Motorcycles – chosen aspects of army exploitation

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Key words: motorcycles, construction, maintenance-repair systems, exploitation standards.

Abstract
This article presents chosen aspects of motorcycle exploitation in contemporary armed forces. Certain types of motorcycles have been presented, as well as their technical solutions and parameters. The authors have made reference to the motorcycle maintenance-repair system and have analyzed chosen activities. Attention was paid to the practical aspects of the exploitation of such army equipment. The article takes into consideration the newly introduced professional regulations in the army regulating the topic of the exploitation of this group of army equipment. Pictures connected with this topic are enclosed as a supplement to the article.

Introduction
For a while now, one can observe an increase in the interest in army application of motorcycles. People started rediscovering their usefulness in various structures, e.g. in recon subunits, as liaison officer vehicles, in safety services, traffic regulation, gendarmerie or in special forces. Due to the lack of motorcycles dedicated specifically for army usage, militarized versions of civil motorcycles have started to come into use [1,7,12], with the division into light and medium motorcycles with two-stroke engines with a cubic capacity of 125 and 250 cm³, stemming from motocross or terrain endure motorcycles and heavy motorcycles with four-stroke engines with a capacity of between 350 and 1000 cm³ stemming from civil road models. Lighter models from the first group usually are better able to deal with difficult terrain, but they are not able to fully carry a passenger and additional load. The second group is able to carry a passenger and an additional load, however they are mainly able to deal with hardened roads. One has to note, however, that the terrain parameters of even the light motorcycles do not fully meet the army expectations concerning the driveability. One can also point out that the standard motorcycles from the civilian market have not fully covered the army’s needs. Concerning motorcycles of this type, there are currently attempts at introducing improved constructions. An example can be the exploitation of such motorcycles e.g. in the American army, as well as the continued production of typically military motorcycles for the armed forces of Russia, China, and a few other countries.

1. Motorcycle exploitation in the Polish Armed Forces in the post-war period
Various types of motorcycles have been exploited in the Polish Armed Forces in different periods of time [10,12] – also typically military ones, in solo versions, as well as ones with a sidecar.

During the last year of the war, up until the end of the 1940s, American Harley-Davidson WLA were the basic heavy motorcycles (fig. 1) [1]. In addition, there was also a small number of Indian 741B motorcycles (fig. 2) [1,10] and individual 640B and 340B models. These motorcycles were introduced into the Polish Armed Forces through the shipments made by Lend-Lease and UNRRA.

Fig. 1. A Harley-Davidson WLA military motorcycle

Fig. 2. An Indian 741B military motorcycle

The Harley Davidson motorcycle is equipped with a two-cylinder side valve V-engine with a cylinder capacity of 742 cm³ and 23 HP power at 4600 RPM. The weight of the motorcycle stood at 243 kg, the drive transferred the chain through a three-gear gearbox.

English military motorcycles, e.g. BSA M 20, Norton, Royal Enfield WD/C, have been introduced into the Polish armed forces similarly after the war, by UNRRA shipments.
Between the 1940s and the 1950s, due to the lack and depletion of spare parts, the Harley-Davidson WLA motorcycles were replaced with Soviet M-72 motorcycles (these were motorcycles based on the German BMW – R71, with a two-cylinder boxer engine with a cylinder capacity of 746 cm³). In the later period, the M-72 motorcycle was replaced with a newer K-750 type version. It is difficult to precisely determine the exact number of Harley-Davidson WLA motorcycles exploited in the army in the post-war period. During warfare, the motorcycles were destroyed. One can roughly estimate that there were approximately 1500-2500 Harley-Davidson WLA motorcycles in the Polish army between 1943-1956.

Several hundred Czechoslovakian Jawa 250 motorcycles were purchased by the Polish army between the 1940s and 1950s in a few batches (fig. 3) [1,10], as well as the 350 version (in smaller amounts).

