Four-wheeled motorcycles – chosen aspects of army exploitation

Dariusz Woźniak, Krzysztof Kukielka, Jacek Woźniak

Key words: four-wheeled motorcycles, construction, maintenance-repair systems, exploitation norms.

Abstract
This article presents the chosen aspects of the exploitation of four-wheeled motorcycles in the army. The authors have described chosen types of motorcycles, and their constructional and technical solutions. References were made to the current four-wheeled motorcycles maintenance-repair system in effect and an analysis of the current exploitation norms was made. The authors also paid attention to the practical aspects of the exploitation of such army equipment. The article also takes into consideration the newly introduced professional army regulations regulating the exploitation of this equipment group. Photographs connected with this topic are a supplement to the contents of the article.

Introduction
In the army, in addition to specialized bicycles [27] and motorcycles [28] a quad were used. It is also important problems of transport [17-19,21,23-26], exploitation [20,22] and storage [26] of the equipment. A quad is a motorcycle on four wheels, used mainly for sport and recreation. It is also called an ATV (All-Terrain Vehicle) or a four-wheeler.

ATV is a vehicle without a cab, designed to be driven out of paved roads. ATV constructions may be three-wheeled (tricycles), four-wheeled (quad) or six- or eight-wheeled and they may also have continuous track. According to ANSI (American National Standards Institute), such a vehicle must be used by a single person sitting on it astraddle. These vehicles should have tires with a lowered pressure (making it easier to drive through boggy terrain) and a motorcycle-type steering wheel.

Due to its driving advantages, it is also used in the army [1,3,8,9], mountain rescue, agriculture. Due to their usage, these vehicles are usually classified by the manufacturers into the following groups [1]:
- sport – racing (sport),
- terrain – crossing (utility),
- recreational,
- micro tractors with the possibility of bodywork or additional optional equipment as needed.

The sport versions usually have a rear-wheel drive for the two rear wheels (2x4) and a big suspension stroke. In theory, it is designed for quick driving through a not too demanding terrain. They differ in their general appearance, slightly sporty, emphasizing their power and dynamics. Their capacity is in the range of 50 cm³ to 1000 cm³ and they are able to go even as fast as over 140 km/h. They are equipped with aluminum frames, special steering wheels and gas-charged shocks [12].

They reach a power of between 45-100 HP. They are produced by the following companies: Kawasaki, Honda, Yamaha, Suzuki, Polaris, Bombardier Can-am.

Terrain versions usually have an all wheel drive (4×4), however very often the option of partially turning off the front drive is left. Many models are equipped with front leaf springs and power steering. This group is designed for driving in difficult terrain (e.g. swamps, deep snow). The engine power may be up to 100 HP. Their maximum speed does not exceed 130 km/h, however they are able to drive on very steep hills and reach places which are difficult to access.

Recreational versions fill up the spot between sport and terrain quads. They are used for sightseeing trips and various kinds of integration meetings. They are often also used in quad rentals. Their models have, according to the user’s needs, a 2- or 4-wheel drive.

Due to fierce competition, the manufacturers (especially the Far Eastern ones, e.g. from China or Taiwan) decide to make models which cannot be classified as any of the groups described above.

1. ATV exploitation in Poland
Due to the immense popularity of 4-wheeled ATV’s in Poland, their common name is quad. This stems from the fact that ATV vehicles started becoming popular in Poland only in the second half of the 1990s, when 4-wheeled vehicles were the dominant ones in the ATV family.

2. ATV exploitation in the Armed Forces
A few types of ATV are used in the armed forces. They are a permanent element of the tank-vehicle service and mainly appear in recon, special subunits. Gestor [2] has defined the inter-service norms for this vehicle group in [7], as well as the repair time-consumption. The maintenance-repair system [5,7,9,11,13] is based on the instructions from the manufacturers of the given type of vehicle. These vehicles do not have any limitations concerning a yearly norm of resource exploitation per equipment unit or a permissible resource for an equipment group in storage. Gestor did not foresee any main repairs for this type of vehicles.

The following types of four-wheeled motorcycles are used in the Polish Armed Forces:
- Honda TRX 300, fig.1-2 [1], the target exploitation norm in years and kilometers is 10 years/150000 km,
- Polaris Sportsman X2 800 EFI, the target exploitation norm in years and kilometers is 10 years/100000 km,
- Arktic Cat 400 IA, the target exploitation norm in years and kilometers is 10 years/150000 km,
Bombardier CAN AM Outlander Max 650, the target exploitation norm in years and kilometers is 10 years/100000 km.

Polaris IPS Sportsman 800, the target exploitation norm in years and kilometers is 10 years/100000 km.

The basic inter-service cycle [7,9,11,12] for the group four-wheel vehicles is 2000 km for OO-1, 4000 km for OO-2, the target exploitation norm is measured in years and kilometers and for this group it is 10 years/150000 km [7]. According to [5] motorcycles are classified in group 6 – other cars – and they are subgroup 6.1 – four-wheeled quad type vehicles. Subgroup 6.1 [5], as well as other equipment groups [7] is subject to a specific type of exploitation and regulated according to the regulations in effect.

