enabling its application for building command-staff vehicles, radiolocation stations or other specialized vehicles. The both versions of the carrier i.e. MT-LB and MT-LBu served as the baseline vehicles for developing varied versions of support vehicles [Szumilin 2010, pp. 5-8].

First support vehicles built on the basis of the MT-LB appeared in the 1970s. In 1976 the self-propelled anti-aircraft missile launcher 9K35M 'Strzała-10' was introduced into the service. Three years later the subsequent support vehicle in the form of the anti-tank guided missile launcher 9P149 'Szturm S'. In the following years a range of the different vehicles built based on MT-LB and MT-LBu occurred. There were the support vehicles such as: CBRN reconnaissance vehicles RHM 'Kaszalot' and KDHR-1N 'Dal', a MT-LB recovery-maintenance vehicle, a combat engineering vehicle UR-77 and a self-propelled mortar. The carriers of radiolocation systems and command vehicles constituted the further group which comprised: vehicles with the artillery radar SNAR-10 'Leopard', ARK-1 'Rys' and 1L219 'Zoopark1', command-staff vehicles of the automated command system 'Manewr' of MP-21-25 type, artillery command-post vehicles of

¹ Anatolij Biełousow was the chief constructor of the Kharkiv Tank Factory in the years 1957-1982.

1W13, 1W14, 1W15 types and 1W16 of 1W12 'Maszyna' system, anti-aircraft artillery command-post vehicles PPRU-1 and UBKP and command vehicles of various levels of W21, W22, W23, W24 types [Uzycki et al. 1996, p. 236].

The universality of the MT-LB armored carrier contributed to its recognition as the basic vehicle recommended to be introduced in all the armies of the Warsaw Pact. In order to satisfy the expected demands it was decided that its production would be implemented under the license outside the USSR. Bulgaria was the first state, which decided to launch the license production. The carrier was in series production since 1972 in the 'Beta' Plant. In a relatively short time, on the basis of the standard version, the plant developed a number of new vehicles, including: infantry fighting vehicles BMP-23 and BMP-30, self-propelled mortars KShM R-80 and KShM R-81, a CBRN reconnaissance vehicle MR HR and a medical vehicle MT-LB SE [Szumilin 2011, pp. 2-3].

3. Obtaining the license and production of MT-LB in Poland

Poland signed the agreement for license-production of the MT-LB carrier in 1974. Having the license and technological documentation handed over, the preparatory and implementation works commenced. The Stalowa Wola Steelworks (HSW), which previously gained the necessary experience during manufacturing tracked artillery prime movers ATS-59a and later D-350 "Mazur" [Garbacz 1993, p. 20; Garbacz 1993a, pp. 11, 37, 39-40; Historia Huty... 1996, pp. 1-3]², began the production of basic components and final assembly. It was not without the significance that by the end of the 1960s in HSW the intensive preparatory works related to launching the series production of BMP-1 infantry fighting vehicle were conducted (factory designation TB-40) which involved the construction of the modern production department, which was thereafter used for production of construction machineries, including tracked vehicles [Stankowski 2013, p. 21-22].

Launching the series production lasted for two years. The Military Institute of Armour and Automotive Technology in Sulejówek was actively involved in this process. In 1976 the first batch of 60 pcs of the MT-LB carriers marked by the plant as product S-70 left the production line. In following years the production volume was systematically increasing to reach in 1982 the target level of 700 pcs annually. The basic version of the

² The Stalowa Wola Steelworks (HSW) was established on the basis of Zakłady Południowe in Nisko built in the years of 1937-1939. The guns of various calibers (75 mm and 105 mm field guns and 100 mm howitzers) were assembled at the Steelworks since 1938. During the Second World War, the artillery equipment (37 mm, 75 mm and 88 mm guns and 105 mm howitzers and the shell cases), components of the PzKfw V 'Panter' tanks, air bombs and armor plates were produced in the plant by the Germans. After the war, in 1950, the production of 122 mm howitzers of 1938 type and afterwards 85 mm anti-aircraft guns of 1939 type was launched in HSW. In 1952 the 85 mm tank gun of 1944 type for T-34/85 tanks began to be produced. In 1955, 85 mm anti-tank gun D-44 and a year later 100 mm anti-aircraft gun KS-19 came into the production. In 1957 the production of other gun was launched – 100 mm tank gun D=10TG for T-54 tank. In the 1960s the subsystems of the wheeled armored carrier SKOT and tracked artillery movers ATS-59 and D-350 'Mazur' were manufactured in Stalowa Wola. In 1967 the preparatory works for launching the production of the infantry fighting vehicle BWP-1 commenced, however, they were ceased in 1969.

carrier was designed for export to the USSR, which was the target customer in this regard. In the years of 1983-1984, 600 pcs of the carrier per year³ were exported to the USSR. Altogether, between 1976 and 1990, thus till the end of the series production, approximately 6500 pcs [Stankowski 2013, p. 25-26] of the vehicle were exported to the USSR. Apart from this, the carriers were exported to the Middle East states, which within the framework of the cooperation with the Warsaw Pact purchased them for the needs of their own armed forces.

In 1982, based on the project prepared by the Research and Development Center for Ground and Transportation Machinery (OBRMZiT) in Stalowa Wola the recovery vehicle on the MT-LB chassis marked as WPT 'Mors' was implemented for the series production. In 1983 the modernized chassis of the MT-LB carrier, which was called SPG-2 (abbreviation of 'High-speed Tracked Vehicle-2), was developed. It served for designing the subsequent specialized vehicles such as: a technical recovery vehicle WPT 'Mors II', as engineering reconnaissance carrier TRI 'Hors' and 'Hors II' and an engineering carrier TI 'Durian'. The extended version of the body, marked SPG-2A, provided the baseline for building automated command vehicles ZWD-1 'Irys' and ZWD-10R 'Łowcza-3' [Historia Huty... 1996, p. 4 and 7; Rylski and Sakowicz 1993, p. 37].

In 1984 in HSW the series production of the self-propelled gun 2S1 'Goździk' was launched, whose chassis was based on the modernized version of the MT-LB carrier marked as MT-LB-usz. It had the longer body in relation to the predecessor, which enabled its better application for construction of various specialized versions. The numerous companies of the Polish defense industry, which cooperated with HSW [Kinski 2013, p. 58], participated in production of the MT-LB carrier and the self-propelled gun 2S1 'Goździk'.

The production of the engineering reconnaissance carrier TRI 'Hors', purchase of which the Polish Armed Forces had been interested in, was launched in 1986. The modernized version of the technical recovery vehicle WPT 'Mors' was produced since the same year. It was not until 1990 when the production of the both vehicles was ceased as a result of the lack of further orders. In total 77 TRI 'Hors' carriers and 74 technical recovery vehicles WPT 'Mors' [Stankowski 2013, pp. 44 and 46] were produced.