Fig. 3. A view of the Jawa 250 motorcycle

Fig. 4. A view of the K-750 motorcycle

This motorcycle is equipped with a one-cylinder two-stroke engine with a cylinder capacity of 249 cm³ with a horsepower of 9 HP, with a fuel efficiency of 30/100 km. It was known for its very good driving dynamics and flexibility and a maximum speed of up to 100 km/h. The vehicle weight stood at approximately 125 kg and both driving wheels were sprung. In the Polish army, the Jawa 250 motorcycles were used for transportation, scout and training purposes. They filled the slot between light Polish motorcycles with a cylinder capacity of 125cm³ and the heavy Harley-Davidson WLA motorcycles which were replaced by (which was mentioned earlier) on the Soviet M-72, and subsequently by the newer version of the K-750 type (fig. 4) [1].

When army exploitation was finished, usually due to wear, the motorcycles were scrapped or sold to the civilian market. The successor of the 250 model was the Jawa 250 type 353, manufactured in the years 1953-1965. The new model had: a more modern suspension, full hub brakes, wheels with a smaller diameter, a double seat and many other important alterations made to the chassis. The engine was only slightly modified.

Between the 1970s and the 1980s, the number of motorcycles in the army was reduced. It is worth mentioning that also other types of motorcycles were used, e.g. foreign USSR IZ-49 motorcycles, which dealt well with the requirements for this type of vehicles. The army’s requirements were also aided by WSK type motorcycles and imported MZ 250 motorcycles made in the former East Germany [9,12].

2. Motorcycle exploitation in the Polish Armed Forces in the contemporary period

There are currently a few types of motorcycles exploited in the Polish Armed Forces and they are mainly used in special, security sub-units, in the tank-vehicle service and in the Gendarmerie. Gestor [3] has defined in [7] various standards for a given type of a motorcycle – exploitation standards, between-maintenance standards and the repair time consumption. The maintenance-repair system [12,13,15] is based on a given type of vehicle manufacturer instructions. These vehicles do not have a limit of annual resource consumption per unit, or an acceptable annual minimal resource for a group of equipment held in storage. Gestor has not foreseen any main repairs for this type of vehicles. According to [5], motorcycles are classified in group 6 (other vehicles), and they constitute the sub-group 6.2.

The army currently exploits the following types of motorcycles [1]:
- Aprilia Pegaso – the target exploitation norm in years and kilometers is 10 years/150000 km,
- Cagiva 350 – the target exploitation norm in years and kilometers is 8 years/120000 km,
- Kawasaki LE 650 – the target exploitation norm in years and kilometers is 10 years/250000 km,
- KTM 640 LC – the target exploitation norm in years and kilometers is 8 years/120000 km,
- MZ 250 – the target exploitation norm in years and kilometers is 6 years/100000 km,
- WSK 125 – the target exploitation norm in years and kilometers is 6 years/100000 km,
- Yamaha XT 660 R – the target exploitation norm in years and kilometers is 10 years/250000 km,
- Intervention Yamaha Fazer – the target exploitation norm in years and kilometers is 10 years/250000 km,
- Intervention Kawasaki ZR 800 – the target exploitation norm in years and kilometers is 10 years/250000 km.

The basic inter-service period [5,6,12] for this group and for service period of the type OO-1 is 2000 km, and for OO-2 it is 400 km, the target exploitation norm is given in years and kilometers and for motorcycles it is set at 10 years/120000 km [7]. The sub-group 6.2 [5], as well as other groups of equipment [3,7] undergoes a certain system of exploitation [12,16] and is accounted for according to the rules in effect.

3. Motorcycle service and repairs

All motorcycle defects [2,8,17] are a result of incorrect cooperation of the parts, occurring when they are overexploited or damaged. It is also important problems of exploitation [21,23,27], transport [18-20,22,24-26] and storage [30]. In order
to eliminate or limit various types of defects, motorcycles need the development and realization of a consistent maintenance-repair system [5,12,13], this including regular service, similarly to other groups of vehicles used as army equipment [5,7].