3. Service and repair time-consumption

Time-consumption norms are expressed in man-hours/minutes needed for carrying out a given service/inspection. They are regulated by army guidelines and instructions [5,6,14] as well as by, which was mentioned before, service/factory instructions from the manufacturer.

Carrying out any service or repair requires a certain amount of time accounted for in man-hours (MH). Table 1 [7] presents the planning time-consumption norms for technical maintenance and repairs for which the Gestor or the Central Logistics Organ is the Leadership of the Support Inspectorate of the Tank-Vehicle Service. The individual norms have been presented globally for army equipment of the Tank-Vehicle Service for comparison.

If the army regulations do not settle the maintenance activities, the detailed scope of these activities is determined by the manufacturer’s factory document, manuals, technological cards/guidebooks for army equipment and other documents [4,9,12].

4. Equipment profiles for chosen four-wheeled motorcycles

4.1. Bombardier CAN-AM Outlander Max 650

Motorcycles of this type – fig. 3-4 [1] are produced by a Canadian company. They appear in a two-person version with the possibility of transporting equipment in the trunks [9].

![Fig. 3. Bombardier during a show](image)

![Fig. 4. A view of the equipment](image)

Their basic technical-exploitation data is as follows [1,9]:

**Size [m]** – length, width, height:
- 2,184x11,68x1,118 m,
- wheelbase 1,295 m, seat height – 0,87 m,
- clearance – 0,279 m,
- weight (dry) – 330 kg, weight of towed trailer – 590 kg,
- trunk carrying capacity – front 45 kg, back 90 kg, storage compartment – back 21,4 l,
- fuel tank capacity – 20,5 l.

**Chassis:**
- front suspension/stroke – double A-arm/229 mm, rear suspension/stroke: independent TTI/236 mm,
- front brake – hydraulic, double disc, rear brake – hydraulic, single disc,
- tires front – 26x8x12, tires rear – 26x10x12,
- rims – steel, black,
- triple-degree DPS power steering.

**Engine:**
- type: 649.6cc, V-2,V water cooled, 8-valve, SOHC, (4-valves/cylinder),
- diameter and stroke – 82 x 62 mm,
- fuel supply – 2 Siemens VDO injectors,
- electrical starting,
- power train 5-gear CVT automated, function of engine braking,
- drive unit transferable to 2 or 4 wheels with Visco-lok front live axis.

**Equipment:**
- gear – multifunctional digital LCD indicator, speedometer, fachometer (graphical and digital setting), mileage counter, road counter and work hour counter, OBD diagnostics, indicators of: gear, drive, fuel level, engine temperature and working, indicator of hours of operations, clock, automatic light switch off after 15 minutes,
- Warn hoist with a wired remote control with a traction force of 1361 kg,
- anti-theft security – DESS immobilizer,
- light – two front headlights with a power of 60 W and double back lights with a power of 55 W with a stop light,
- power plug – the lighter socket on the console, with the ability of connecting power from the back (15 A).

4.2. Polaris Sportsman 800 EFI

Motorcycles of this type – fig. 5 [1] – are produced by a company from the USA. In the standard version, the motorcycle is exploited on wheels, mainly on roads and in the wilderness. In the autumn-winter season, it is possible to use this motorcycle on caterpillar tracks [3,9].

In this case, Polaris’ traction parameters are greatly improved. The caterpillar track – fig. 6 [1] – which is a replacement for wheels in certain terrain conditions, mainly reduces the vehicle’s unit pressure on the ground, e.g. in snow, bogs or deep sand. The manufacturer has developed two types of caterpillar tracks [13]: winter with rubber tapes, with a set of rolls greased with water and a special anti-slip tread and a multi-season caterpillar track – more advanced technologically, requiring regular regulation and technical inspections.

Below is the basic technical-exploitation data [1,9]:
- gross vehicle weight 563 kg,
- dry weight 349 kg,
- fuel tank – capacity 15,6 l
- motor oil – capacity 1,9 l, oil in rear gear box – capacity 150 ml,
- oil in front gear box – capacity 150 ml, transmission oil 450 ml,
- front trunk capacity 45 kg, rear trunk capacity 91 kg,
- clinch pressure 68 kg (together with the rear trunk, the total weight should not exceed 91 kg),
- maximum tower weight 681 kg.