Starting from 1993, HSW in cooperation with OBRMZiT prepared several proposals of combat vehicles for the Polish Armed Forces. In September 1993 during the I International Defence Industry Exhibition in Kielce (MSPO) two types of vehicles based on the MT-LB carrier were presented. Those were BWO-40 and MT-LB-23M vehicles. A year later during MSPO-94 the modified version of the latter, marked LWB-23 'Krak' was offered. The vehicle was developed with the intention to use for its presumptive production the MT-LB carriers stored in the HSW stock, which due to the UN embargo could not be exported to the Middle East states (approx. 100 pcs for Iraq). However,

³ *Materiały do rozmów dwustronnych podczas posiedzenia Komitetu Ministrów Obrony Narodowej państw członków Układu Warszawskiego, 14.11.1983, Instytut Pamięci Narodowej 02958/06/567, k. 247, 259 and 261.*

none of the offered vehicles met with the interest from the Ministry of National Defense's side [OBRMZiT... 1995].

In 1994 the production of the engineering carrier TI 'Durian' [Historia Huty... 1996, p. 7] was launched in small quantities. The first piece of the automated command vehicle ZWD-10R 'łowcza-3' based on the MT-LB chassis was produced in 1998. After having built 3 vehicles the production was ceased [Dura 2014]. Manufacturing of the command vehicle ZWD-1 'Irys', for the needs of the Polish Armed Forces began in 1999. The production was undertaken in cooperation with the Military Communication Works No 2 in Czernica. 13 vehicles were built till the end of 1999. In 2000 and 2001 another 10 vehicles of this type were produced. In 2004 the series production of the scattered mine laying carrier TMN 'Kroton' started. 6 such vehicles [Kinski 2013, p. 50] were delivered to the Polish Armed Forces by the end of 2008.

4. Versions of the MT-LB carrier produced in Poland

The baseline version built by HSW constituted the standard version based on the license documentation. Apart from it, the number of specialized versions was constructed, which were ordered by the Polish Armed Forces facing the lack of the alternate purchase sources of the similar combat equipment. These vehicles were of a significant importance with regard to replenishment of the armored equipment considerably increasing the capabilities of the operational units that required various types of recovery and engineering vehicles as well as mobile assets supporting the command process in order to conduct combat operations.

MT-LB armored carrier (Fig. 1). The multipurpose vehicle designed for transportation of the personnel, ammunition and other dangerous goods on a battlefield, towing the armament, various types of the military equipment and trailers with a maximum permissible mass of 6.5 t. It was considered as the basic vehicle that could be used for mounting varied types of weapon systems as well as for building specialized versions. In the standard version, the carrier had the mass of 9.7 t and was able to carry 13 people or 2 people and 2.5 t of cargo [Lekki gasienicowy... 1981, pp. 9-10]. The low silhouette of the carrier together with the high maneuverability in harsh terrain provided the relatively high level of the protection on a battlefield enabling execution of tasks directly under an enemy's fire. The vehicle in this configuration was mainly used as an artillery prime mover for anti-tank guns or the ammunition transportation vehicle. On the basis of the MT-LB the specialized tracked vehicle SPG-2 with the mass of 13 t was constructed, which was to serve as the baseline for the special body. Compared to the prototype, it was equipped with the rebuilt body with increased displacement and capacity as well as the engine of Polish construction. The buoyancy of the vehicle was improved through the application of additional water propellers with the hydraulic drive. The level of the protection was increased by introduction of the firefighting system [Rylski and Sakowicz 1993, p. 36].



Fig. 1. MT-LB armored carrier in basic version (photo by HSW)

Recovery and repair vehicle 'Mors'. It was designed for mechanized units equipped with MWP-1 combat fighting vehicle, which did not possess technical support tracked vehicles. Both the construction and research-implementation works were conducted in OBRMZiT in Stalowa Wola. The vehicle's tactical and technical criteria were developed by the Military Institute of Armoured and Automotive Technology (WITPiS) in Sulejów [Chodkowski and Orłowski 1987, pp. 16-17]. The works commenced in 1978, the project and the technical documentation were drawn, whereas the first prototype was built in 1980. The basic version of the MT-LB armored carrier was used for its construction. The prototype was tested until 1982 when the Ministry of National Defense agreed to adopt the vehicle into the service in the Polish Armed Forces [Wardencki 2002, p. 28]. In 1986 OBRMZiT together with WITPiS performed a significant modernization, which consisted in developing the new, modern version of the vehicles on the basis of the SPG-2 chassis. The new vehicle was marked as WPT 'Mors-II' (Fig. 2). The modified vehicle successfully underwent the qualification tests and was accepted into the service in the Polish Armed Forces [OBRMZiT... 1995, pp. 3]. The vehicle was designed for: conducting technical reconnaissance of a battlefield, providing technical assistance and crews' evacuation, providing medical assistance, towing vehicles with the mass not exceeding 14 t, carrying cargo and personnel, supporting crossings of water obstacles and carrying out simple engineering works [Kurasinski 2014, p. 285]. The recovery-repair equipment consisted of: a winch with the set of blocks, a crane, a digging blade, an engineering set, towing devices and tool and spare parts sets. The winch, with the hydraulic drive of 6 t towing weight and 16 t with the use of the blocks, was located in the transportation compartment. The folding crane, with the triangle-shaped extension arm, was mounted on the upper-rear edge of the body. The crane with the maximum working load of 1.5 t was driven by the vehicle's winch. The blade of the dragged type was mounted in the rear part of the body. The towing devices consisted of the hook, the spring and the absorber. It was capable of towing a trailer with the mass not exceeding 6.5 t. WPT 'Mors' weighed 12.7 t, was armored with 12.7 mm heavy machine gun NSW, supplied with 500 rounds of ammunition. Its crew amounted to 3 people [Wolf 1990, p. 10].

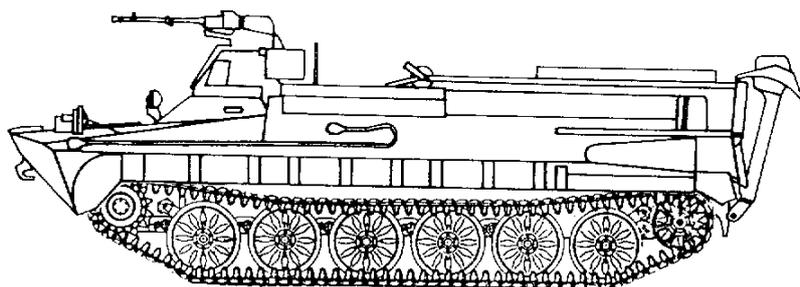


Fig. 2. Technical recovery vehicle WPT 'Mors II'