When defining the term motorcycle technical service, one can assume that it is a set of activities with the aim of maintaining the vehicle in fully operational condition. The technical condition of the motorcycles influences not only its trouble-free exploitation, but also the safety of the driver and other road users. Systematic and planned service greatly increases the durability of the individual motorcycle units, and other road users. Systematic and planned service greatly increases the durability of the individual motorcycle units, and the wear and tear goes almost exactly in the same way for all the mechanisms parts cooperating with one another, depending on the machine’s operating time. In the case of a motorcycle, one can assume that, if the motorcycle’s servicing is done correctly, the wearing of a given element depends on its mileage.

### 4. Motorcycle maintenance and repair time

Time-consumption norms are expressed in man-hours and man-minutes needed for the execution of a given service/inspection. They are set by army guidelines and instructions [5,7,13,14,15] and, as it was mentioned before, also by the manufacturer’s service/factory instructions. The carrying out of a service or repair requires a certain amount of time calculated in man-hours (MH). Table 1 [7] presents the time-consumption norms for technical services and repairs for vehicles taken care of by the Manager or Central Logistic Organ in the Leadership of the Tank-Vehicle Service. For the sake of comparison and potential analyses, the individual norms were presented comprehensively for army equipment within the tank-vehicle service/inspection.

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### 5. Chosen motorcycle profiles

#### 5.1. The Aprilia Pegaso 650 motorcycle

Motorcycles of this type – fig. 5-6 [1] are produced by an Italian company which has also developed and introduced a factory maintenance-repair plan into the exploitation of motorcycles [4,12,29].