---

**Table 1. Time-consumption norms for technical maintenance and repairs**

<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 18-20</td>
<td>32-36</td>
<td>88-96</td>
<td>up to 200</td>
</tr>
<tr>
<td>2.</td>
<td>Medium tanks T-90 and derivative</td>
<td>MH 18-20</td>
<td>32-36</td>
<td>82-87</td>
<td>up to 200</td>
</tr>
<tr>
<td>4.</td>
<td>Armored tractors on T-72 chassis</td>
<td>MH 14-16</td>
<td>32-36</td>
<td>88-98</td>
<td>up to 200</td>
</tr>
<tr>
<td>5.</td>
<td>Armored tractors on T-55 chassis</td>
<td>MH 14-16</td>
<td>30-32</td>
<td>84-80</td>
<td>up to 200</td>
</tr>
<tr>
<td>7.</td>
<td>Special crawler chassis</td>
<td>MH 10-12</td>
<td>25-30</td>
<td>72-80</td>
<td>up to 150</td>
</tr>
<tr>
<td>8.</td>
<td>Infantry fighting vehicles</td>
<td>MH 10-12</td>
<td>30-32</td>
<td>82-86</td>
<td>up to 150</td>
</tr>
<tr>
<td>9.</td>
<td>Crawler armored personnel carriers</td>
<td>MH 10-12</td>
<td>25-30</td>
<td>72-80</td>
<td>up to 150</td>
</tr>
<tr>
<td>10.</td>
<td>Wheeled armored personnel carriers and chassis</td>
<td>MH 3-6</td>
<td>15-20</td>
<td>32-38</td>
<td>up to 120</td>
</tr>
<tr>
<td>12.</td>
<td>Armored cars</td>
<td>MH 2-3</td>
<td>12-17</td>
<td>26-32</td>
<td>up to 100</td>
</tr>
<tr>
<td>13.</td>
<td>Medium road and high-mobility cars</td>
<td>MH 3-4</td>
<td>4-6</td>
<td>6-10</td>
<td>up to 100</td>
</tr>
<tr>
<td>14.</td>
<td>Small road and high-mobility cars</td>
<td>MH 3-4</td>
<td>4-6</td>
<td>6-10</td>
<td>up to 100</td>
</tr>
<tr>
<td>15.</td>
<td>Tractor units</td>
<td>MH 3-4</td>
<td>4-6</td>
<td>6-10</td>
<td>up to 100</td>
</tr>
<tr>
<td>16.</td>
<td>General purpose big-load cars</td>
<td>MH 3-4</td>
<td>4-6</td>
<td>6-10</td>
<td>up to 100</td>
</tr>
<tr>
<td>17.</td>
<td>General purpose medium-load cars</td>
<td>MH 3-4</td>
<td>4-6</td>
<td>6-10</td>
<td>up to 100</td>
</tr>
<tr>
<td>18.</td>
<td>General purpose small-load cars</td>
<td>MH 3-4</td>
<td>4-6</td>
<td>6-10</td>
<td>up to 100</td>
</tr>
<tr>
<td>19.</td>
<td>High mobility truck-personnel cars</td>
<td>MH 3-4</td>
<td>4-6</td>
<td>6-10</td>
<td>up to 100</td>
</tr>
<tr>
<td>20.</td>
<td>Motorcycles</td>
<td>MH 1-2</td>
<td>1-3</td>
<td>3-5</td>
<td>up to 100</td>
</tr>
<tr>
<td>21.</td>
<td>Microbuses</td>
<td>MH 2-3</td>
<td>3-5</td>
<td>5-6</td>
<td>up to 100</td>
</tr>
<tr>
<td>22.</td>
<td>Passenger buses</td>
<td>MH 3-4</td>
<td>9-11</td>
<td>26-32</td>
<td>up to 100</td>
</tr>
<tr>
<td>23.</td>
<td>Dump trucks</td>
<td>MH 3-4</td>
<td>4-6</td>
<td>6-10</td>
<td>up to 100</td>
</tr>
<tr>
<td>24.</td>
<td>Wheeled tractors</td>
<td>MH 0.8-1.0</td>
<td>6-10</td>
<td>18-25</td>
<td>up to 100</td>
</tr>
<tr>
<td>25.</td>
<td>Motorcycles</td>
<td>MH 0.5</td>
<td>0.8-1.0</td>
<td>1-1.5</td>
<td>up to 100</td>
</tr>
<tr>
<td>26.</td>
<td>Four-wheeled vehicles</td>
<td>MH 0.8-1.0</td>
<td>1-1.5</td>
<td>5-7</td>
<td>up to 100</td>
</tr>
<tr>
<td>27.</td>
<td>Transport and special trailers</td>
<td>MH 0.5-0.8</td>
<td>2-3</td>
<td>3-4</td>
<td>up to 42</td>
</tr>
<tr>
<td>28.</td>
<td>Semi-trailers</td>
<td>MH 2-3</td>
<td>3-4</td>
<td>6-10</td>
<td>up to 100</td>
</tr>
<tr>
<td>29.</td>
<td>Truck crane</td>
<td>MH 2-3</td>
<td>3-4</td>
<td>6-10</td>
<td>up to 100</td>
</tr>
<tr>
<td>30.</td>
<td>Mobile workshops</td>
<td>MH 3-8</td>
<td>4-10</td>
<td>6-12</td>
<td>up to 100</td>
</tr>
</tbody>
</table>

---
Fig. 6. Polaris in a caterpillar track version

Sizes [m]:
- length 2.11 m, width 1.22 m, height 1.22 m,
- wheelbase 1.29 m, clearance 0.285 m,
- minimum turn radius 1.82 m (without load).