Engineering reconnaissance carrier TRI 'Hors' (Fig. 3). The works on the vehicle were launched in 1978 in OBRMZiT in Stalowa Wola. The carrier's tactical and technical criteria were compiled by the Military Institute of Engineering Technology (WITI) in Wrocław. The modified, armored carrier MT-LB, marked as SPG-2, constituted the baseline for this construction. At the early 1980s, on the basis of its chassis, the prototype was built which then was sent for technological and field tests. In 1982 the vehicle underwent the qualification tests and was accepted in the service in the Polish Armed Forces as the engineering reconnaissance carrier TRI 'Hors'. Between the years of 1985-1986 the carrier was modernized by installing the engine SW-680 [OBRMZiT... 1995, pp. 3] of the Polish design. The specialized accessories enabling execution of the reconnaissance and engineering tasks were as follows: engineering equipment and assets, water obstacles reconnaissance system, road and terrain reconnaissance system, chemical and radioactive reconnaissance system and signaling system. The engineering equipment and assets consisted of: the sapper kit (explosives, fuses and exploders) and the minefield barriers reconnaissance kit (mine detectors, mine-detection feelers, hooks for mine clearing and warning and direction signs). The water obstacles reconnaissance system included: a profile echograph enabling depth measurement and assessment of the hardness of the bottom, a diver's equipment, two rubber boats, a gauge for ice depth measurement, a hydro speedometer for measurement of water current speed, a hand lead for depth measurement and a hydrophone. The road and terrain reconnaissance system was composed as follows: a sapper rangefinder, an engineering reconnaissance periscope, a camera with telephoto lens, a long-range photography periscope, a theodolite (a geodetic tool for horizontal and vertical angles measurement, designation of azimuths and distance measurement), prism binoculars, a set of probes for ground and terrain reconnaissance and a set of signs and guides for marking the terrain or recognized roads. The chemical and radioactive reconnaissance system contained the chemical contamination control device PChR-54M and the Geiger counter DP-75. The signaling system included: a signal mine and a signal pistol. The additional vehicle's accessories covered: a decontamination set, a camouflage net, engineering tools (a spade and a crowbar) and a kit for meals preparation. The vehicle weighed 12.4 t with the crew of 7 soldiers [Transporter rozpoznania... 1990].



Fig. 3. Engineering reconnaissance carrier TRI 'Hors' (photo by HSW)

Communication vehicle R-137T 'Maciejka'. The vehicle was developed in 1985 as the deployable carrier of the VHF average power radio station of R-137 type. It was produced between the years of 1985-1986 based on the MT-LB chassis in the WAREL Electronic Enterprises in Warsaw. The vehicle was designed for providing the static and mobile radio communication on operational and tactical levels of command. The vehicle was equipped with: a transmitter and a receiver, a radio station desk, a radio link, telephonic and telegraphic apparatus, antennas system and a generator powering the systems. The radio station worked at the frequency range 20-60 MHz. The transmitter's power accounted between 800 and 1000 W, which enabled for maintaining the static communication at the distance up to 150 km and not exceeding 70 km during the movement [Paszkowski 1998, p. 99]. The vehicle possessed the remote control panel PZS which allowed for using the radio station from the remote communication element through the radio link via the telephonic or telegraphic channels [Hucal 2014].

Engineering carrier TI 'Durian' (Fig. 4). The vehicle, similarly to the previous ones, was developed by OBRMZiT in Stalowa Wola in compliance with the tactical and technical criteria drawn by WITI in Wrocław [Grzeszczak 1987, p. 389]. The works on the carrier commenced in 1990 and a year later the works on the prototype were accomplished.



Fig. 4. Engineering carrier TI 'Durian' (photo by OBRMZiT)

The vehicle was subjected to the series of the technical and field tests, which lasted till 1993. The same year the carrier entered the service in the Polish Armed Forces. In 1994 the sample batch was completed and delivered to engineering units [OBRMZiT... 1995, pp. 6].

The vehicle's specialized equipment consisted of: equipment for reconnaissance, marking and crossing of minefield barriers, blasting equipment and materials, engineering equipment and equipment for auxiliary works at water obstacles. The equipment for reconnaissance, marking and crossing of minefield barriers included: mine detectors of W-3 P/A type, mine feelers and types, electric exploders, mine cords and mine clearing hooks as well as warning and direction signs. The blasting equipment and materials covered: explosives (40 kg of TNT and 40 kg of plastic explosives), linear demolition charges ŁW-1/2 (92 pcs), shaped charges, detonators, detonation and blasting fuses, sapper wires and electric exploder. The engineering equipment included: a chainsaw with the accessories for ground and ice drilling and an engineering and sapper toolkit. The equipment for auxiliary works at water obstacles contained: a rubber boat and water works clothing. The combat engineering version towed the P2P-WŁWD trailer with the mounted combat linear demolition charge system (Fig. 5). Additionally, two containers with ŁWD-100/5000 linear demolition charges serving for making gaps in minefields by the blasting method. Having launched the charges, the trailer could be disconnected which allowed for the independent operation of the carrier. The vehicle's mass was of 13.1 t with the crew of 9 soldiers [Skrzypek 1993, pp. 22-24; Transporter inżynieryjny... 1996].

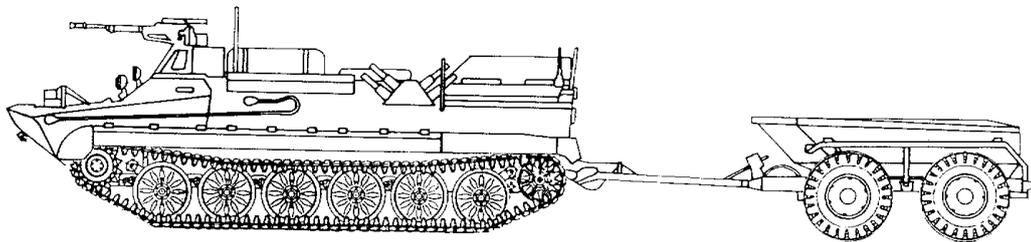


Fig. 5. Engineering carrier TI 'Durian' in combat version

Scattered mine laying carrier TMN 'Kroton' (Fig. 6). The prototype model of the vehicle was prepared in OBRMZiT in cooperation with WITI in 1993. The SPG-2 chassis powered by the engine of SWT 11/307/1 with the power of 300 hp produced in WKS Mielec was used in the vehicle. The prototype of 'Kroton' came into existence in 1995. The vehicle underwent the series of technical and qualification tests but met with the lack of the interest of the armed forces [OBRMZiT... 1995, pp. 4]. In the years of 1997-2002 the development program of the vehicles was completely ceased. The vehicle was for the first time publically presented during the 2001 International Defence Industry Exhibition in Kielce. Its standard equipment included: 4 rotary modules of mine launchers – 20 tube guides each, a guidance system, a tester and 400 anti-tank mines

of MN-123 type with the tandem shaped charge placed in 80 mine clusters. The vehicle weighed 14 t with the crew of 2 soldiers [Garstka 2007, pp. 60-61].



Fig. 6. Scattered mine laying carrier TMN 'Kroton'

Automated command vehicle ZWD-1 'Irys'. The vehicle was developed at the end of 1990s. The first vehicle on the MT-LB chassis was built in 1999. It was designed to support the command process on the tactical level. The vehicle was equipped with the following means of communication: 2 digital VHF radio stations TRC-9500 with the range up to 20 km, 1 HF radio station RF-5200, a tactical radio access subsystem, a exchange-multiplexer ŁK-24A, a cable regenerator RK-128/2, an internal communication system SOTAS PL and 4 field phones AP-82 and AP-92. The vehicle contained also the computer equipment such as: the microcomputer TDR-20K, the computer modules MK16A and a personal terminal PC9600. A generator powered the vehicle's onboard devices during standstill. The crew consisted of 3 soldiers. The command compartment provided the working space for 3 people [Fraczek 2015, p. 24].