### Table 1. Technical service and repairs time-consumption norms

<table>
<thead>
<tr>
<th>No.</th>
<th>Type of army equipment</th>
<th>Unit</th>
<th>Types of maintenance</th>
<th>Types of repairs</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Medium tanks T-72 and derivative</td>
<td>MH</td>
<td>18-20</td>
<td>32-36</td>
<td>88-96</td>
</tr>
<tr>
<td>2</td>
<td>Medium tanks PT-91 and derivative</td>
<td>MH</td>
<td>18-20</td>
<td>34-38</td>
<td>92-100</td>
</tr>
<tr>
<td>4</td>
<td>Armored tractors on T-72 chassis</td>
<td>MH</td>
<td>14-16</td>
<td>30-30</td>
<td>84-90</td>
</tr>
<tr>
<td>5</td>
<td>Armored tractors on T-65 chassis</td>
<td>MH</td>
<td>14-16</td>
<td>30-30</td>
<td>84-90</td>
</tr>
<tr>
<td>6</td>
<td>Armored tractors on Leopard-1 chassis</td>
<td>MH</td>
<td>14-16</td>
<td>Technical inspections: P1 – 20, P2 – 50, P3 – 100, F4 – 150</td>
<td>up to 200</td>
</tr>
<tr>
<td>7</td>
<td>Special trailer chassis</td>
<td>MH</td>
<td>10-12</td>
<td>26-30</td>
<td>72-80</td>
</tr>
<tr>
<td>8</td>
<td>Infantry fighting vehicles</td>
<td>MH</td>
<td>10-12</td>
<td>30-30</td>
<td>82-90</td>
</tr>
<tr>
<td>9</td>
<td>Crawler armored personnel carriers</td>
<td>MH</td>
<td>10-12</td>
<td>26-30</td>
<td>72-80</td>
</tr>
<tr>
<td>10</td>
<td>Crawler armed personnel carriers and chassis</td>
<td>MH</td>
<td>3-8</td>
<td>10-10</td>
<td>32-38</td>
</tr>
<tr>
<td>12</td>
<td>Armored cars</td>
<td>MH</td>
<td>2-3</td>
<td>12-17</td>
<td>25-32</td>
</tr>
<tr>
<td>13</td>
<td>Medium-load and high-mobility cars</td>
<td>MH</td>
<td>3-4</td>
<td>4-6</td>
<td>6-10</td>
</tr>
<tr>
<td>14</td>
<td>Small-load and high-mobility cars</td>
<td>MH</td>
<td>3-4</td>
<td>4-6</td>
<td>6-10</td>
</tr>
<tr>
<td>15</td>
<td>Tractor units</td>
<td>MH</td>
<td>3-4</td>
<td>4-6</td>
<td>6-10</td>
</tr>
<tr>
<td>16</td>
<td>General purpose high-load cars</td>
<td>MH</td>
<td>3-4</td>
<td>4-6</td>
<td>6-10</td>
</tr>
<tr>
<td>17</td>
<td>General purpose medium-load cars</td>
<td>MH</td>
<td>3-4</td>
<td>4-6</td>
<td>6-10</td>
</tr>
<tr>
<td>18</td>
<td>General purpose small-load cars</td>
<td>MH</td>
<td>2-3</td>
<td>3-5</td>
<td>5-6</td>
</tr>
<tr>
<td>19</td>
<td>High mobility truck-personnel cars</td>
<td>MH</td>
<td>1-2</td>
<td>3-4</td>
<td>6-10</td>
</tr>
<tr>
<td>20</td>
<td>Motorcycles</td>
<td>MH</td>
<td>1.0-1.5</td>
<td>2-3</td>
<td>3-4</td>
</tr>
<tr>
<td>21</td>
<td>Microbuses</td>
<td>MH</td>
<td>2-3</td>
<td>3-5</td>
<td>5-6</td>
</tr>
<tr>
<td>22</td>
<td>Passenger buses</td>
<td>MH</td>
<td>3-4</td>
<td>8-11</td>
<td>20-32</td>
</tr>
<tr>
<td>23</td>
<td>Dump trucks</td>
<td>MH</td>
<td>3-4</td>
<td>4-6</td>
<td>6-10</td>
</tr>
<tr>
<td>24</td>
<td>Crawler tractors</td>
<td>MH</td>
<td>0.6-1.0</td>
<td>6-8</td>
<td>18-25</td>
</tr>
<tr>
<td>25</td>
<td>Motorcycles</td>
<td>MH</td>
<td>0.3-0.7</td>
<td>6-8</td>
<td>18-25</td>
</tr>
<tr>
<td>26</td>
<td>Four-wheeled vehicles</td>
<td>MH</td>
<td>0-1.6</td>
<td>1.5-1.5</td>
<td>1-2</td>
</tr>
<tr>
<td>27</td>
<td>Transport and special trailers</td>
<td>MH</td>
<td>0.5-5.8</td>
<td>2-3</td>
<td>3-4</td>
</tr>
<tr>
<td>28</td>
<td>Tank-tractors</td>
<td>MH</td>
<td>2-3</td>
<td>6-10</td>
<td>up to 100</td>
</tr>
<tr>
<td>29</td>
<td>Truck cranes</td>
<td>MH</td>
<td>3-4</td>
<td>4-6</td>
<td>6-10</td>
</tr>
</tbody>
</table>

**Fig. 5. The Aprilia Pegaso 650 motorcycle**
Table 2. The periodical maintenance schedule for Aprilia motorcycles

<table>
<thead>
<tr>
<th>No.</th>
<th>Motorcycle mileage in km (or period)</th>
<th>Type of service</th>
<th>Scope of activities</th>
<th>Technical-control parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Every 12 months</td>
<td></td>
<td>1. Warming indicators – check and replace if necessary. 2. Wear of brake blocks – check and replace if necessary.</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Every 500 km</td>
<td></td>
<td>1. Chain tension and greasing – check and clean, set, grease and replace if necessary.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Every 2000 km</td>
<td></td>
<td>1. Brake block wear – check and clean, set, grease and replace if necessary.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Every 5000 km</td>
<td></td>
<td>1. Front brake block – check and clean, replace if necessary. 2. Transmission – check and clean, set, grease and replace if necessary.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Each time the drive unit is replaced</td>
<td></td>
<td>1. Anti-vibration fastening and slide roll – replace.</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Every 2 years</td>
<td></td>
<td>1. Brake fluid – replace. 2. Coolant – replace.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>After the first 30000 km and then after every 20000 km</td>
<td></td>
<td>1. Oil seal in the forks – replace.</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Every 4 years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td>1. Oil lines – replace.</td>
<td></td>
</tr>
</tbody>
</table>

Engine and power train:
- One-cylinder engine type, cylinder capacity 650 cm³, liquid cooled,
- Maximum power – 50 HP, maximum torque 61 Nm at 5250 RPM,
- Cylinder diameter x piston stroke 100x85 mm,
- Compression ratio 10:1,
- SOHC valve train, 2 camshafts, electric start,
- Pressure greasing system with a wet oil pan, liquid cooled,
- 6-gear gearbox, chain power train.