Engine:
- engine type EH0760LE011, two-cylinder, straight, liquid cooled,
- engine displacement 760 cm$^3$, diameter x piston stroke 78.5x68, compression ratio 10:1,
- alternator 500 W at 3000 RPM,
- electric starter,
- electric fuel system injection ECU type,
- 8BTDC synchronization at 2000 RPM,
- spark plug/distance between electrodes RC7YC/0.9 mm,
- greasing – wet sedimentation tank under pressure.

Power train:
- 4-wheel drive, with an independent shaft,
- front suspension – Mac Pherson, with a stroke of 20.8 cm,
- rear suspension – Progressive Rate, with a stabilizer with a stroke of 24.1 cm,
- gearbox: automatic variable-speed PVT (Polaris Variable Transmission), it has five gears, it is operated by a lever next to the driver’s right leg, gear setting in the selector: between the H mode (High), L (Low), N (Neutral), R (Reverse) and P (Parking), ADC, 4x4, 2x4, (fig. 7 [1]),
- the vehicle is equipped with an Engine Braking System (EBS), very useful during terrain driving and a system of drive switching on uphill roads and downhill drives,
- gear – Low 7.49:1, rear gear 5.11:1, gear – High 2.70:1,
- gear ratio – front 3.82:1, final gear ratio 3.10:1,
- front tires Polaris PXT 26 x 8R-12 (0.35 MPa), rear tires Polaris PXT 26 x 11R-12 (0.35 MPa).

Braking system:
- front brake hydraulic, disc, rear brake hydraulic, disc,
- auxiliary brake (foot) hydraulic, disc,
- parking brake hydraulic, on 4 wheels.

Electrical equipment:
- front headlight – single on the steering wheel with a power of 50 W, single on the bumper with a power of 27 W,
- rear lights with a power of 8.26 W, brake light with a power of 26.9W,
- LCS dashboard with e.g.: liquid crystal display, display on the steering wheel, right under the speedometer scaled in miles and kilometers, apart from the gear indicator also e.g. fuel level indicator and a control of cooling liquid temperature,
- Warn hoist type 3000 with a steel line, fig. 8 [1].

Fig. 7. ADC system

Fig. 8. Hoist equipment

In the constructional solution of this motorcycle [1,4,9], the power train is very advanced technologically and it uses an automatic gear box. The functioning of the PVT drive system is dependent on the engine’s RPM and on the value of the tightening torque of the individual parts. When the engine’s RPM increases, also the pressure on the pulley increases, which in turn increases the belt strain. Similarly, when the RPM decreases, the pressure force on the individual parts of the system also decreases.

The difference in gear ratio, depending on the mode, High or Low is approximately 1:2.25.

This difference has an important influence on the functioning of the PVT drive system, especially in speed lower than 12 km/h, due to the dependence between the system and the RPM, e.g. during driving at 5 km/h in low gear, the engine will be working at approximately 3000 RPM. In the high gear mode, the engine will be working at only 1500 RPM while driving at 5 km/h.

Driving in low gear at low speeds significantly decreases the temperature of the clutch casing unit, which in turn prolongs the lifetime of the PVT drive system.
4.3. The maintenance-repair system of the Polaris Sportsman 800 EFI vehicle

The authors have prepared and presented in the form of a table, on the basis of available manufacturer data, the specific types of service activities [9,11,12] depending on the exploitation time for the Polaris Sportsman 800 EFI vehicle [4].

Table 2 [4] presents the scope of current maintenance OB [11], and table 3 [4,9] – the planned scope of the periodic maintenance.

The factory scope of periodic maintenance for the Polaris Sportsman 800 EFI vehicle [4,9].

The periodical inspection calendar was planned by the manufacturer for 50 hours [4]. In order to use the remaining