Automated command-staff vehicle ZWDSz-1. The vehicle was completed on the basis of MT-LB chassis in a single copy. The chassis of the combat fighting vehicle BWP-1 was used for building the subsequent vehicles of this type. The vehicle was designed to provide the mobile and static communication on the tactical level. The essential equipment included: computer devices (microcomputer TDR-20K and 3 computer modules MK-16A), radio communication devices (3 VHF radio stations TRC-9500, 1 HF radio station TRC-3530 and a tactical radio access subsystem BSR), line communication devices (the exchange-multiplexer ŁK-24AW, the cable regenerator RK-128/2, the bulk encryption device GUU-2B), internal communication devices (internal communication system SOTAS PL, 4 field phones AP-82 and AP-92) and the power generator ZPD-220/2. The range of radio communication in HF band accounted up 30 km and 20 km in VHF band. 6 soldiers, including 3 staff officers, maintained the vehicle⁴.

Automated command vehicle ZWD-10R 'łowcza-3'. The vehicle was designed to provide the automatization of the anti-aircraft defense command on the tactical formation level. The chassis SPG-2A, built in 1992 based on the command vehicle 'Opal'

⁴ ZWDSz-1. *Opis techniczny*, Warsaw 1998, pp. 7-9.

developed in 1980s was used for its construction. The works on the vehicle started in 1997 after having the modern digital radio stations had been introduced into the armed forces. The Science-Production Centre of Professional Electronics 'RADWAR' coordinated the project. The prototype of the vehicle was constructed in 1999. After passing the factory and qualification tests the relatively small series of the vehicles was completed and delivered to anti-aircraft defense units of the Polish Armed Forces. However, the further production of the vehicle was not continued due to the fact that it was replaced by the new version based on the off-road vehicle chassis. The equipment of the ZWD-10R 'łowcza-3" included: 3 VHF radio stations of RRC-9500, the exchange-multiplexer ŁK-24AR, the communication desk AC-16C, the desk PKM-10, the server block BS-127/1, the data transmission block BTD-001, a plotting board and a power generator. Besides the commander and the driver, 3 soldiers could work in the vehicle [Kinski 2000, p. 15-16].

Automated reconnaissance-jamming system 'Przebiśnieg'. The Department of Radio-communication and the Department of Telecommunication Systems of the Military University of Technology in Warsaw developed the technical and connectional projects in cooperation with the Military Electronic Works in Zielonka [Zautomatyzowany system...]. The system consisted of 7 vehicles built in the MT-LB armored carrier chassis and included: the command vehicle WD krel, 3 reconnaissance vehicles SR and 3 jamming vehicles SZ. The SR vehicles could conduct radio communication at the distance not exceeding 30 km at the frequency range 20-3000 MHz, establish the position of the source of the emission and record transmitted information. The SZ vehicle enabled setting the active selective, blocking and deception jamming at the frequency range 20-500 MHz with the power output of 1 kW at the band of 20-100 MHz and 500 W at the band 100-500 MHz. The reconnaissance and jamming stations were equipped with the folding-out, hydraulic 3-segment antennas providing the adequate range of the onboard devices. The system was designed to reconnaissance and jam enemy's communication systems on the tactical level. As the automated electronic warfare system, it included the subsystems: command, radio watch, radio bear and jamming. Apart from reconnaissance and jamming, the system allowed for data collecting and analyzing, the radio electronic situation display and its transfer to a higher echelon [Rochowicz 2006, pp. 34-36].

Light tracked chassis LPG is the thoroughly modernized by HSW version of the MT-LB carrier the chassis of whose was used for production the self-propelled guns 2S1 'Goździk'. Only the elements of suspension and motion systems were left from the previous vehicle. The new drive system in the form of the German power pack was used, consisting in the diesel engine MTU-6V 199TE20 with the power of 353 hp, integrated with the ZF LSG1000 gearbox and the hydrostatic steering system. The LPG chassis was applied to develop command-staff vehicles WDSz and command vehicles WD for the artillery battalion module 'Regina' with 155 mm self-propelled howitzers 'Krab' and the prototype of the self-propelled tracked mortar M120G 'Rak' [Maciejewski 2011].

5. Prototype constructions based on MT-LB designed in Poland

Polish research and development centers, based on the MT-LB armored carrier produced by HWS, designed numerous versions of combat and support vehicles which potentially could constitute the alternate solutions for foreign constructions used by the Polish Armed Forces. The standard Warsaw Pact weapon, artillery and missile systems were applied during their production which was to assure the standardization requirements and facilitate implementation of particular vehicles in the service of the Armed Forces.

Self-propelled anti-aircraft missile launcher 'Turkus' (Fig. 7). The first project realized by OBRMZiT in Stalowa Wola and the Military University of Technology in Warsaw. The works commenced in 1976 thus, soon after the production of MT-LB had been launched. The anti-aircraft weapon system consisted of two launchers of K-13 infrared guided missiles. Two prototypes were produced. The modernized version 'Turkus 2' in which the double anti-aircraft 9M31 'Strzala-1M' missile launcher was applied constituted the further step. The vehicle was to be equipped with the passive sighting system assuring its non-detectability. It was designed to destroy low-flying targets at the altitude between 50 and 3000 m. The research and development works were conducted in the years of 1976-1981. The prototype, which was subjected to the technical tests, was built. During the tests the representatives of the Armed Forces decided that the vehicle did not comply with the accepted tactical and technical criteria and the further works were ceased [Historia Huty... 1996, p. 5].

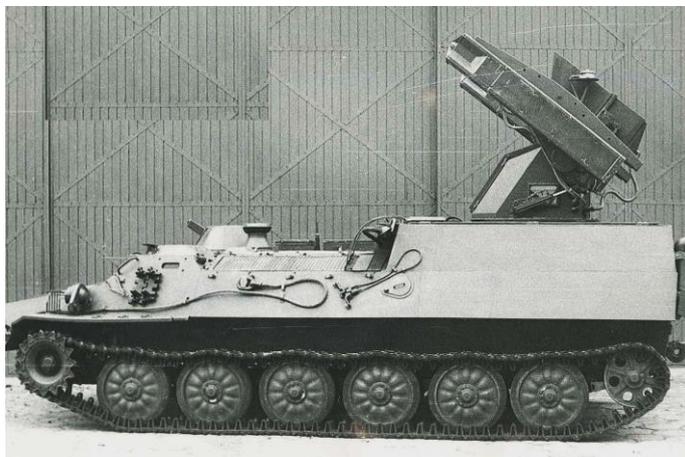


Fig. 7. Prototype of self-propelled launcher 'Turkus 2' (photo by OBRMZiT)

Self-propelled anti-aircraft gun 'Promet'. The constructional works on this vehicle were conducted since 1979. Two 23 mm guns were applied in the vehicle. Only 4 prototypes were completed, which were subjected to the field tests. The tests unveiled unsatisfactory accuracy of the system during certain types of shootings. In 1980 the further version 'Promet 2' was produced, which was equipped with 30 mm guns and Surveillance and Target Acquisition radiolocation station designed by the RADWAR Works. In the light of non-sufficient capacity of the chassis this version did not come

into the prototype phase. Due to the lack of the interest from the Armed Forces' side, the works on the system were finished in 1981 [Historia Huty... 1996, p. 5].