Size and weight:
- Length 2,16 m, saddle height 0,78 m,
- Dry weight 161 kg.

Chassis - front tire 100/90/19, rear tire 130/80-R17.

Based on the available factory data from the manufacturer, the authors have prepared [4,12] in MH-form and grouped the specific types of maintenance activities for this type of motorcycle, depending on the mileage and exploitation time [5,6,16]. Such a schedule of periodical maintenance is presented in Table 2 [4].

The factory [4,12] recommends carrying out the maintenance-control activities twice as often as the periods described in the table above if the motorcycle is used in sandy, terrain or sport conditions.

Table 3 [4] describes the basic exploitation materials [11,12] recommended by the manufacturer, together with their replacements which are permitted by the factory.

5.1. The Yamaha XT 660 R motorcycle

Motorcycles of this type, fig. 7-8 [1] are produced by Yamaha. Their basic technical-exploitation specifications are as follows [1].

Engine and power train:
- Type of engine: one-cylinder, four-stroke, cylinder capacity 660 cm³, liquid cooled,
- Maximum power – 47,33 HP (34,5 kW), maximum torque 60 Nm at 6100 RPM,
Engine and power train:
- type of engine: one-cylinder, four-stroke, cylinder capacity 660 cm³, liquid cooled,
- maximum power – 47.33 HP (34.5 kW), maximum torque 60 Nm at 6100 RPM,
- cylinder diameter x piston stroke 100x84 mm,
- power – fuel injection,

- SOHC valve train, electric start,
- pressure greasing system with a wet oil pan,
- 5-gear gearbox, chain power train,
- wet type clutch.

Size and weight:
- height 1.23 m, length 2.24 m, width 0.84 m, saddle height 0.86 m,
- clearance 0.21m, wheelbase 1.5 m,
- dry weight 172 kg.

Chassis:
- frame welded from steel pipes, suspension – front telescope fork,
- front suspension spring rate 22.5 cm, rear suspension – trailing arm, rear suspension spring rate 20.0 cm,
- front tire 120/70/17, rear tire 160/60/17,
- one-disk front brake, front disk diameter 298 mm,
- one-disk rear brake, rear disk diameter 245 mm,
- 15 l fuel tank,
- fuel consumption approximately 4.5 l/100 km.

5.2. The MZ 250 motorcycle
MZ ETZ type motorcycles – fig. 9 [1,12] were produced in the years 1981-1989 by Motorradwerk Zschopau in the former East Germany.
MZTS 250/1 were their predecessor. Models with a cylinder capacity of 250 cm³ were the biggest and the fastest single-track vehicles produced in the MZ factory between the 1980 and 1990s [1,9,12].

The EM 250 engine – fig. 10 [1] – is a typical two-stroke engine [12] with rinsing, air cooled. A duralumin, heavy finned cylinder with a head has cooling fins (only horizontal) with rubber elements which reduce noise. A cast-iron sleeve with a set of channels was casted inside the cylinder. A low torque is a characteristic feature of the EM 250 engines, in the scope of 3000 RPM and its fast growth above this value. The torque process itself indicates there are two peaks, one for 3500 RPM and a second one for 5200 RPM. This is the so-called double axis, frequently occurring in two-stroke engines with a high strain and with a piston camshaft. In practice, this is manifested in the fact that the motorcycle accelerates relatively slowly on low RPM, and starts accelerating rapidly when the engine RPM is above 3000-3500 RPM. This was characteristic of all the then manufactured motorcycles with two-stroke engines and this type of camshaft and with a similar strain.