---

Table 2. Current/everyday maintenance

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>Servicing period</th>
<th>Hours Calendar</th>
<th>Kilometers</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Steering wheel and steering</td>
<td>before driving</td>
<td></td>
<td></td>
<td>Check if the wheels turn appropriately after turning the steering wheel.</td>
</tr>
<tr>
<td>2.</td>
<td>Front suspension</td>
<td>before driving</td>
<td></td>
<td></td>
<td>Check if there is no damage, grease if necessary.</td>
</tr>
<tr>
<td>3.</td>
<td>Rear suspension</td>
<td>before driving</td>
<td></td>
<td></td>
<td>Check if there is no damage, grease if necessary.</td>
</tr>
<tr>
<td>4.</td>
<td>Tires</td>
<td>before driving</td>
<td></td>
<td></td>
<td>Check tire condition and pressure. Minimum head depth 3 mm, pressure approximately 0.035 MPa.</td>
</tr>
<tr>
<td>5.</td>
<td>Brake fluid level</td>
<td>before driving</td>
<td></td>
<td></td>
<td>DOT-3, in the eye of the leveling container head to the level.</td>
</tr>
<tr>
<td>6.</td>
<td>Brake lever clearance</td>
<td>before driving</td>
<td></td>
<td></td>
<td>The main brake, the lever on the left side of the steering wheel, auxiliary brake, fluid container under the seat.</td>
</tr>
<tr>
<td>7.</td>
<td>Braking system</td>
<td>before driving</td>
<td></td>
<td></td>
<td>Fluid level, braking smoothness, no leaks.</td>
</tr>
<tr>
<td>8.</td>
<td>Fastening, screws, joints</td>
<td>before driving</td>
<td></td>
<td></td>
<td>Check and tighten wheels, other screw nuts and joints.</td>
</tr>
<tr>
<td>9.</td>
<td>Frame fastening</td>
<td>before driving</td>
<td></td>
<td></td>
<td>Check joint condition.</td>
</tr>
<tr>
<td>10.</td>
<td>Motor oil level</td>
<td>before driving</td>
<td></td>
<td></td>
<td>Check with a dipstick, refill if necessary.</td>
</tr>
<tr>
<td>11.</td>
<td>Air filter</td>
<td>every day</td>
<td></td>
<td></td>
<td>Check and clean if necessary.</td>
</tr>
<tr>
<td>12.</td>
<td>Air filter drain pipe</td>
<td>every day</td>
<td></td>
<td></td>
<td>Remove pollution if it is visible.</td>
</tr>
<tr>
<td>13.</td>
<td>Cooling liquid</td>
<td>every day</td>
<td></td>
<td></td>
<td>Control of liquid level, replacing it every 2 years.</td>
</tr>
<tr>
<td>14.</td>
<td>Front/rear lights</td>
<td>every day</td>
<td></td>
<td></td>
<td>Check if they work correctly, replace bulbs if necessary.</td>
</tr>
<tr>
<td>15.</td>
<td>Chassis and exhaust system</td>
<td>every day</td>
<td></td>
<td></td>
<td>Check and, if necessary, remove the pollution which may cause a fire or disrupt the proper driving of this vehicle.</td>
</tr>
</tbody>
</table>