MT-LB armored carrier with the anti-aircraft turret. It was developed in the beginning of the 1980s at the Military University of Technology in cooperation with the Military Institute of Armoured and Automotive Technology in Sulejów. The similar vehicles introduced into the service at the Bulgarian Army were the inspiration for the constructors. In the vehicle the so-called anti-aircraft turret constructed by WAT's constructors was used, which previously had been applied into SKOT-2AP and TOPAS-2AP armored carriers. A single prototype vehicle was built in order to assess its usefulness for the Armed Forces. The carrier did not meet with the interest from the military side due to the significant capacity limitation of carrying soldiers in the troop compartment [Uzycki et al. 1996, p. 339].

Combat anti-tank carrier BTP-20 'Skorpion' (Fig. 8). In 1981, OBRMZiT in cooperation with the Military Institute for Armament Technology in Zielonka tackled the 'Skorpion' issue under which the missile tank destroyer on the MT-LB chassis was covered. The vehicle was armed with the anti-tank guided missile system 9M14M 'Malutka' with the range of 3000 m. The research and development works were carried out between the years 1981-1983. The prototype, which was subjected to the factory tests, was built and the construction documentation was prepared. However, the series production of this vehicle was not continued [Historia Huty... 1996, p. 5].

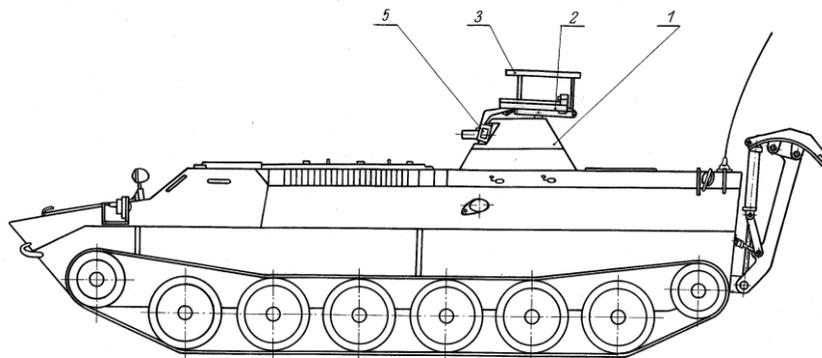


Fig. 8. Anti-tank carrier BTP-20 'Skorpion' (picture by OBRMZiT)

Armored personnel carrier 'Piasť. The works on the implementation of the engine of Polish construction into the MT-LB carrier, which would replace the imported engine JaMZ238, commenced in 1982. The engine SW 680 with the power of 245 hp was used. This engine was more economical and was characterized by better resilience. As a result of 2-year works, the prototype called 'Piasť' was constructed. However, the vehicle was not produced in series but the experiences gained during its development were implemented while works on the further vehicles on the basis of the MT-LB chassis [Historia Huty... 1996, p. 6].

Self-propelled anti-aircraft system 'Polon'. The project was developed in 1986 in OBRMZiT in cooperation with the Research and Development Center for Mechanical Engineering of the Mechanical Works in Tarnów and the Military University of Technology in Warsaw. The vehicle was armed with two 30 mm rapid-fire guns and infrared guided anti-aircraft missile 9M33 'Osa' launchers. The system was intended to be equipped with the fire control system and the radiolocation guidance station. Ultimately, the vehicle was to replace the self-propelled anti-aircraft guns ZSU-23x4 'Szyłka' used by the Polish Armed Forces. The works on the vehicle were ceased in 1987 due to the expected purchase of the Soviet self-propelled anti-aircraft guns 2K22 'Tunguska'. The collapse of the Warsaw Pact erased the implementation of those projects [Szulc 1994, p. 12-15].

Ammunition supply vehicle 'Bor'. The works on the ammunition vehicle 'Bor' designed to supply the self-propelled howitzers 2S1 'Goździk' (which had been introduced into the service) with the ammunition commenced in 1986 (Fig. 9). The vehicle provided the possibility to transport the ammunition and its reloading to the gun via the conveyor belt. The research and development works were conducted between the years of 1986-1989. In 1987, the prototype that was subjected to the initial and qualification tests was completed. Despite the positive test results, upon the decision of the Ministry of National Defense on July 1989, the further works were suspended [OBRMZiT... 1995, pp. 9].



Fig. 9. Prototype of the ammunition supply vehicle (photo by OBRMZiT)

Medical vehicle 'Lotos'. The construction works on the vehicle were carried out between the years of 1987-1990. The vehicle was intended to evacuate casualties from a battlefield and provide the basic resuscitation treatments. The vehicle could carry 4 wounded persons in supine or 8-10 in sitting position. The prototypes in two versions with the Polish and Russian engines were prepared. It was scheduled that the vehicle would be produced for export, mainly to Iraq. The 1990-1991 War in the Persian Gulf and the embargo on the supply of the military equipment prevented the realization of those plans. The only one vehicle, sent for test operation to the 11th Armored Cavalry Division, was completed [Historia Huty... 1996, p. 6].

Self-propelled artillery command vehicle 'Opal-540' (Fig. 10). The vehicle was developed by OBRMZiT in 1987-1990. It was equipped with the battalion automated fire control system, radio communication systems and navigation devices. 4 prototype vehicles of 'Opal-I' version based on the SPG-2 chassis and 2 vehicles of the version 'Opal-II' on extended SPG-2A chassis, which were subjected to the qualification tests, were constructed. The lack of the interest from the Armed Forces caused the suspension of the further works in 1994 [Historia Huty... 1996, p. 6-7]. The 'Opal' chassis served later for the development of the baseline vehicles for TI 'Durian' and BWO-40 carriers.



Fig. 10. Command vehicle 'Opal-540' (photo by OBRMZiT)

NBC reconnaissance vehicle 'Parys 01'. In 1988, OBRMZiT undertook the research and development works on the chemical and nuclear explosions reconnaissance vehicle 'Parys'. The project was realized jointly with the Military Institute of Chemistry and Radiology. The accessories of the vehicle contained the nuclear explosion and chemical contamination detection devices as well as radioactive contamination measurement apparatus. The vehicle was adopted to operate in a heavily contaminated terrain owing to the hermetic body with anti-radiation shield and air filtration units. Having completed a single prototype in 1991, the further works were halted due to the lack of funding [OBRMZiT... 1995, pp. 10].