A technical curiosity of the engine construction [9] is putting the clutch in the crankshaft. In the case of a one-cylinder engine, this e.g. enables a more stable operation in neutral and on low RPM due to a higher whirl mass. The engine’s torque is carried through a bevel gear onto the 5-gear gearbox, and then by the covered roll chain onto the rear wheel.

Below are the approximate values for the range between 3000 to 5800 RPM [9]:

- I gear 20 ... 35 km/h, II gear 30 ... 60 km/h, III gear 35 ... 85 km/h, IV gear 55 ... 110 km/h,
- V gear 70 ... 130 km/h.

The motorcycle’s maximum speed is 125-130 km/h, the acceleration (at 6000 RPM): from 0 to 8 km/h in 6,6 s, to 100 km/h – in 10,9 s.

**Basic specifications** [1,9,12]:
- weight when ready to drive 151 kg (153 in the disk brake version),
- gross vehicle weight approximately 330 kg,
- amount of oil in gearbox – 900 cm³ of SAE 80 gear oil,
- fuel tank – 17 l ; 1,5l is the reserve,
- amount of liquid in spring elements – 250 cm³,
- maximum power at approximately 5500 RPM: 21 HP (15,5 kW),
- maximum torque at approximately 5200 RPM: 27,4 Nm,
- engine greasing with a mixture of oil and fuel in the ratio of 50:1,
- fuel consumption from 3 to 5,5 l of fuel per 100 km.

**5.3. The Kawasaki ZR 800 motorcycle**

Motorcycles of this type – presented in fig. 11-12 [1] – are used by military gendarmerie and other types of armies. The gendarmerie version is well equipped and has equipment for road traffic control. They are produced by Kawasaki. Their basic technical-exploitation parameters are as follows [1,12].

**Engine and power train:**
- engine type – liquid cooled, 4-stroke, 4-cylinder, straight,
- maximum power 113 HP at 10200 RPM (optionally 95 HP), compression ratio – 11,9:1,
- valve train/number of valves – DOHC, 16 valves,
- power – fuel injection: φ34 mm x 4, with two throttle valves,
- ignition – electronic with a microprocessor,
- starter – electric,
- greasing – forced circulation, wet oil pan,
- maximum torque 83 Nm at 8000 RPM (optionally 76 Nm),
- cylinder diameter x piston stroke 71,0x50,9mm,
- fuel tank capacity 28 liters.
Fig. 13. A general view of the motorcycle’s equipment

Size and weight:
- length 2.1 m, width 0.8 m, height 1.05 m,
- wheelbase 1.44 m, saddle height 0.83 m, clearance 0.15 m,
- motorcycle weight when ready to drive 180/229 kg.

Chassis:
- front tire 120/70/17, rear tire 180/55/17,
- steel frame,
- front telescope USD suspension, diameter 44 mm, stroke 120 mm,
- rear suspension aluminum control arm, stroke 137 mm,
- front disk diameter 2x310mm, 4-piston clamps,
- back disk diameter 1x250mm, 1-piston clamp,
- maximum speed: over 200 km/h,
- fuel consumption: 5.9 l/100 km,
- left/right turn radius 310/310.

Power train:
- engine-clutch: gears 1,714,
- clutch: multidisc, wet,
- rear wheel drive: chain, 3.00.

Servicing/technical inspections every 6000 km of mileage.

5.5. The WSK 125 motorcycle

Even though many years have passed, this type of motorcycle is still used in the army. These motorcycles were produced in the years 1954-1985 by the Wytwórnia Sprzętu Komunikacyjnego PS in Świdnik (fig. 13-14) [1,12].

The basic M06 model was produced (with amendments) up until the year 1985. The last WSK motorcycle was produced on 31 October 1985 and it was the last motorcycle produced in Poland. For the sake of comparison with the contemporary maintenance-repair system, the author presents the maintenance-repair system for the WSK motorcycle based on a factory repair manual [12,17]. When comparing table 4 with table 2 (the Aprilia Pegaso motorcycle maintenance), one may notice that the activities are more simple for the WSK motorcycle, and are mainly carried out directly by the users of this motorcycle; in a less mileage cycle and in a shorter exploitation period. This fact stems from the flow of time and the technical development in motorcycle construction, e.g. of equipment and electrical equipment, using a new generation of construction materials (this including composites) [14] and exploitation materials [11,12].