Table 3. Periodic maintenance

<table>
<thead>
<tr>
<th>No.</th>
<th>Component</th>
<th>Servicing period</th>
<th>Hours Calendar</th>
<th>Kilometers</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Servicing during the run in period</td>
<td>10 or after using 2 full fuel tanks with a capacity of 15.6 l</td>
<td></td>
<td></td>
<td>Exploitation without heavy luggage and trailer towing. Change the oil and oil filter after completing 20 hours of driving or after a month – depending on which happens first.</td>
</tr>
<tr>
<td>2.</td>
<td>Main air filter</td>
<td>every week</td>
<td></td>
<td></td>
<td>Check the condition, replace if necessary.</td>
</tr>
<tr>
<td>3.</td>
<td>Brake blocks usage</td>
<td>every month</td>
<td>160</td>
<td></td>
<td>Regular checking of the condition – minimal block thickness 10 mm.</td>
</tr>
<tr>
<td>4.</td>
<td>Bolts</td>
<td>every month</td>
<td>320</td>
<td></td>
<td>Checking clamp condition, periodic conservation.</td>
</tr>
<tr>
<td>5.</td>
<td>Oil in front gear box</td>
<td>every month</td>
<td>400</td>
<td></td>
<td>Check the level, changing every year – capacity of 0.15 l.</td>
</tr>
<tr>
<td>6.</td>
<td>Oil in rear gear box</td>
<td>every month</td>
<td>400</td>
<td></td>
<td>Check the level, changing every year – capacity of 0.15 l.</td>
</tr>
<tr>
<td>7.</td>
<td>Oil in transmission oil</td>
<td>every month</td>
<td>400</td>
<td></td>
<td>Check the level, changing every year – capacity of 0.045 l.</td>
</tr>
<tr>
<td>8.</td>
<td>Engine vent hole filter</td>
<td>every month</td>
<td>400</td>
<td></td>
<td>Check the condition, replace if necessary.</td>
</tr>
<tr>
<td>10.</td>
<td>Steering unit</td>
<td>6 M</td>
<td>800</td>
<td></td>
<td>Grease.</td>
</tr>
<tr>
<td>11.</td>
<td>Front suspension</td>
<td>6 M</td>
<td>800</td>
<td></td>
<td>Grease.</td>
</tr>
<tr>
<td>12.</td>
<td>Rear suspension</td>
<td>6 M</td>
<td>800</td>
<td></td>
<td>Grease.</td>
</tr>
<tr>
<td>13.</td>
<td>Carburetor</td>
<td>6 M</td>
<td>800</td>
<td></td>
<td>Filter regularly and before every longer period without usage.</td>
</tr>
<tr>
<td>14.</td>
<td>Gas cable/electronic throttle control</td>
<td>6 M</td>
<td>800</td>
<td></td>
<td>Checking the condition, regulating and greasing, replacing if necessary. Clearance measured at the end of the lever should be between 16 and 32 mm.</td>
</tr>
<tr>
<td>15.</td>
<td>Suction cable/applyable</td>
<td>8 M</td>
<td>800</td>
<td></td>
<td>Check the condition, regulate and grease, replace if necessary.</td>
</tr>
<tr>
<td>16.</td>
<td>Carburetor</td>
<td>8 M</td>
<td>800</td>
<td></td>
<td>Check the tightness of the unit.</td>
</tr>
<tr>
<td>17.</td>
<td>Ignition harness</td>
<td>8 M</td>
<td>800</td>
<td></td>
<td>Check the condition, regulate and replace if necessary.</td>
</tr>
<tr>
<td>18.</td>
<td>Cooling system</td>
<td>8 M</td>
<td>800</td>
<td></td>
<td>Check the condition, check the pressure every year.</td>
</tr>
<tr>
<td>19.</td>
<td>Changing the motor oil</td>
<td>8 M</td>
<td>1600</td>
<td></td>
<td>Capacity 1.9 l</td>
</tr>
<tr>
<td>20.</td>
<td>Clearing the oil filter</td>
<td>8 M</td>
<td>1600</td>
<td></td>
<td>Check the level when changing the motor oil.</td>
</tr>
<tr>
<td>21.</td>
<td>Valve clearance</td>
<td>12 M</td>
<td>1600</td>
<td></td>
<td>Check the condition, regulate.</td>
</tr>
<tr>
<td>22.</td>
<td>Fuel supply system</td>
<td>12 M</td>
<td>1600</td>
<td></td>
<td>Checking if there are no leaks, replacing the pipes every 2 years.</td>
</tr>
<tr>
<td>23.</td>
<td>Radiator/applyable</td>
<td>12 M</td>
<td>1600</td>
<td></td>
<td>Checking the condition, cleaning from the outside.</td>
</tr>
<tr>
<td>24.</td>
<td>Cooling system cables/applyable</td>
<td>12 M</td>
<td>1600</td>
<td></td>
<td>Checking and removing leaks.</td>
</tr>
<tr>
<td>25.</td>
<td>Engine fastening</td>
<td>12 M</td>
<td>1600</td>
<td></td>
<td>Checking the condition.</td>
</tr>
<tr>
<td>26.</td>
<td>Exhaust system</td>
<td>12 M</td>
<td>1600</td>
<td></td>
<td>Checking the condition.</td>
</tr>
<tr>
<td>27.</td>
<td>Spark plugs</td>
<td>12 M</td>
<td>1600</td>
<td></td>
<td>Check and replace if necessary. Type of Spark plugs RC7YC-break 0.9 mm. Spark plug torque 24 Nm.</td>
</tr>
<tr>
<td>28.</td>
<td>Ignition system</td>
<td>12 M</td>
<td>1600</td>
<td></td>
<td>Check if it is operational.</td>
</tr>
<tr>
<td>29.</td>
<td>Wiring</td>
<td>12 M</td>
<td>1600</td>
<td></td>
<td>Check the condition and usage, grease.</td>
</tr>
<tr>
<td>30.</td>
<td>Clutch</td>
<td>12 M</td>
<td>1600</td>
<td></td>
<td>Check the condition, clean, replace the worn out parts.</td>
</tr>
<tr>
<td>31.</td>
<td>Impact wheel fastening</td>
<td>12 M</td>
<td>1600</td>
<td></td>
<td>Check the condition, replace if necessary. Torque: aluminum rims 122 Nm, steel rims: 37 Nm.</td>
</tr>
<tr>
<td>32.</td>
<td>Brake fluid</td>
<td>24 M</td>
<td>3200</td>
<td></td>
<td>Replace every 2 years.</td>
</tr>
<tr>
<td>33.</td>
<td>Fuel filter</td>
<td>12 M</td>
<td>3200</td>
<td></td>
<td>Replace every year.</td>
</tr>
<tr>
<td>34.</td>
<td>Magnets</td>
<td>3 M</td>
<td>4800</td>
<td></td>
<td>Clean.</td>
</tr>
<tr>
<td>35.</td>
<td>Idle speed</td>
<td></td>
<td></td>
<td></td>
<td>Regulate if necessary.</td>
</tr>
<tr>
<td>36.</td>
<td>Foot brake</td>
<td></td>
<td></td>
<td></td>
<td>Check every day, regulate if necessary.</td>
</tr>
<tr>
<td>37.</td>
<td>Tors setting</td>
<td></td>
<td></td>
<td></td>
<td>Periodic control, regulate if necessary. Tires need to be replaced when the depth of the tread is 3 mm or less. Recommended toe setting is 3-6 mm.</td>
</tr>
<tr>
<td>38.</td>
<td>Headlight setting</td>
<td></td>
<td></td>
<td></td>
<td>Regulate as necessary.</td>
</tr>
</tbody>
</table>
function, one has to program it. The function is programmed in such a way, that one has to subtract the real engine working time from the time expected for servicing the vehicle. When the difference is 0 (one has to carry out an inspection then) and the tool icon will be pulsating, it will be signaling the need for an inspection. The vehicle also has a diagnostic mode EFI, in the shape of alphanumerical codes.