Self-propelled anti-aircraft system 'Stalagmit'/'Sopel'. The design studies on the system marked as 'Sopel' began in 1993 and at the end of that year the prototype model of the vehicle was finished (Fig. 11). The vehicle was built based on SPG-2 chassis with the SWT-11/307/2 engine. Two 23 mm automatic guns of 2A14 type and two anti-aircraft missile launchers 9K32 'Strzała-2M' constituted the armament of the vehicle. This armament was to provide the possibility of striking air targets at the range up to 4200 m and at the altitude not exceeding 2300 m. In 1994 the 'Sopel' program was combined with the conducted since 1992 'Stalagmit' program aimed at developing the self-propelled anti-aircraft system on the basis of T-55 tank's chassis. In 1995, the prototype of 'Sopel', which was subjected to traction and fire tests, was completed. The positive results of the tests allowed for drawing the tactical and technical criteria of the self-propelled anti-aircraft 'Stalagmit'/'Sopel' system. The prototype of the vehicle was

prepared in 1998. In comparison to the previous version it was armed with the 'Grom' missile launchers capable of destroying air targets at the range up to 5200 m and at the altitude up to 3500 m. The vehicle was equipped with an aiming head with TV and thermovision cameras and a laser range finder. Between 1998-1990 the vehicles underwent the factory and field tests. In September 1999 it was presented to the public during MSPO in Kielce. The lack of the interest from the Ministry of National Defense resulted in ceasing the works in 1999 [Holdanowicz 1999, p. 36-38].



Fig. 11. Self-propelled anti-aircraft system 'Sopel' (photo by OBRMZiT)

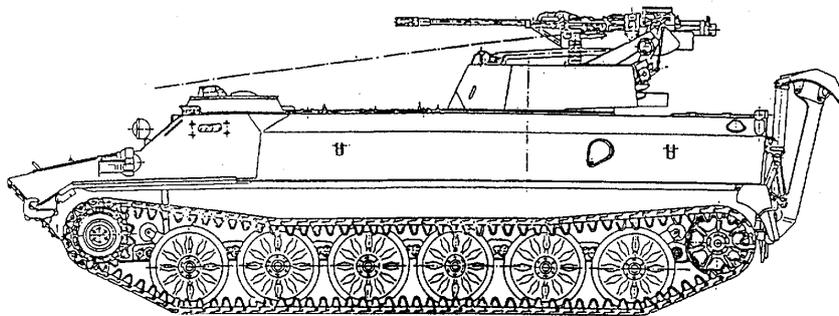


Fig. 12. Light armored fighting vehicle LWB-23 'Krak' (figure by OBRMZiT)

Light armored fighting vehicle LWB-23 'Krak'. The vehicle was constructed in 1993. The first version was marked as MT-LB-23M and afterwards renamed into LWB-23 'Krak' (Fig. 12). The prototype of the vehicle was publically presented during MSPO in September 1993. The vehicle had a single-person turret developed by the Research and Development Center for Mechanical Engineering of the Mechanical Works in Tarnów. 23 mm automatic gun of 2A14 type and 7.62 mm PKT machine gun were mounted on the roof of the turret. The vehicle weighed 12.6 t and its crew consisted of 3 persons. The vehicle could carry 6 soldiers in the troop compartment. The vehicle was de-

signed to use by the newly formed mountain infantry brigades. However, the vehicle was not accepted by the military [Kajetanowicz 1995, p. 123].

Infantry fighting vehicle BWO-40. The vehicle was created in cooperation with the Swedish Bofors Company in 1993. The vehicle built on the 'Opal' SPG-2A chassis had the Swedish turret system borrowed from the CV-90 infantry fighting vehicle. 40 mm Bofors L/70 automatic gun constituted its main armament. The vehicle weighed 16 t and reached maximum speed of 60 km/h. After conducting initial research and firing tests in the Military Institute of Armament Technology, further works were suspended due to the lack of interest from the military [OBRMZiT... 1995, pp. 8-9].

6. Imported support vehicles on MT-LB chassis exploited in Poland

Apart from the basic and specialized versions of the MT-LB carrier produced in Poland for the purposes of Polish Armed Forces, different vehicles based on its chassis were purchased. There were self-propelled anti-aircraft missile launchers, communication jamming vehicles, artillery reconnaissance radiolocation stations and command-staff vehicles of various levels which constituted the standard vehicles used by the all Warsaw Pact's armies.

Missile anti-aircraft system 9K35M 'Strzala-10M'. The system was introduced into the service of the Polish Armed Forces in 1982 as the anti-aircraft system for armored forces. The missile combat vehicle 9A35M constituting the integral part of the system was developed based on the MT-LB armored carrier. The vehicle was armed with the 9M37M ground-to-air missile launcher located on the rotary turret in 4 starting containers and the control and the 9W839 measurement station. The missiles could strike air targets at the range of 800-5000 m and at the altitude of 10-3500 m. The combat weight of the launcher was 12 t with the crew of 3 soldiers [Paszkowski et al. 1998, p. 61].

Communication jamming vehicle R-330P 'Piramida'. 9 vehicles of this type were purchased by Poland in the mid-20th century. The vehicle was constructed based on the MT-LBu carrier. The system selectively jammed the sources of microwave emission at the frequency range between 30-100 MHz. The jamming generator of AN-404 type was used for generation of the jamming signals. The transmitting power of the jamming signals accounted to 1 kW. Two radio receivers R-323 served for the recognition of the transition sources. The panoramic indicator AN-403 enabled the precise determination of the character and parameters of the transmission. The UKF R-130 radio station provided the external communication. The vehicle was equipped with the power generator of ET-T-8/400WSS type located in a tank at the back of the body. The vehicle weighed 15.5 t with the crew of 4 soldiers [Szulc 2010, p. 66-67].

Artillery reconnaissance radiolocation station SNAR-10 'Leopard' (Fig. 13). The vehicle was implemented into the service of the Russian Army in 1973 and purchased by the Polish Armed Forces in the 1980s. The system was based on the MT-LB carrier's chassis, designed for reconnaissance of both surface and naval targets operating at the front of the battle line of own troops, determination of the position of larger stationary

objects and correction of own artillery fire. The maximum range of localization of moving surface targets (fighting vehicles, vehicles) was 17 km and naval targets up to 30 km. The acquisition range of artillery surface blasts not exceeded 10 km and naval 23 km. The average error value of tracing objects – 20 m. The time required to determination of the target position accounted to 3-5 s. The vehicle weighed 12.5 and the crew consisted in 3 soldiers [Szumilin 2011, p. 25-26].



Fig. 13. Radiolocation station SNAR-10 'Leopard'

System 1W12 'Maszyna' was introduced into the Russian Army in 1973 to support the command process in the self-propelled artillery units. It started to be delivered to the Polish Armed Forces at the beginning of the 1980s. The system included 4 types of the vehicles built based on the MT-LBu carrier, which were marked as: 1W13, 1W14, 1W15 and 1W16. These vehicles supported the reconnaissance and fire control processes of artillery units.

Command-observation vehicle 1W13 was designed to control fire of an artillery platoon. It provided determination of firing positions location, setting the guns at the commanded direction reception of fire missions and targets positions data and maintaining the constant communication with guns commanders and a battery commander. The 1T121 apparatus with the azimuth block together with the gyrocompass assured the above-mentioned characteristics. The communication was maintained through 3 R-123M radio stations. The vehicle weighed 14.8 t. The crew consisted of 5 soldiers, including a platoon leader and a battery officer.