5.5.1. Everyday maintenance
The everyday maintenance during exploitation of the WSK motorcycle [5,12,13,15] includes such basic activities as [12,17]:
- checking if the brakes are working,
- checking if the clutch is working,
- checking if the electrical installation is working, with special attention to the stop light,
- checking the tire pressure.

An important maintenance activity, however not necessarily done before each drive, is washing the bodywork and cleaning the engine. This activity is important not only from aesthetical reasons, but also because it allows to notice loosened bolt connections. Moreover, one has to point out that a clean engine guarantees correct thermal conditions for its operation.

5.5.2. Periodic maintenance
Periodic technical maintenance [5,12,13,15] for WSK motorcycles is divided into groups (apart from the running-in period) of maintenance activities such as [12,17]:
- the group of activities which must be done after every 2500 km,
- the group of activities which must be done after every 5000 km,
- activities done once every 2 … 4 weeks.
There are also other activities which are considered important periodic technical maintenance. Usually during the autumn period, such an activity would be the preparation of the motorcycle for a longer stand without being used. During the spring period, this would mean also preparing the motorcycle for exploitation after a longer period of inactivity. Apart from this, there are also all activities which must be done with a new motorcycle before the first drive. These are mainly activities connected with de-conservation of the motorcycle, checking and tightening the bolts, regulation etc. A detailed maintenance schedule along with the scope of activities has been prepared by the authors in MH form and is given in table 4 [12,17].

**Table 4. Periodic maintenance activity schedule for WSK motorcycles**

<table>
<thead>
<tr>
<th>No.</th>
<th>Motorcycle mileage in km (or period)</th>
<th>Type of maintenance</th>
<th>Scope of carried out activities</th>
<th>Technical regulation parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>Before the first drive</td>
<td>1. Allow the battery to be charged up for the first time. 2. Check the oil level in the gearbox. 3. De-conservate the motorcycle by washing the oil parts with petrol. 4. Checking, if necessary, adjusting the setting of the gearwheel and shifter. 6. Filling up the tank with a mixture of petrol and oil.</td>
<td>0.4-0.6 mm</td>
</tr>
<tr>
<td>2</td>
<td>500 and 1000 during the running-in period</td>
<td>OT-1</td>
<td>1. Tighten the bolts and nuts. 2. Replace the oil in the gearbox (only after 500 km). 3. Check the chain tension. 4. Check the clutch lever and brake clearance. 5. Check spoke tightening.</td>
<td>0.2-0.3 mm</td>
</tr>
<tr>
<td>3</td>
<td>2500 OT-1</td>
<td>1. Clean the air filter and saturate it with a mixture of Mixol S oil and petrol in 1:1 ratio. 2. Satiate the felt tongue and breaker axis with 1…2 drops of Mixol S or Lux 10 oil. 3. Wash and grease the chain with graphite grease or saturate it with mitten tailor with graphite. 4. Grease the brake pedal axis with LT-43 grease. 5. Check and, if necessary, refill the oil in the gearbox. 6. Check and, if necessary, adjust the clutch. 7. Check and, if necessary, adjust the brakes. 8. Fill the fuel tank with a mixture of petrol and oil.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>5000 OT-2</td>
<td>1. Carry out OT-1-activities on the same way as after 2500 km. 2. Grease the clutch, accelerator and speedometer cords with Lux 10 or Mixol S oil. 3. Grease the cord ends and lever axes with LT-43 grease. 4. Grease and adjust the bearing tension in the frame head. 5. After dismantling the wheel, grease the exponent and speedometer drive with LT-43 grease. 6. Grease the rear hub bearings, the expander and the bearing of the driver drum with LT-43 grease. 7. Grease the control arm axis with LT-43 grease. 8. Replace the oil in the gearbox. 9. Wash the front telescopes (in case of spotting leaks) and replace the Lux oil (with a fresh one). 10. Check and, if necessary, set the ignition retard angle.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2…6 weeks after a longer period without usage</td>
<td>1. Carry out the battery maintenance.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Before a longer period without usage</td>
<td>1. Change the air in the gearbox. 2. Wash the power system. 3. Maintain the crank unit by filling it with 30-40 cm³ of oil into the spark plug hole and distribute it by turning the crankshaft. 4. Wash and grease the drive chain. 5. Change the battery and pour the electrolyte oil. 6. Thoroughly wash the entire motorcycle. 7. Preserve the varnished parts with silicone polish milk. 8. Preserve the chromed parts with Vaselin or with oil. 9. Carry out the greasing of the motorcycle as per the instructions from OT-2 (after 5000 km mileage). 10. Decrease the tire pressure to 0.005 MPa and set the motorcycle on supports (on the frame).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>After a longer period without usage</td>
<td>1. De-conservate the chromed parts. 2. Remove the oil from the crank unit. 3. Fill the battery with an electrolyte with a density of 1,24 g/cm³ and, after two hours, charge it in the same way as when the motorcycle was brand new.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* during the running-in period, the manufacturer recommended using a mixture of fuel and oil in 1:20 ratio, and 1:30 in the period of normal exploitation.