The manufacturer advises to archive all maintenance activities, which is in accordance with army documentation and e.g. entries into the book/card of carried out technical maintenance activities [11,12].

4.4. Arktic Cat

These motorcycles are produced in Austria, in the army they are exploited in a version with a winch, fig. 9 [1], they are fully adapted to terrain exploitation, fig. 10 [1].

Below is the basic technical-exploitation data [1,9]:
Manufacturer: ACE Trade AG
- vehicle weight 298 kg, 2 seats, maximum gross weight 565 kg,
- maximum front axle load 260 kg, maximum rear axle load 360 kg,
- maximum weight of towed trailer: 480 kg without brake, 480 kg with brake.

Vehicle sizes [m]:
- length 2,09 m, width 1,16 m, height 1,16 m,
- wheelbase 1,27 m, front track of wheels 1,15 m, rear track of wheels 1,15 m,
- front overhang 0,39 m, rear overhang 0,43 m,
- angle of attack 45°, angle of departure 45°.

Traction parameters:
- smallest turning back diameter when turning right/left 5,40/4,70 m,
- fording depth 0,40 m,
- maximum speed 70 km/h,
- minimum clearance 0,30 m.

Engine:
- Suzuki type K425,
- duty cycle 4T, number and setting of cylinders 1, cylinder diameter 82 mm, piston stroke 67 mm,
- engine displacement 376 cm³, compression ratio 7,8:1,
- maximum engine power 14 kW, maximum RPM 5500 RPM,
- maximum torque 28 Nm at 3500 RPM,
- engine idling speed 1500 RPM,
- turning direction right,
- fuel filter – box type, air filter – box-foam type,
- RPM regulator – electronic type,
- cooling system by air and oil, pump type Arctic Cat.

Power train:
- automatic CVT clutch, automatic CVT gear box,
- reduction-distribution automatic CVT gearbox Arctic Cat type,
- shaft wheel drive,
- drive shafts – 1 Arctic Cat construction,
- live axis: front independent suspension, Arctic Cat, rear, independent suspension, Arctic Cat,
- block steering mechanism – with a dial and mechanically.

Steering:
- steering mechanism for turning wheels with a system of forks,
- maximum wheel turn radius 1,8m,
- axis parallel 1,27 m.

Braking system:
- work brake: front hydraulic, disc, rear – hydraulic, disc,
- mechanical emergency brake,
- parking brake mechanical/hydraulic.

Wheels:
- rim size 7J15 or 6,5J12,
- tire front: 185/65/15 or 195/65/15 or AT205/80R12, tire rear: 195/5/15 or 205/60/15 or AT270/60R12,
- frame – pipe, steel, welded.

Electrical installation:
- type 12 V with waterproof joints,
- battery – type Varta 51411, capacity: 14 Ah, 12 V,
- alternator – Suzuki, Volante Magneteico,
- alternator voltage regulator RS4138FO/RS4144D3,
- starter – electrical/hand type, power: 0,4 kW,
- Warn 3000 hoist with a steel line and a remote control.

The basic data concerning exploitation materials [10] is presented in table 4 below [4,9].

5. The potential advantages of the exploitation of four-wheel motorcycles in the army

During the analysis of usage possibilities and examples of usage of four-wheeled motorcycles by other countries and various users (this including the army), one can find at least a few usages of these motorcycles. These are for example [1,3,8,9]:
- organizing ambushes and activities with a diversionary-aggressive nature,
- patrolling areas with a specific value (e.g. defensive-protection) alone or as certain sub-units, or individual components,
The army, through uniformed services, appropriately equips the soldiers driving ATV vehicles [1,9]. Such a soldier is typically equipped with a so-called armor with a protection for the back and spine, together with elbow pads, knee pads, gloves, goggles and a helmet. Before starting driving such a vehicle, each driver has a special training for this (a certification).

7. Soldier-quad driver equipment

Quads driving on Polish roads [9,15] should be registered, have license plates and have liability insurance. Until January 2013, driving them was allowed on the same rules as driving a moped. Since January 19, 2013, there is an amendment to their road traffic law, which introduces the definition of a quad.

Each quad is treated as a different type of vehicle – a quad, a four-wheeler or as a light four-wheeler (as well as a three-wheeled motorcycle and moped). These vehicles, which are driven on public roads, in home zones or in traffic zones, should be technically operational and registered, and the driver should have a document confirming permission to drive, a vehicle registration certificate and a document confirming having a valid liability insurance.