Command-observation vehicle 1W14 was the vehicle of a self-propelled artillery battery commander. It was designed for conducting the reconnaissance, determination of targets location to be destroyed and a battery fire control during co-ordination with armored and mechanized forces. Equipped similarly to 1W13, the vehicle possessed the laser artillery range finder DAK 2M1 and the coordinates transformation device 1T804K1. The communication was assured via 3 VHF R-123M and 1 R-107M radio stations. The crew consisted of 6 soldiers, including a battery commander and an operator-topographer.

Command-observation vehicle 1W15 was the artillery battalion commander's vehicle. It was designed to conduct the reconnaissance and control the battalion's fire. Its on-board accessories did not differ from 1W14 and additionally the vehicle was equipped with the encryption device T-219 *Jachta* and the fire control device PUO-9U. The communication was maintained through 5 radio stations, including 2 R-123M and such as: R-111M, R-107M i R-130M. The vehicle weighed 14.8 t. The crew consisted of 6 soldiers, including the battalion commander and the operator-topographer.

Command-staff vehicle 1W16 served for an artillery battalion executive officer. It provided: determination of fire positions for individual batteries, methods of conducting fire at identified targets, conveying data to batteries' firing positions, maintaining the constant communication with a regiment HQ, a battalion commander, battery commanders and commanders of assigned reconnaissance units. Its equipment included: the ballistic computer 9W59, 2 R-123M radio stations, R-111 and R-130 radio stations and the receiver R-326. The vehicle weighed 15.9 t [Wyroby 1W13... 1987, pp. 7-14; Karpieńko 2009, p. 8; Szulc 2008, p. 78-81].

Command-staff vehicles MP-12-25 constituted the basic element of the Field Automated Command and Control System (PASUW), which was introduced into the Warsaw Pact's armies in the 1980s. The vehicles were built based on the MT-LBu armored carrier. Each vehicle possessed: the data transmission device of APD *Bazalt-B1* type, the on-board computer WK175 *Argon-1M* and the encryption apparatus T-219M *Jachta*. The communication assets were also standardized and in the first version they were as follows: 2 radio stations VHF R-111, 1 radio station VHF R-123MT, 1 radio station VHF R-138 and 1 radio station HF R-130M. Subsequently the modern types were installed in the vehicles.

Command-staff vehicle MP-21 (Fig. 14) was introduced to the Polish Armed Forces in the mid-1980s. Its equipment included: 2 radio stations R-111, the radio stations R-173 and R-134, the radio link R-415W and the power generator 143M. The vehicle existed in various types as MP-21M – the division commander vehicle, the executive deputy division commander vehicle, division chief of staff vehicle, MP-21M2 – the chief of chemical branch vehicle and MP-21M3 – the chief of reconnaissance branch vehicle. The MO-21 crew consisted of 6 soldiers, including 2 officers and 2 wireless operators [Iwanow 2006, pp. 83-84].

Command-staff vehicle MP-22M was the vehicle designed for a division chief of anti-air craft defense. Its equipment included: 2 radio stations R-111, 2 radio stations R-173, 1 radio station R-173P and 1 radio station R-134 and R-159. The crew consisted of 7 soldiers, including 3 staff officers and 2 wireless operators.

Command-staff vehicle MP-23M supported the chief of operational aviation control group. The vehicle's equipment covered: 2 radio stations R-111, 2 radio stations R-173 and 1 radio station R-134.

Command-staff vehicle MP-24M supported the work of the division chief of missile and artillery forces. Its equipment included: 2 radio stations R-111 and radio stations R-134, R-173 and R-159. The version MP-24M1 was intended for the chief of staff of

artillery regiment, the version MP-24M2 for the regiment commander and the artillery commander of general military regiment.

Command-staff vehicle MP-25M was designed for collecting and processing the information essential for the execution of the command and control processes. Its equipment covered: 2 radio stations R-111, 2 radio stations R-173 and 1 radio station R-134. The command-staff vehicles MP-22, 23 and 25 were assembled until 1990 by the Polish Works RADWAR based on the MT-LBu carriers produced in Bulgaria [Szulc 2016, p. 72-81; Stauß].

Data processing vehicle 'Beta-3M'. The vehicle was introduced into the service at the beginning of the 1980s as the element of the Automated Command and Control System (PASUW). It was designed for collecting, processing and providing data required for making a decision by a division HQ. Its basic equipment consisted in a computing system composed by: the on-board computer Beta-3M with A-40 processor, a control panel, a mobile control device and peripheral devices (alphanumeric digital printer and optical reader). The communication devices included 2 R-111 radio stations and 1 R-173 radio station. The time required for reaching operational readiness – approx. 40 min. The vehicle weighed 15.5 t [Beta-3M Mobile...].



Fig. 14. MT-LBu carrier in the MP-21 command-staff version

7. Service of MT-LB and its versions in the Polish Armed Forces

The basic version of the MT-LB armored carrier practically was not used to a greater extent in the Polish Armed Forces. Single vehicles were used in training centers, where they served for training of drivers, who during their further service were to operate support vehicles based on this carrier. At the beginning of the 1980s an experiment was conducted in the Warsaw Military District, during which 28 pieces of the carriers were used. The purpose of the experiment was to proof whether or not the carrier was suitable for combat operations executed by mechanized forces, therefore, the tests were conducted on the basis of the 1st Mechanized Regiment in Wesola. In 1983 the

carrier was declared as not complying with the requirements and the further works in this regard were suspended. The vehicles used for the experiment served as the recovery vehicles in units equipped with infantry fighting vehicles⁵.

The technical recovery vehicles WPT 'Mors' which as the first of the specialized versions came into the service in 1982, found the broadest application in the Polish Armed Forces. The vehicles were included in the structures of technical evacuation platoons of maintenance companies of mechanized regiments and armored regiments equipped with the BWP-1 infantry fighting vehicles. Their main task was providing the crews of the infantry combat vehicles in field conditions with technical assistance, and in the case of major damages the evacuation of the vehicles to the damage equipment collection points. After restructuring the regiments into mechanized and armored brigades in the 1990s, WPT 'Mors' were included into maintenance platoons of logistic companies in the structures of mechanized battalions. Each platoon contained the evacuation squad equipped with such the vehicle [Korzeniowski et al. 1999, p. 19; Ciekot and Penkalla 2010, p. 45]. At the mechanized brigade level, in the logistic battalion, the evacuation platoon of the maintenance company possessed these vehicles in its structures. The platoon was equipped with 3 such the vehicles. The vehicles were designed to organize evacuation and maintenance groups in the field conditions [Kurasinski 2014, pp. 111-112].