** during exploitation in the summer season, the manufacturer recommended using M14x1,25 spark plugs with a heat value of 240 produced by Bosch or F 100 produced by the company Iskra.

- Mixol oil is still being produced.
6. Intervention motorcycle Yamaha FZ 6

Motorcycles of this type – fig. 15-16 [1,7,12] are used as intervention motorcycles by the Military Gendarmerie (Zadarnienia Wojskowa). They are produced by Yamaha. Their basic technical-exploitation specifications are as follows [1,12].

Additional equipment:
- unit steering signaling for an emergency vehicle along with warning lamps and sound signals,
- radiotelephone with a microphone and an antenna.

Maintenance/technical inspections every 10000 km of mileage.

7. Rules of safe motorcycle exploitation

- having the appropriate permissions, this including a driver’s license for this category of vehicles,
- starting exploitation/driving must be preceded by training,
- checking the vehicle before every drive,
- the driver must have appropriate equipment: a helmet, goggles or protective shield, gloves, pads, appropriate shoes, clothing,
- adjusting the speed to the road conditions and your own skills,
- not carrying out dangerous maneuvers which may cause the motorcycle to overturn,
- mastering the technique of taking turns and the rules of driving e.g. on slippery roads and steep hills,
- mastering the technique of driving in various atmospheric-road conditions,
- not exceeding the speed limit,
- drying and maintenance of the vehicle’s units after rain, getting wet etc. ,
- current wheel and tire maintenance, this including replenishing the correct pressure,
- timely execution of maintenance and inspections (also the seasonal ones),
- keeping the correct vehicle load and ensuring correct fastening and security of the carried loads and passengers.

8. Conclusions

This article presents the chosen technical aspects connected with the equipment group: motorcycles and their construction solutions, equipment and the rules of their exploitation within the army. Chosen types of motorcycles were presented and the authors have made reference to normative documents in effect prepared by technical and material services. An example of a maintenance-repair system for chosen types of motorcycles was also presented.

As one may notice, this generation of army equipment is quite diverse. Even though it is named motorcycle, it requires very good preparation or driving it, for example in changing and various weather conditions, which carries a lot of risk. Moreover, maintenance and repairs of this army equipment are quite complicated: in older motorcycles, these can be done by army workshops, however the newer ones require using civil services.

This equipment group is constantly developing in the construction-technical respect, e.g. by using modern construction materials, as well as being equipped and filled with electronics.

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Motocykle - wybrane aspekty eksploatacji w wojsku

Słowa kluczowe: motocykle, konstrukcja, systemy obsługowo-naprawcze, normy eksploatacji.