If a vehicle is registered as a light four-wheeler, with a weight of no more than 350 kg, a maximum speed of no more than 45 km/h, engine capacity lower than 50 cm³, and the power less than 5,4 HP – the driver should have a driver’s license of the AM category (permission to drive mopeds and light four-wheelers).

In order to be able to drive a quad with any power and engine capacity, one has to have a B1 or B-type driver’s license. The B1 category allows also to drive a moped and the minimum age for this one is 16 years old. As in the case of the AM category, one has to pass a medical examination, complete a training course and pass an exam.

6. Permissions required to drive

Quads driving on Polish roads [9,15] should be registered, have license plates and have liability insurance. Until January 2013, driving them was allowed on the same rules as driving a moped. Since January 19, 2013, there is an amendment to their road traffic law, which introduces the definition of a quad.

According to the regulations currently in effect [14], each quad is treated as a different type of vehicle – a quad, a four-wheeler or as a light four-wheeler (as well as a three-wheeled motorcycle and moped). These vehicles, which are driven on public roads, in home zones or in traffic zones, should be technically operational and registered, and the driver should have a document confirming permission to drive, a vehicle registration certificate and a document confirming having a valid liability insurance.

If a vehicle is registered as a light four-wheeler, with a weight of no more than 350 kg, a maximum speed of no more than 45 km/h, engine capacity lower than 50 cm³, and the power less than 5,4 HP – the driver should have a driver’s license of the AM category (permission to drive mopeds and light four-wheelers).

In order to obtain a driver’s license of this type [9,15], one has to be at least 14 years old, successfully pass a medical examination, complete a training course and pass an exam – or already have a driver’s license of a higher category.

In the case of a four-wheeler, which is used for carrying people or loads, with the exception of a car, truck and motorcycle with a mass no bigger than 400 kg (for carrying people) or than 550 kg (for carrying items).

This means that, in this case, the engine capacity, maximum speed and power may be unlimited; the driver should have a B1 or B type driver’s license (which allows to drive a car with a total weight up to 3,5 t, four-wheelers with any capacity, mopeds, tractors with a trailer up to 750 kg and a car with a total weight permitted and a trailer of up to 750 kg. One has to be at least 18 years old to apply for such a license and has to pass a medical examination, complete a training course and pass an exam.

If a quad is registered as a moped, motorcycle, or as a tractor, the driver (depending on the age) should have a moped license or an AM-category driver’s license for the appropriate type of vehicles (motorcycle, tractor).

8. Basic rules of safe exploitation

- there must be proper training given before the exploitation/driving of such a vehicle,
- each time before driving, there has to be an inspection of the vehicle,
- the driver must have appropriate equipment: helmet, goggles or face protection, gloves, pads, appropriate shoes and clothing,
- adjusting the speed to the driving conditions and one’s skills,
- not performing any dangerous maneuvers which may lead to the overturning of the vehicle,
- mastering the technique of turning, the rules of driving through slippery and steep terrain,
- mastering the technique of driving in various terrain conditions,
- not exceeding the speed limit,
- drying and unit maintenance of the vehicle after terrain exploitation, getting wet etc.,
- current maintenance of wheels and tires, this including maintaining proper pressure,
- keeping the boundaries of the vehicle load and the proper fastening of additional equipment and load,
- securing the vehicle from unwanted start-up.

9. Conclusions

This article presents the chosen aspects connected with the equipment group: four-wheeled motorcycles and their construcional solutions, equipment and the rules of their exploitation within the army. Chosen motorcycles were presented and reference was made to the normative documents of the technical and material services. A maintenance-repair system was presented for each chosen type of motorcycle.

This is a relatively new equipment generation used in the army. Even though it carries the name motorcycle, it requires
very good preparation for driving and driving it in various and changing conditions is very dangerous. Moreover, the maintenance and repairs here require using the services from the public sector in the shape of periodical servicing or fixed-period agreements – according to the Public procurement act.

Bibliography

1. The authors’ own archives.
2. The decision of the Minister of Defense no 384/MON from 25 September 2015 concerning the definition of gestor function and the function of central logistics organs in the department of national defense.
4. Factory maintenance manual of the Polaris Sportsman EFI vehicle.
5. Instructions on managing tank-vehicle service equipment. DD/4.22.2.
6. Instructions on managing the exploitation of weaponry and army equipment in the Polish Armed Forces. General rules.
7. The Land Technology Catalogue of Exploitation Norms. DU-4.22.13.1


Autorzy:
mgr inż. Dariusz WOŹNIAK – Car Technology and Road Traffic Assessor Association in Warsaw, Koszalin Branch
dr inż. Krzysztof KUKIEŁKA – Technical University of Koszalin
mgr Jacek WOŹNIAK – University of Szczecin

Motocykle czterokolowe - wybrane aspekty eksploatacji w wojsku

Uzupełnieniem artykułu są zdjęcia związane z tematem.

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