The engineering reconnaissance carriers TRI 'Hors' based on the MT-LB carrier were implemented into the service of the Polish Armed Forces in the 1980s. The engineering reconnaissance sub-units of the engineering brigades' command companies and engineering battalions of mechanized and armored divisions were equipped with these vehicles. In the 1990s during the maintenance in the Military Engineering Works, some of the vehicles were modified into the engineering vehicle version PI by mounting the device to tow the trailer P2P-WŁWD, the electrical guidance system SE and containers and clamps for specialized accessories. In 1994, the engineering carriers TI 'Durian' were introduced to the engineering forces which as well were called engineering vehicles PI. They were introduced into the structures of engineering brigades and battalions replacing the well-worn SKOT engineering carriers [OBRMZi... 1995, p. 6]. In 2004, the engineering company of the 10th Armored Brigade in Świętoszów was equipped with the first 2 scattered mine laying carrier TMN 'Kroton'. According to the then assumptions these vehicles were to ultimately constitute the equipment of the mechanized and armored brigades' engineering companies and divisional engineering battalions. However, only few pieces of the 'Kroton' were implemented into the service by the military [Garstka 2007, pp. 60-61].

At the beginning of the 1980s, 4 missile anti-aircraft systems 9K35M 'Strzała-10M' which came into the service in the anti-aircraft battery of the 24th Armored Regiment in Stargard Szczeciński subordinated to the 20th Armored Division [Babinowski et al. 2008, p. 139] were purchased. The purchase was of the pilot character aimed at verifying the suitability of these vehicles for providing the cover for the armored forces. Due

⁵ *Pismo szefa Zarządu Planowania Materiałowego No PF 456/P/I dated on 20.06.1983.* Instytut Pamięci Narodowej 02958/567, k. 142.

to the significant costs, the further acquisition of the system was ceased. After disbandment of the 24th Armored Regiment in 1990, the system was handed over to the 33rd Mechanized Regiment in Budowo subordinated to the 2nd Mechanized Brigade. In 1995 'Strzała-10' system were introduced into the structures of the anti-aircraft battalion in 12th Armored Cavalry Brigade, which was formed upon the 33rd Mechanized Regiment. In 2001, after disbanding the brigade, the vehicles as non-perspective were withdrawn from the service [Informacja Rady... 2001, print No 100].

In the mid-1980s, the 8th Radio Jamming Regiment in Grudziądz, the electronic warfare battalions and reconnaissance battalions of armored and mechanized divisions were equipped with the communication jamming vehicles R-330P 'Piramida'. The 10th Reconnaissance Battalion of the 11th Armored Cavalry Division in Żagań [Szulc 2010, p. 72] used the vehicles by the longest period of time. Afterwards the vehicles were replaced by the modern systems of the domestic production. Simultaneously, the Polish Armed Forces obtained a several pieces of the artillery reconnaissance radiolocation station SNAR-10 'Leopard', which served in the artillery reconnaissance battalions of the artillery brigades at the operational level. The vehicles assured the increased fire effectiveness of the self-propelled artillery units through more precise positioning of the targets designated to destroy. The Automated reconnaissance-jamming system 'Przebiśnięg' was came into the service in the radiolocation company of the 2nd Reconnaissance Regiment in Hrubieszów in 2005 and in the radiolocation company of the 10th Reconnaissance Battalion subordinated to the 11th Armored Cavalry Division [Rochowicz 2006, pp. 34 and 36] in 2007. After disbanding of this battalion, the 8th Electronic Warfare Battalion in Grudziądz became the user of the system [Kowaluk 2012].

The command vehicles of the system 1W12 'Maszyna' were implemented in the Polish Armed Forces in 1982. They constituted the equipment of the self-propelled artillery battalions of the 1st Mechanized Regiment subordinated to the 1st Mechanized Division and 11th Mechanized Regiment subordinated to the 4th Mechanized Division armed with 122 mm self-propelled guns 2S1 'Goździk'⁶. Afterwards, the 1W12 system was introduced to the 5th Artillery Brigade armed with 203 mm self-propelled guns 2S7 'Pion' [Buczek 2009]. In the second half of the 1980s, in the Silesian Military District, the command-staff vehicles MP-21-25 on the MT-LBu chassis belonging to the Field Automated Command and Control System were experimentally introduced. In 1986 they came into the service in the 11th Armored Division in Żagań. Altogether, the division received 24 vehicles of this type, which constituted the complete set meeting its requirements. The vehicles were subjected to the practical tests during various field exercises. The significant technical unreliability of the system and its low effectiveness caused that it was not introduced in other divisions of the Polish Armed Forces [Taraśkiuk 1992, p. 43; Szulc 2016, p. 81]. The automated command vehicles ZWD-1 'Irys' were implemented in the Polish Armed Forces in 1999. At first, the vehicles came into the service in the command battalions of the 11th Armored Cavalry Division in Żagań

⁶ Pismo dowódcy wojsk raketowych i artylerii do szefa Zarządu I Sztabu Generalnego WP No 0582 dated on 24.11.1982. The Military Archive in Nowy Dwór Mazowiecki. Sygn. 1272/96/47, k. 114.

and the 12th Mechanized Division in Szczecin. Currently, the command brigades of the central level and command battalion of the divisions and brigades are equipped with them [Fraczek 2015, p. 26].

In the 1980s and 1990s of the 20th century, the drivers-mechanics of the MT-LB carriers were trained at the junior specialists schools incorporated in the structures of the training subunits of the mechanized divisions. Since 2002, the Artillery and Armaments Training Center in Toruń has been organizing courses on operating rules, service and driving the MT-LB armored carriers and built on its basis the self-propelled howitzers 2S1 'Goździk', engineering vehicles, technical recovery and command vehicles. The modern versions constructed on the SPG-2 chassis are used for the practical training. The training covers the tuition of the structure, service activities and safety rules during operating of the carrier and the practical vehicle driving in the field conditions [Kisiel 2016].

Conclusion

The license production of the MT-LB Carrier in Poland allowed for gaining the range of the modern technologies that in turn enabled undertaking of the extensive works on own vehicles. Since the second half of the 1970s till the 1990s of the 20th century more than 20 projects of combat and support vehicles were developed, the majority of which reached the prototype phase, but several of them met with the interest from the Polish Armed Forces' side and were introduced in the series production. These vehicles were of significant importance as far as the replenishment of the armored equipment is concerned, providing the possibility of conducting more effective operations by mechanized and armored units within the comprehensive condition of the contemporary battlefield. Mainly, it concerned the technical recovery, engineering and command vehicles, which played an increasingly important role. Launching the series production of these vehicles resulted in achieving the significant budgetary savings due to the fact the price of the equivalences produced by other countries was then significantly higher. The experience gained during the production allowed the dynamic development of the didactic and research potential which was confirmed by the aforementioned numerous examples of the combat and support vehicles projects. This potential, in a longer term, allowed for meeting by HSW in the 21st century the challenges such as the production of: the artillery command vehicles AWD, the command-staff vehicles WDSz and the self-propelled mortars M-120G 'Rak' whose traction elements were built on the basis of the LPG chassis constituting thoroughly modernized version of the MT-LBu carrier.

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Conflict of interests

The author declared no conflict of interests.

Author contributions

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

Ethical statement

The research complies with all national and international ethical requirements.

ORCID

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